103rd Scientific Assembly and Annual Meeting

November 26 to December 1
McCormick Place, Chicago

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Monday

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SPDL20

Mess With the Bull, You Get the Horns (Case-based Competition)

Monday, Nov. 27 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, Narberth, PA (*Presenter*) Nothing to Disclose
Sandeep P. Deshmukh, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Christopher G. Roth, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

adam.flanders@jefferson.edu

LEARNING OBJECTIVES

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

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SPSC20

Controversy Session: PET/MR: Is There Added Value in Oncology?

Monday, Nov. 27 7:15AM - 8:15AM Room: E350

MR NM RO

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

Participants

Evis Sala, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose
Marius E. Mayerhoefer, MD,PhD, Vienna, Austria (*Presenter*) Nothing to Disclose
Hebert Alberto Vargas, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the pros and cons of combined PET/MRI in oncology compared to PET and MRI performed separately. 2) Highlight potential indications where combined PET/MRI may provide added value in oncology patient. 3) Outline the cost implications and future directions.

SPSH20

Hot Topic Session: Machine Learning and Artificial Intelligence in Lung Imaging

Monday, Nov. 27 7:15AM - 8:15AM Room: E451A

BQ CH CT IN

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

Participants
Bram Van Ginneken, PhD, Nijmegen, Netherlands (*Moderator*) Stockholder, Thirona BV Co-founder, Thirona BV Research Grant, MeVis Medical Solutions AG Research Grant, Delft Imaging Systems Research Grant, Toshiba Corporation

For information about this presentation, contact:

bram.vanginneken@radboudumc.nl

Sub-Events

SPSH20A Deep Learning for CT Lung Cancer Screening

Participants
Bram Van Ginneken, PhD, Nijmegen, Netherlands (*Presenter*) Stockholder, Thirona BV Co-founder, Thirona BV Research Grant, MeVis Medical Solutions AG Research Grant, Delft Imaging Systems Research Grant, Toshiba Corporation

LEARNING OBJECTIVES

1) Understand the benefits, risks and opportunities of integrating artificial intelligence into CT lung cancer screening. 2) Become aware of the state-of-the art in this field, following the spectacular results of the Data Science Bowl 2017 organized by Kaggle where fully automated systems for diagnosing lung cancer from baseline screening CT scans were presented that outperform radiologists.

SPSH20B Using Artificial Intelligence to Develop Noninvasive Biomarkers in Lung Cancer

Participants
Hugo Aerts, PhD, Boston, MA (*Presenter*) Stockholder, Sphera Inc

For information about this presentation, contact:

Hugo_Aerts@dfci.harvard.edu

LEARNING OBJECTIVES

1) Learn about the motivation and methodology of A.I. technologies in Radiology. 2) Learn about scientific studies investigating the role of radiologic AI with other -omics data for precision medicine. 3) Learn about open-source informatics developments.

SPSH20C CT Quantitation of ILD: The End of the Beginning

Participants
Joseph Jacob, MBBS, MRCP, Rochester, MN (*Presenter*) Consultant, Boehringer Ingelheim GmbH

For information about this presentation, contact:

joseph.jacob@nhs.net

LEARNING OBJECTIVES

1) Understand why computer analysis of CT imaging has relevance in interstitial lung diseases. 2) Understand the limitations of visual CT scoring. 3) Understand the various quantitative analytic techniques/tools. 4) Become aware of the latest results achieved by quantitative tools in predicting outcome across the various interstitial lung diseases.

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RCB21

Prostate MRI (Hands-on) Course will be repeated Monday, Tuesday, Wednesday and Thursday from 8am-10am

Monday, Nov. 27 8:00AM - 10:00AM Room: S401CD

GU MR

AMA PRA Category 1 Credits ™: 2.00
ARRT Category A+ Credits: 2.25

Participants
Jelle O. Barentsz, MD, PhD, Nijmegen, Netherlands (*Presenter*) Advisor, SPL Medical BV
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG
Roel D. Mus, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Geert M. Villeirs, MD, PhD, Ghent, Belgium (*Presenter*) Nothing to Disclose
Marloes van der Leest, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Rianne R. Engels, Cuijk, Netherlands (*Presenter*) Nothing to Disclose
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Presenter*) Investor, Healfies LLC
Joseph J. Busch, MD, Chattanooga, TN (*Presenter*) Nothing to Disclose
Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC
Philippe A. Puech, MD, Lyon, France (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Geert.Villeirs@UGent.be

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renske.vandelft@radboudumc.nl

Lkayat@gmail.com

LEARNING OBJECTIVES

1) Understand the PI-RADS v2 category assessment to detect and localize significant cancer for both peripheral zone and transitional zone lesions. 2) Recognize benign pathology like inflammation and BPH and to differentiate these from significant prostate cancers.

ABSTRACT

In this Hands-on Workshop, the participants will able to review up to 30 multi-parametric MRI cases with various prostatic pathology using a dedicated workstation. Focus will be on the overall assessment of PI-RADS v2 category, which enables them to score the probability of the presence of a significant cancer in patients with elevated PSA and/or clinical suspicion. All cases are from daily non-academic practice, and have various levels of difficulty. The cases include: easy and difficult significant peripheral-transition- and central zone cancers, inflammation, BPH, and the most common pitfalls. Internationally renowned teachers will guide the participants during their PI-RADS v2 scoring. PLEASE NOTICE: Based on our experience we expect this course to be very popular. We only have 50 computers, and two spots per computer. Only the first 100 people will be accepted in the room. The front rows are reserved for beginners. In case you have experience with prostate MR: Please take a seat at the computers in the back of the room. We will not have space for any additional listeners this year. The coursebook can be found as handout to this course, please download it and take it with you on your tablet or other device.

Active Handout:Renske Lian van Delft

http://abstract.rsna.org/uploads/2017/16002000/Active RCB21.pdf

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MSAS21

Enterprise Radiation Dose Management (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: S105AB

SQ

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

Participants
Nancy McDonald, MS, Chicago, IL (*Moderator*) Nothing to Disclose
Nicole Murphy, MS, Chicago, IL (*Presenter*) Nothing to Disclose
Christina L. Sammet, PhD, Chicago, IL (*Presenter*) Advisory Board, Bayer AG

For information about this presentation, contact:

csammet@luriechildrens.org

nicole.murphy@nm.org

LEARNING OBJECTIVES

1) Understand the roles and responsibilities of the enterprise radiation dose management committee. 2) Implement a radiation dose monitoring program that satisfies regulatory requirements. 3) Develop a radiation risk management policy that specifies follow-up and optimization procedures.

MSCM21

Case-based Review of Magnetic Resonance (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: S100AB

MR

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

Participants
Jorge A. Soto, MD, Boston, MA (*Director*) Royalties, Reed Elsevier

Sub-Events

MSCM21A MRI of the Brain

Participants
Korgun Koral, MD,MBA, Queens, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kkoral@northwell.edu

LEARNING OBJECTIVES

1) Become familiar with the normal changes in the appearance of the developing brain. 2) Increase confidence in recognizing normal changes that may mimic pathology in pediatric brain MRI. 3) Develop an algorithm for preoperative diagnosis of suprasellar and cerebellar brain tumors.

MSCM21B MRI of the Spine

Participants
Pia C. Maly Sundgren, MD, PhD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Becoming familiar with normal and abnormal findings in the spine. 2) Increase confidence in recognizing traumatic spine injuries. 3) Describe a range of pathologies in the spine and spinal cord.

MSCM21C MRI of the Pancreas

Participants
Jaroslaw N. Tkacz, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with normal and abnormal appearance of the pancreas on routine MRI sequences. 2) Develop strategies to detect pathology involving the pancreas. 3) Increase confidence in diagnosis of cystic and solid pancreatic neoplasms.

MSCM21D MRI of the GI System

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the normal and abnormal appearances of the GI tract on MRI. 2) Discuss strategies to navigate the numerous MR sequences. 3) Describe a range of pathologies of the GI tract including the liver.

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MSMC21

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

Monday, Nov. 27 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 (*Director*) Nothing to Disclose
Pamela K. Woodard, MD, Saint Louis, MO (*Moderator*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ;
Jill E. Jacobs, MD, New York, NY (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

woodardp@mir.wustl.edu

LEARNING OBJECTIVES

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

Sub-Events

MSMC21A Normal Coronary Anatomy

Participants
Amar B. Shah, MD, Queens, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ashah27@northwell.edu

LEARNING OBJECTIVES

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

MSMC21B Anomalous Coronary Arteries

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

For information about this presentation, contact:

prachia@med.umich.edu

LEARNING OBJECTIVES

1) Learn the spectrum of anomalous origins of the coronary arteries on CT. 2) Identify the imaging features and hemodynamics of clinically significant coronary artery anomalies. 3) Understand treatment options, normal postoperative appearance and postoperative complications.

Active Handout:Prachi P. Agarwal

http://abstract.rsna.org/uploads/2017/9001141/Active MSMC21B.pdf

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MSMI21

Molecular Imaging Symposium: Basics of Molecular Imaging

Monday, Nov. 27 8:30AM - 10:00AM Room: S405AB

BQ MI MR US

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

FDA Discussions may include off-label uses.

Participants
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Moderator*) Nothing to Disclose
Jan Grimm, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

MSMI21A MI Using Radioactive Tracers

Participants
Jan Grimm, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the various radio tracers and their applications in Molecular Imaging studies. 2) Understand in which situations to use which radio tracers, what to consider when developing the imaging construct and what controls to obtain for nuclear imaging studies. 3) Examples will contain imaging with small molecules, with antibodies and nanoparticles as well as with cells in order to provide the participants with examples how o correctly perform their imaging studies. 4) Most of the examples will be from the oncology field but their underlying principles are universally applicable to other areas as well.

ABSTRACT

Nuclear Imaging is currently the only true "molecular" imaging method utilized in clinic. It offers quantitative imaging of biological processes in vivo. Therefore, it is not surprising that it is also highly frequented in preclinical imaging applications since it is currently the only true quantitative imaging method. Multiple agents have been developed, predominantly for PET imaging but also for SPECT imaging.In this talk, we will discuss the application of radio tracers to molecular imaging and what to consider. Common pitfalls and mistakes as well as required measures to avoid these will be discussed. We will discuss various examples of imaging constructs, ranging from small molecules to antibodies, nanoparticles and even cells. In addition, the imaging modalities will also briefly discussed, including PET, SPECT and Cherenkov imaging.

MSMI21B MI MRI and MRS

Participants
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To define the role of MRI and MRS in molecular and functional imaging and cover specific applications in disease processes. 2) The primary focus will be advances in novel theranostic approaches for precision medicine.

ABSTRACT

With an array of functional imaging capabilities, magnetic resonance imaging (MRI) and spectroscopy (MRS) techniques are valuable in obtaining functional information, but the sensitivity of detection is limited to the 0.1-1 mM range for contrast agents and metabolites, respectively. Nevertheless, MRI and MRS are finding important applications in providing wide-ranging capabilities to tackle key questions in cancer and other diseases with a 'molecular-functional' approach. An overview of these capabilities and examples of MR molecular and functional imaging applications will be presented with a focus on theranostic imaging for precision medicine.

MSMI21C Nanoparticles

Participants
Heike E. Daldrup-Link, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

heiked@stanford.edu

LEARNING OBJECTIVES

1) Understand important safety aspects of ultrasmall superparamagnetic iron oxide nanoparticles, which are used as contrast agents for magnetic resonance imaging. 2) Recognize the value of immediately clinically applicable iron oxide nanoparticles for cancer imaging. 3) Learn about intrinsic immune-modulating therapeutic effects of USPIO.

ABSTRACT

Amid recent concerns about nephrogenic sclerosis and gadolinium deposition in the brain, patients and physicians are questioning

the use of gadolinium chelates and are actively seeking alternatives. In North America, the iron supplement ferumoxytol has gained considerable interest as an MR contrast agent. Ferumoxytol is composed of superparamagnetic iron oxide nanoparticles with strong T1- and T2-relaxivities and therefore can be used "off label" to enhance soft tissue contrast on MR images. In fact, ferumoxytol was originally designed as an MR contrast agent, but was later developed for anemia treatment. Ferumoxytol (Feraheme) is increasingly being used for a varierty of MR imaging applications in North America. In parallel, the iron oxide nanoparticle compound ferumoxtran-10 (Sinerem/Combidex) has regained a surge of interest in Europe and is currently undergoing continued clinical development. As these agents are adopted by a new generation of radiologists, it is important to build on the many lessons learned from previous experience with other iron oxide nanoparticle compounds. This presentation will explain basic concepts of iron oxide nanoparticle safety, biodistribution and MR imaging patters and offer important practical insights for the use of these agents for clinical MR imaging. Open questions and research needs will be discussed as well.

MSMI21D Advances in Ultrasound Molecular Imaging

Participants
Katherine W. Ferrara, PhD, Davis, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Inform of clinical utility and safety of contrast enhanced ultrasound (CEUS) imaging. 2) Educate on current diagnostic and therapeutic approaches. 3) Introduce newer concepts for combined diagnostic and therapeutic applications.

ABSTRACT

Contrast-Enhanced Ultrasound (CEUS) provides a novel, multi-faceted approach to diagnostic imaging and localized drug/gene delivery systems. The value-added proposition of CEUS centers on the pillars of safety, effectiveness, and economics. Specifically, in the field of diagnostic imaging, 3D CEUS ultrasound technology challenges the established formats CT, MR, and PET. CEUS provides distinct advantages including real-time volumetric imaging, unparalleled spatial and temporal resolution, economies of scale and all without exposure to unnecessary, ionizing radiation. Our efforts to develop 3D and contrast-enhanced ultrasound imaging continues to provide academic leadership while advancing the clinical field of cardiovascular medicine, urology (prostate imaging), and cancer (monitoring and therapy). In the evolving field of the ultrasound therapeutics, CEUS provides a novel, localized delivery system for ethical drugs and nucleic acids; all effectively delivered without viral-mediated agents. Further, the global installed base of ultrasound along with the safety record and ease of patient access highlights the utility of CEUS as a truly competitive, therapeutic delivery modality.In April 1, 2016, the USA FDA approved CEUS for liver imaging in adults and children. This is likely to have a major, paradigm chage in healthcare in the USA.

MSMI21E Quantitative Imaging Biomarkers

Participants
Robert J. Gillies, PhD, Tampa, FL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify at least one method of quantitatively assessing anatomic tumor response. 2) Identify at least one method of quantitatively assessing metabolic tumor response using FDG PET. 3) Identify an MRI quantitative metric which is associated with cellularity of biological processes and which can be used in response assessments.

ABSTRACT

Radiology initially developed as an analog imaging method in which non quantitative data were interpreted in a "qualitative and subjective" manner. This approach has worked well, but modern imaging also is digital, quantitative and has the opportunity for more quantitative and objective interpretations. This lecture will focus on a few areas in which quantitative imaging is augmenting qualitative image assessments to lead to more precise interpretation of images. Examples of such an approach can include measuremental of tumor "metabolic" activity using formalisms such as PERCIST 1.0; methods of assessment of tumor size and volumes using the RECIST 1.1 and emerging formalisms and metrics of tumor heterogeneity, density, receptor density, diffusion, vascular permeability and elasticity using techniques incuding PET/SPECT, MRI, CT and ultrasound. With quantitative imaging, the opportunity to move from qualitative methods to precise in vivo quantitative pheontyping is a real one, with a quantitative "phenome" complementing other "omics" such as genomics. However, the quality of quantitation may vary and close attention to technical methodologies and process are required to have reliable and accurate quantitation. The RSNA QIBA effort will be briefly reviewed as one approach to achieve precise quantiative phenotyping. Examples of the use of quantitative phenotyping to inform patient management will be discussed.

MSRO21

BOOST: Head and Neck-Nasopharynx & Perineural Spread (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: S402AB

HN NR OI RO

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

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

MSRO21A Imaging of the Nasopharynx: Applied Anatomy

Participants
Suresh K. Mukherji, MD, Northville, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the normal anatomy of the nasopharynx. 2) Explain common spread patterns of nasopharyngeal carcinoma. 3) Describe the anatomy landmarks that determine staging of nasopharyngeal carcinoma.

MSRO21B Current Concepts and Controversies in Radiation Planning of the Nasopharynx

Participants
Sung Kim, MD, New Brunswick, NJ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review important points in contouring nasopharynx cancer based on patterns of spread.

ABSTRACT

Radiation therapy is a cornerstone of treatment for nasopharynx cancer. This session will discuss key points in contouring nasopharynx cancer and how contouring is based on patterns of spread.

MSRO21C Question & Answer

MSRO21D Anatomy and Imaging of Perineural Spread

Participants
Suresh K. Mukherji, MD, Northville, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe common pathways of perineural spread. 2) Review the imaging findings of perineural spread. 3) Describe the proper imaging technique for being able to detect perineural spread.

ABSTRACT

This session will be a detailed review of the normal anatomy and the various pathways of perineural spread. The session will focus on optimizing the MRI techniques to visualize perineural spread various landmarks that need to be idenfied to help make this important diagnosis.

MSRO21E Current Concepts and Controversies in Contouring and Treatment of Perineural Spread

Participants
Allen M. Chen, MD, Kansas City, KS (*Presenter*) Nothing to Disclose

MSRO21F Question & Answer

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MSRO25

BOOST: Breast—Oncology Anatomy (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: S103CD

BR OI RO

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

Participants
Jean L. Wright, MD, New York, NY (*Presenter*) Nothing to Disclose
Karen Y. Oh, MD, Portland, OR (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand breast and regional lymph node anatomy. 2) Become familiar with basic anatomic structures and breast pathology using various imaging modalities. 3) Be familiar with breast and regional lymph node contouring techniques used in radiation treatment planning for breast cancer. 4) Apply contouring knowledge to inform radiation treatment planning for breast cancer.

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RC201

Imaging of Thoracic Neoplasms: Update 2017

Monday, Nov. 27 8:30AM - 10:00AM Room: E353C

CH CT MR OI

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

Participants
Edith M. Marom, MD, Ramat Gan, Israel (*Moderator*) Speaker, Bristol-Myers Squibb Company

For information about this presentation, contact:

edith.marom@gmail.com

jerasmus@mdanderson.org

LEARNING OBJECTIVES

1) Utilize MR for imaging lung cancer. 2) Evaluate tumor response. 3) Image thymoma. 4) Stage lung cancer with the 8th edition TNM staging.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC201A Advances in MR Imaging of Lung Cancer

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Presenter*) Research Grant, Toshiba Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Fuji Pharma Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA;

For information about this presentation, contact:

yosirad@kobe-u.ac.jp

LEARNING OBJECTIVES

1) Understand the appropriate MR sequence lung cancer for answering each clinical question. 2) Identify the clinical relevance of MR imaging as compared with other modalities in not only lung cancer, but also pulmonary nodule patients. 3) Recognize the potential of 3T MR system for new MR imaging of lung cancer.

ABSTRACT

Since the clinical application of MR imaging in thoracic diseases, numerous basic and clinical researchers reported technical advances in sequencing, scanners and coils, image acquisition and reconstruction techniques, contrast media utilization, and development of post-processing tools. Among these, MR imaging was considered a major new research and diagnostic tool for various pulmonary diseases, especially lung cancer. As a result, state-of-the art thoracic MR imaging now has the potential to be used as a substitute for traditional imaging techniques and/or play a complimentary role in patient management. In this lecture, I will 1) present the appropriate MR sequence of lung cancer for answering each clinical question, 2) identify the clinical relevance of MR imaging as compared with other modalities in not only lung cancer, but also pulmonary nodule patients, and 3) discuss the potential of 3T MR system for new MR imaging in lung cancer.

RC201B Evaluating Tumor Response

Participants
Tina D. Tailor, MD, Durham, NC (*Presenter*) Research support, General Electric Company

For information about this presentation, contact:

tina.tailor@duke.edu

LEARNING OBJECTIVES

1) Discuss the role of CT for tumor response assessment. 2) Discuss limitations for traditional CT response criteria, including WHO and RECIST. 3) Discuss therapy response in the setting of novel lung cancer therapies, including immunotherapy.

RC201C Imaging of Thymoma

Participants
Edith M. Marom, MD, Ramat Gan, Israel (*Presenter*) Speaker, Bristol-Myers Squibb Company

For information about this presentation, contact:

edith.marom@gmail.com

LEARNING OBJECTIVES

1) Identify an incidental thymoma. 2) Apply the most appropriate imaging modality for the evaluation of thymoma. 3) Assign the newly proposed TNM stage to a newly diagnosed thymoma.

URL

http://pubs.rsna.org/doi/figure/10.1148/rg.2017160096

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/ Edith M. Marom, MD - 2015 Honored Educator

RC201D Lung Cancer Staging

Participants
Travis S. Henry, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

travis.henry@ucsf.edu

LEARNING OBJECTIVES

1) List the changes to the 8th TNM system for lung cancer staging. 2) Interpret CT for lung cancer staging by providing relevant T, N, and M information to the referring clinician. 3) recognize pertinent positive and negative imaging findings that alter management of lung cancer patient.

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/ Travis S. Henry, MD - 2016 Honored Educator

RC202

What's New from the ABR?

Monday, Nov. 27 8:30AM - 10:00AM Room: S403A

ED

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Valerie P. Jackson, MD, Tucson, AZ (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the value of ABR board certification and Maintenance of Certification (MOC). 2) Identify the components of initial certification in diagnostic radiology. 3) Describe recent changes in ABR MOC and their rationales. 4) Compare ABR MOC with the MOC processes for other boards.

Sub-Events

RC202A The Value of Certification and MOC

Participants
Brent J. Wagner, MD, Reading, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC202B Initial Certification Update

Participants
Donald P. Frush, MD, Durham, NC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

donald.frush@duke.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC202C MOC Update

Participants
Lisa A. Kachnic, MD, Nashville, TN (*Presenter*) Consultant, Epictm; Consultant, INSYS Therapeutics, Inc; Royalties, Wolters Kluwer nv

LEARNING OBJECTIVES

1) Access the results of new research and assess their potential applications to clinical practice. 2) Improve basic knowledge and skills relevant to clinical practice. 3) Practice new techniques. 4) Assess the potential of technological innovations and advances to enhance clinical practice and problem-solving. 5) Apply principles of critical thinking to ideas from experts and peers in the radiologic sciences.

RC202D What are Other Boards Doing?

Participants
David Laszakovits, MBA, Tucson, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand what other medical specialty boards are doing with their MOC programs. 2) Understand the differences between the ABR's Maintenance of Certification (MOC) program and other board's programs. 3) Understand our goals for outstanding customer service and communication.

RC203

Cardiac Imaging for Intervention Planning

Monday, Nov. 27 8:30AM - 10:00AM Room: S502AB

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

RC203A Cardiac CT Acquisition - Protocol Optimization

Participants
Brian B. Ghoshhajra, MD, Waban, MA (*Presenter*) Consultant, Siemens AG; Consultant, Medtronic plc

RC203B Imaging of Cardiac Shunts

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

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LEARNING OBJECTIVES

1) Understand the role of imaging, particularly CT and MRI in the evaluation of cardiac shunts. 2) Learn the optimal imaging protocols for evaluating cardiac shunts. 3) Review the imaging appearances of several cardiac shunts. 4) Discuss the contribution of imaging prior to intervention of cardiac shunts.

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

RC203C The Role of Imaging Prior to 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) Discuss the evolving role of transcatheter interventions for aortic stenosis and mitral regurgitation. 2) Review the role of CT to help size the mitral and aortic annulus. 3) Discuss how CT be used to help improve clinical outcomes of patients undergoing transcatheter valvular interventions.

Honored Educators

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RC203D Cardiac MRI and CT for Arrhythmia Treatment

Participants
Stefan L. Zimmerman, MD, Ellicott City, MD (*Presenter*) Nothing to Disclose

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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) Know how CT and MRI datasets are used to assist intraprocedural mapping of cardiac structure in patients undergoing electrophysiologic ablation procedures. 3) Understand how MRI and CT can be used for imaging of the arrhythmia substrate and pre-procedural planning. 4) Comprehend the role of non-invasive imaging for sudden cardiac death risk stratification and ICD placement decisions in various cardiomyopathies.

Honored Educators

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RC204

Musculoskeletal Series: MRI of Root Joints - Hip and Shoulder

Monday, Nov. 27 8:30AM - 12:00PM Room: E450A

MR MK

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
Lynne S. Steinbach, MD, San Francisco, CA (*Moderator*) Nothing to Disclose
Miriam A. Bredella, MD, Boston, MA (*Moderator*) Nothing to Disclose
Marc H. Willis, DO, Houston, TX (*Moderator*) Nothing to Disclose
Robert S. Campbell, MBBCh, Liverpool, United Kingdom (*Moderator*) Nothing to Disclose
William B. Morrison, MD, Philadelphia, PA (*Moderator*) Consultant, AprioMed AB; Patent agreement, AprioMed AB; Consultant, Zimmer Biomet Holdings, Inc

For information about this presentation, contact:

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Sub-Events

RC204-01 Hip MRI Technique

Monday, Nov. 27 8:30AM - 8:55AM Room: E450A

Participants
William B. Morrison, MD, Philadelphia, PA (*Presenter*) Consultant, AprioMed AB; Patent agreement, AprioMed AB; Consultant, Zimmer Biomet Holdings, Inc

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LEARNING OBJECTIVES

1) Understand the different MR imaging protocols used for imaging the hip. 2) Be able to apply MRI techniques for diagnosis of hip pathology. 3) Appreciate different hip conditions that can be diagnosed using MRI.

ABSTRACT

Hip and groin pain can be related to intra-articular or extra-articular pathology, and it can be difficult even for an experienced subspeciaist surgeon to distinguish these conditions. MRI is an essential part of the diagnostic algorithm. Because of the multiplicity of clinical scenarios and conditions, there are a variety of MRI protocols that can be applied. This lecture will address the broad topic of MR imaging techniques for the patient with hip or groin pain.

RC204-02 Hip MRI Pitfalls

Monday, Nov. 27 8:55AM - 9:20AM Room: E450A

Participants
Scott D. Wuertzer, MD, MS, Winston-Salem, NC (*Presenter*) Nothing to Disclose

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swuertze@wakehealth.edu

LEARNING OBJECTIVES

1) Apply a systematic approach to evaluating hip MRI.2) Recognize normal osseous and soft tissue variants of the hip that can mimic pathology.3) Differentiate normal acetabular labral variants from labral tears.

RC204-03 Hip MRI: What the Surgeon Wants to Know

Monday, Nov. 27 9:20AM - 9:45AM Room: E450A

Participants
Miriam A. Bredella, MD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Be familiar with challenging intra- and extra-articular hip pathology, important to the orthopedic surgeon. 2) Understand advanced MR imaging techniques to assess intra-articular hip pathology, esp. the chondrolabral junction. 3) Diagnose hip conditions that need to be identified prior to hip preservation surgery.

RC204-04 Supra- and Infratrochanteric Femoral Torsion Abnormalities and Its Association with Femoroacetabular Impingement and Hip Dysplasia

Monday, Nov. 27 9:45AM - 9:55AM Room: E450A

Awards
Trainee Research Prize - Resident

Participants
Benjamin Fritz, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Susanne Bensler, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Michael Leunig, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Patrick Zingg, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Reto Sutter, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate a novel measurement technique for assessing the supra- and infratrochanteric component of femoral torsion, to establish reference values in healthy volunteers, and to compare supra- and infratrochanteric torsion in patients with hip dysplasia and femoroacetabular impingement.

METHOD AND MATERIALS

Femoral torsion was retrospectively assessed in 380 patients and 61 healthy volunteers by MRI: For assessing supra- and infratrochanteric torsion three measurement techniques (Kim-, simplified Kim-, and Centroid-method) were evaluated by two readers on 100 patients. The technique with the highest inter-reader reliability was selected to perform measurements on all patients and volunteers. Patients' supra- and infratrochanteric torsions were correlated to hip disorders diagnosed by specialized hip surgeons, and compared to reference values of healthy volunteers. Statistical analysis included the independent t-test, Mann-Whitney-U-test and the intraclass correlation coefficient (ICC).

RESULTS

The most reliable technique for measuring supra-/infratrochanteric torsion was the Centroid-method, with an ICC of 0.979. The supra-/infratrochanteric torsion of the volunteers was 31.5°±7.4° and -18.3°±9.9°, respectively. In comparison to volunteers, patients with hip dysplasia had significantly higher supra- and infratrochanteric torsion with 37.5°±10.3° ($P = 0.001$) and -9.6°±11.7° ($P < 0.001$), respectively, and patients with pincer-type FAI had significantly higher supratrochanteric torsion of 37.8°±8.0° ($P = 0.002$).

CONCLUSION

The supra- and infratrochanteric component of femoral torsion differs substantially between hip disorders: Patients with hip dysplasia have predominantly increased infratrochanteric torsion, while patients with pincer-type FAI have increased supratrochanteric torsion. Separate quantification of supra- and infratrochanteric torsion allows a more detailed analysis of hip disorders and may influence treatment planning.

CLINICAL RELEVANCE/APPLICATION

Distinguishing whether femoral torsion deformities originate at the femoral neck or the femoral shaft may influence on the choosing of the location of the osteotomy in patients in need of derotational surgery of the femur.

RC204-05 A Virtual Dynamic Model of the Hip: Utility for Surgical Planning In Patients with Femoroacetabular Impingement (FAI) and Correlation of Predicted Impingement with Preoperative Measures

Monday, Nov. 27 9:55AM - 10:05AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Hamid Bagce, MD,PhD, New York, NY (*Presenter*) Nothing to Disclose
Thomas S. Lynch, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Tony T. Wong, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Develop a virtual dynamic model of the hip that allows for optimal surgical planning in patients with femoroacetabular impingement (FAI).

METHOD AND MATERIALS

An IRB-approved retrospective search yielded 14 patients with FAI (Mean±SD age: 25±8.5 yrs) who received CT scans and underwent arthroscopy from 10/5/16 to 3/17/17. Clinical data included presurgical maximal hip flexion, alpha angle, lateral center edge angle, femoral version, acetabular version and the total depth of osteoplasty (femoral+acetabular) resected at surgery. Using custom-written MATLAB software, DICOM data were interpolated over an equal-axes three-dimensional volume and segmented. Femoral head rotation was programmed to either a user-specified limit or to the point of femoroacetabular impact. To test model validity, virtual maximal hip flexion was compared to patients' actual maximal hip flexion. To simulate functional impingement, the

model hip was flexed 90° and internally rotated 40°. The corresponding depth (mm) of osseous overlap was recorded as the amount of virtual osteoplasty required to restore physiologic motion. Applied test statistics included paired t-test (t), Pearson correlation (r) and Bartlett's test of equal variance (X2).

RESULTS

Model validity testing demonstrated no significant difference (t=-0.78, p=0.44) and a significant correlation (r=0.67, p=0.009) between virtual (Mean±SE: 109.6±6.1°) with actual (104±2.8°) maximal hip flexion. There was no significant correlation between the depth of virtual osteoplasty required to restore normal motion with alpha angle (r=0.27, p=0.35), lateral center edge angle (r=-.02, p=0.96), or femoral (r=-0.51, p=0.06) or acetabular version (r=-0.46, p=0.10). There was no significant difference in means (t=0.18, p=0.86) but a significant difference in variances (X2=35.0, p<0.001) of total osteoplasty depth resected at surgery (6.6±0.2 mm) compared to the depth recommended by the model (6.3±1.5 mm).

CONCLUSION

A virtual dynamic hip model provides quantitative impingement data far more valuable than conventional radiologic parameters and would allow for optimal individually-tailored surgical planning in patients with FAI.

CLINICAL RELEVANCE/APPLICATION

A virtual dynamic model of the hip provides invaluable detailed impingement data, with the goal of optimizing surgery and improving postsurgical functional outcomes in patients with FAI.

RC204-06 Can a 3D 'Pseudo-CT' MRI Sequence replace CT for Preoperative Evaluation of Femoroacetabular Impingement?

Monday, Nov. 27 10:05AM - 10:15AM Room: E450A

Participants
Albair Guirguis, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Naveen Subhas, MD, Cleveland, OH (*Presenter*) Research Grant, Siemens AG
Nancy A. Obuchowski, PhD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Siemens AG Research Consultant, QT Ultrasound Labs Research Consultant, Elucid Bioimaging Inc
James Rosneck, Garfield Heights, OH (*Abstract Co-Author*) Nothing to Disclose
Wadih Karim, RT, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Ryan Goodwin, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Kavitha Yaddanapudi, MD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Joshua M. Polster, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In the preoperative evaluation of femoro-acetabular impingement (FAI), both MRI and CT are often obtained for evaluation of soft tissue and bone anatomy, respectively. The purpose of this study was to determine if the addition of a 3D MRI sequence post-processed to simulate a CT, a "pseudo-CT" MRI sequence, could be used instead of CT to evaluate bone anatomy in FAI patients.

METHOD AND MATERIALS

Acetabular version and alpha angles were independently and blindly measured by 4 readers in 40 hips of 20 patients (mean age, 26 years) who had both a pelvis CT and MRI which included a 3D gradient-echo two-point Dixon sequence post-processed to simulate a CT scan. The need to perform an acetabuloplasty and/or femoroplasty were assessed by 2 orthopedic surgeons who independently and blindly reviewed the 2D images and 3D volume rendered models created from the CT and pseudo-CT MRI sequence. The agreement between readers using MRI and CT (interprotocol agreement) was compared to the agreement when readers were only using CT (intraprotocol agreement) for interchangeability (i.e. substituting MRI for CT can result in no more than a 5% excess disagreement).

RESULTS

Interprotocol (74% within 5 degrees) and intraprotocol (72% within 5 degrees) agreement for acetabular version were nearly identical and interchangeable without significant excess disagreement. Interreader agreement with MRI for acetabular version was higher than with CT for all cutoff values. Interprotocol (45% within 5 degrees) and intraprotocol (44% within 5 degrees) agreement for alpha angle was poor with both CT and MRI but very similar. Interprotocol (55%) and intraprotocol (55%) agreement for the need to perform acetabuloplasty and/or femoroplasty was poor with both CT and MRI but nearly identical.

CONCLUSION

Acetabular version measurements, alpha angle measurements and surgical planning using a 3D "pseudo-CT" MRI sequence were similar with that using a CT suggesting that it could be used to replace CT in the preoperative evaluation of FAI.

CLINICAL RELEVANCE/APPLICATION

The use of a "pseudo-CT" MRI sequence to evaluate bone anatomy instead of CT in the preoperative evaluation of FAI could not only lower health care costs by eliminating the need for an additional test but avoid radiation exposure in this young patient population.

RC204-07 Shoulder MRI Technique

Monday, Nov. 27 10:15AM - 10:35AM Room: E450A

Participants
Robert S. Campbell, MBBCh, Liverpool, United Kingdom (*Presenter*) Nothing to Disclose

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Active Handout:Robert SD Campbell

LEARNING OBJECTIVES

1) To understand the choice of image sequences for routine shoulder MR imaging. 2) To understand the choice of image planes for routine shoulde r MR Imaging. 3) To understand the limitations of routine shoulder MR protocols and to identify when protocols need to be modified. 4) To understand which additional sequences and image planes may be required to identify less common shoulder pathologies. 5) To understand when the use of alternative techniques such as MR arthrography are indicated.

RC204-08 Shoulder MRI Pitfalls

Monday, Nov. 27 10:45AM - 11:05AM Room: E450A

Participants
Lynne S. Steinbach, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review normal anatomy and variants in the bones of the glenohumeral joint that can simulate pathology. 2) Understand the normal variants of the labrum that can be mistaken for tears. 3) Avoid overcalling abnormalities in the rotator cuff and biceps tendons. 4) Recognize the significance of some cysts and bursae around the shoulder. 5) Reduce misinterpretation of expected postoperative findings.

LEARNING OBJECTIVES

1) Review normal anatomy and variants in the bones of the glenohumeral joint that can simulate pathology. 2) Understand the normal variants of the labrum that can be mistaken for tears. 3) Avoid overcalling abnormalities in the rotator cuff and biceps tendons. 4) Recognize the significance of some cysts and bursae around the shoulder. 5) Reduce misinterpretation of expected postoperative findings.

RC204-09 Inferior Glenohumeral Vertical Distance: A Novel Radiographic Marker Better Suited for Detection of Rotator Cuff Tears Involving the Infraspinatus Tendon

Monday, Nov. 27 11:05AM - 11:15AM Room: E450A

Participants
Mohammed Alfaqih, MD, Burlington, MA (*Presenter*) Nothing to Disclose
Shalin M. Soni, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Sebastian Flacke, MD, Burlington, MA (*Abstract Co-Author*) Consultant, BTG International Ltd Consultant, Surefire Medical, Inc Consultant, Koninklijke Philips BV Consultant, XACT Robotics
Yasir Andrabi, MD, MPH, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Dmitry Elentuck, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Robert J. French Jr, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the association between the radiographically determined inferior glenohumeral vertical distance (IGHVD) and rotator cuff tears (RCT) involving the infraspinatus (IS) tendon; and, compare the sensitivity and specificity of acromiohumeral distance (AHD) and IGHVD for RCT involving IS tendon.

METHOD AND MATERIALS

In this IRB approved retrospective study, 140 patients with MRI proven full thickness rotator cuff tear were included after they met the inclusion and exclusion criteria. The exclusion criteria include but not limited to any patient with isolated partial thickness tear. Patients were divided into two groups, Group A: patients with RCT involving full or partial IS tears, and Group B: RCT not involving IS. Shoulders MRI were evaluated by board certified musculoskeletal radiologists. Radiographs were analyzed blinded to MRI findings. IGHVD determined by measuring vertical distance from anatomical neck to inferior glenoid level in anteroposterior (AP) view; distance of more than 2mm was considered positive. AHD was assessed by measuring vertical interval between inferior border of acromion process and humeral head in (AP) view; distance less than 7 mm was considered positive. The correlation between increased IGHVD and presence of IS involvement was assessed. Sensitivity, specificity, PPV and NPV were compared between IGHVD and AHD in assessing IS tendon tear. Further subgroup analysis of Group A separating full and partial IS tears were performed.

RESULTS

Group A included 89 patients and Group B involved 51 patients. A strong association was found between IGHVD and rotator cuff tears involving infraspinatus tendon ($p < 0.001$). IGHVD was found to have increased sensitivity, PPV and NPV (66%, 92%, 60%, respectively) compared to AHD (20%, 85%, 40% respectively). The specificity of both was comparable (90% for IGHVD and 94% for AHD). Subgroup analysis included 54 patients with full thickness infraspinatus tear and 35 patients with partial infraspinatus tear. No statistically significant difference between these two groups in terms of IGHVD was found.

CONCLUSION

There is a strong association between radiographically determined IGHVD and infraspinatus tear and is more sensitive than AHD.

CLINICAL RELEVANCE/APPLICATION

Many non-pathological factors can decrease AHD, and increase the false positive rate. IGHVD has greater efficacy than AH in detecting rotator cuff tears that involve the infraspinatus tendon.

RC204-10 Usefulness of 3D T1 High-Resolution Isotropic Volume Excitation Sequence Obtained From Direct Shoulder MR Arthrography for the Diagnosis of SLAP and Bankart Lesions: Comparison with 2D Proton-Density Fat-Suppressed Sequence

Monday, Nov. 27 11:15AM - 11:25AM Room: E450A

Participants
Youngno Yoon, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Seong Jong Yun, Cheongwon-gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Hwa Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyeon Hwan Jo, Anyang, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Dong Hyeon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Gwang Song, Cheongwon-gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jin Yang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Wook Jin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the diagnostic accuracy of three-dimensional T1 high-resolution isotropic volume excitation (3D-THRIVE) sequence obtained from direct shoulder magnetic resonance arthrography (MRA) for superior labral anterior-to-posterior (SLAP) and Bankart lesions compared to that of three plane (axial, coronal, sagittal) two-demensional proton-density fat-suppressed (2D-PD-FS) sequence.

METHOD AND MATERIALS

We retrospectively studied 84 patients who underwent direct shoulder MRA using 3D-THRIVE and 2D-PD-FS sequences. Arthroscopic finding was considered as reference standard. Quantitative image quality was evaluated in terms of the contrast-to-noise ratio (CNR) of the intra-articular (glenohumeral joint) signal by one physician. Qualitative image quality (subjective image noise and image sharpness) and radiologic diagnosis of SLAP (type I~IV) /Bankart lesions (cartilaginous vs. osseous) were separately assessed by two radiologists. Bankar variant lesions such as Perthes lesion were also considered as Bankart lesions. Both the 3D-THRIVE sequence and the 2D-PD-FS sequence were evaluated in random order. Wilcoxon rank sum tests, chi-square/Fisher's exact tests, and DeLong's tests were used to compare image quality and diagnostic performance between the two sequences. Inter-observer agreement was calculated using the an intraclass coefficient (ICC).

RESULTS

3D-THRIVE images had significantly higher CNR ($p<0.001$), and subjective ratings of image noise ($p=0.009$) and image sharpness ($p=0.039$) than 2D-PD-FS images ($p<0.001$). Although there was no difference in diagnostic accuracy for SLAP/Bankart lesions between 3D-THRIVE and 2D-PD-FS images ($p>=0.18$), 3D-THRIVE images had higher diagnostic performance (sensitivity, 93.0-97.2%; specificity, 95.8-100%; accuracy, 95.2-97.6%) with almost perfect agreement (ICC=0.898-0.942) when compared to 2D-PD-FS images (sensitivity, 86.1-91.7%; specificity, 93.8-95.8%; accuracy, 90.5-92.9%; agreement, ICC=0.782-0.858).

CONCLUSION

The diagnostic performance of imaging for the detection of SLAP and Bankart lesions might be improved with the use of 3D-THRIVE. In addition, 3D-THRIVE has the ability to be reconstructed freely without an additional scan.

CLINICAL RELEVANCE/APPLICATION

The use of 3D-THRIVE may be helpful in patients with SLAP and Bankart lesions, and may be routinely obtained during direct shoulder MRA.

RC204-11 Incidence of Rotator Cuff Tears in the Setting of Calcific Tendinopathy on MRI: A Case-Controlled Comparison

Monday, Nov. 27 11:25AM - 11:35AM Room: E450A

Participants
Nicholas M. Beckmann, MD, Houston, TX (*Presenter*) Nothing to Disclose
Michael Q. Tran, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Chunyan Cai, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

Primary: Determine incidence and size of rotator cuff tears in patients with rotator cuff calcific tendinopathy diagnosed on MRI. Secondary: Compare incidence of MRI inflammatory changes between homogeneous and heterogeneous morphologies of calcific tendinopathy.

METHOD AND MATERIALS

Retrospective review of all patients with rotator cuff calcific tendinopathy (RCCT) diagnosed by MRI at our institution during a 5 year peroid (N=37). Retrospective review of an age, gender, and laterality matched cohort without RCCT (N=36) was performed for comparison of rotator cuff tear incidence. The presence of rotator cuff tear was compared between the two groups using Chi-square test with tear size and location being compared using Fisher's exact test. The RCCT group was subcategorized as homogenous (N=26) or heterogenous (N=11) calcifications. The presence of joint effusion, bursal effusion, soft tissue edema, and bone marrow edema was compared between these two subgroups using Fisher's exact test.

RESULTS

The incidence of rotator cuff tear in the RCCT and non-RCCT group was 30% and 42%, which was not statistically significant (p=0.2870). Only 36% (4 of 11) of rotator cuff tears in the RCCT group involved the same tendon as the calcific tendinopathy. Rotator cuff tear size approached statistical significance between the two groups with none of the RCCT group having full-thickness cuff tears and 33% of the non-RCCT group having full-thickness tears (p=0.0527). Heterogeneous calcifications (HTC) were associated with more inflammatory changes compared to homogeneous calcifications (HC). Moderate/severe soft tissue edema was present in 64% of HTC and 4% of HC (p=0.0005). Bone marrow edema was present in 18% of HTC and 0% of HC (p=0.0826). Moderate/large bursal was present in 27% of HTC and 4% of HC (p=0.0880).

CONCLUSION

Calcific tendinopathy is not associated with an increased incidence of rotator cuff tear, and calcific tendinopathy in the setting of shoulder pain likely confers a decreased incidence of full-thickness rotator cuff tear. Heterogeneous calcifications are associated with more soft tissue inflammation than homogeneous calcifications and likely represent the acute symptomatic phase of calcification.

CLINICAL RELEVANCE/APPLICATION

Calcific tendinopathy has low incidence of associated full-thickness rotator cuff tear, so a period of conservative theraphy should be considered prior to performing MRI to assess rotator cuff pathology.

RC204-12 Shoulder MRI: What the Surgeon Wants to Know

Monday, Nov. 27 11:35AM - 12:00PM Room: E450A

Participants
Jenny T. Bencardino, MD, Lake Success, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review common preoperative indications for cross sectional imaging with emphasis on MR imaging assessment of rotator cuff tears, long head of biceps tendon disease and anterior shoulder dislocation. 2) To identify different morphological variants of rotator cuff tears and treatment implications. 4) To review the indications for the use of bicipital tenodesis and tenotomy. 5) To review current methods for evaluation of bone loss in the setting of shoulder dislocation

Honored Educators

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RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RC205

Neuroradiology Series: Big Data in Neuroradiology

Monday, Nov. 27 8:30AM - 12:00PM Room: S406B

IN NR RS

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
Christopher P. Hess, MD, PhD, Mill Valley, CA (*Moderator*) Research Grant, General Electric Company; Research Grant, Quest Diagnostics Incorporated;
Jody L. Tanabe, MD, Aurora, CO (*Moderator*) Nothing to Disclose

Sub-Events

RC20501 Population Neuroimaging: How to Use It in Your Practice

Monday, Nov. 27 8:30AM - 9:00AM Room: S406B

Participants
Meike W. Vernooij, MD, Rotterdam, Netherlands (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To understand the rationale and general design of population neuroimaging studies. 2) To learn how information derived from population neuroimaging can be translated to clinical practice. 3) To realize opportunities and challenges of the "population to practice"-approach.

RC205-03 Radiogenomics Analysis in Hemodynamic Abnormality of Patients with Newly Diagnosed Glioblastomas: Combination with TCIA Database

Monday, Nov. 27 9:10AM - 9:20AM Room: S406B

Participants
Xiang Liu, MD, Rochester, NY (*Presenter*) Nothing to Disclose
Wei Tian, MD, PhD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Rajiv Mangla, MD, Syracuse, NY (*Abstract Co-Author*) Nothing to Disclose
Dongmei Li, PhD, Rochster, NY (*Abstract Co-Author*) Nothing to Disclose
Laila M. Poisson, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose
Rajan Jain, MD, Hartsdale, NY (*Abstract Co-Author*) Consultant, Cancer Panels; Royalties, Thieme Medical Publishers, Inc

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PURPOSE

Tumor angiogenesis is critical important for survival outcome in glioblastoma patients, the radiogenomics association of hemodynamic changes, remains unclear. The purpose of this study is to investigate the association between MR perfusion abnormalities and genomic biomarkers in new diagnosed glioblastomas.

METHOD AND MATERIALS

MR DSC-PWI examinations of 41 new diagnosed glioblastomas were enrolled in URMC, the genomics biomarkers of TP53, Ki-67 labelling index, isocitrate dehydrogenase (IDH), mammalian target of rapamycin (mTOR), and EGFR were evaluated. 45 glioblastoma cases with MR DSC-PWI and U133 array gene expression in TCIA were reviewed for comparison. The mean and maximal rCBV ratio of the enhancing tumor (rCBVmean and rCBVmax) were measured in all cases, maximal and mean rCBV ratio of peri-enhancing tumor area (rCBVperi-tumor-max, rCBVperi-tumor-mean)were measured in two groups respectively. The correlation analysis, and Cox regression were performed. Additional U133 array gene expression of 483 glioblastoma cases archived in TCGA were used to identify the detected radiogenomics associations.

RESULTS

The rCBV ratio of peri-enhancing tumor area was the strongest predictor of overall survival (OS) in both groups, (hazard ratio= 1.29 and 1.16 respectively). The correlation analysis found difference of radiogenomic association in enhancing and peri-enhancing areas in both groups. In URMC group, the rCBVmax correlated with mTOR and the rCBVperi-tumor max had significant association with mTOR after adjustment of gender and EGFR. In TCIA group, the rCBVmax correlated with AKT2 and the rCBVperi-tumor mean had significant correlation with FOXO3. AKT2 and FOXO3 had significant association with mTOR ($p<0.05$). The gene expression analysis in 483 glioblastoma cases identify this gene network.

CONCLUSION

The difference of radiogenomic associations in enhancing and peri-enhancing areas and gene network may suggest PI3K/Akt/mTOR signaling pathway plays important role in different moderation of angiogenesis in glioblastomas. The implication of rCBVperi-tumor will promote future development of new targeting therapies aiming to tumor proliferation and vasculature infiltration.

CLINICAL RELEVANCE/APPLICATION

The rCBVperi-tumor had better prognostic value than molecular genomic biomarkers alone. The different radiogenomic associations involving PI3K/Akt/mTOR pathway suggest different moderation of hemodynamic abnormalities within glioblastomas.

RC205-04 Machine Learning Reveals Multimodal MRI Patterns Predictive of Isocitrate Dehydrogenase Genotype in Diffuse Lower-Grade Glioma

Monday, Nov. 27 9:20AM - 9:30AM Room: S406B

Awards
Trainee Research Prize - Resident

Participants
Harrison X. Bai, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Ken Chang, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To build a random forest predictive model of isocitrate dehydrogenase genotype in lower-grade gliomas (LGGs) that integrates clinical, preoperative, and multimodal automated features.

METHOD AND MATERIALS

Preoperative MRIs of 118 patients from an institutional cohort (training cohort) and 105 patients form the Cancer Imaging Archive (TCIA)(validation cohort) with primary grades II and III gliomas were scored by two neuroradiologists (HT and QS) according to the Visually Accessible Rembrandt Images (VASARI) annotations. Histogram, geometric and texture features were extracted from T1-weighted, T2-weighted, and T1 contrast enhanced sequences. Using a random forest algorithm, automated features or VASARI scores were integrated with clinical data to generate a model predictive of IDH genotype. IDH genotype was determined by immunohistochemistry and next generation sequencing. All statistical analyses were performed using the Statistics and Machine Learning Toolbox 2016a (MATLAB).

RESULTS

There was no significant in age, gender, WHO grade, KPS score and IDH mutation between the training and testing cohorts. For each patient, 4 clinical features were analyzed and 15510 automated features were extracted. After feature selection, 604 features remained. This included 1 clinical feature, 41 histogram features, 48 geometric features, and 514 texture features. Our model achieved accuracies of 90% (area under the curve [AUC]=0.89) in the training cohort and 81% (AUC=0.75) in the validation cohort. In addition, 4 clinical and 120 VASARI features were analyzed for each patient. After feature selection, 13 feature remained. This included 1 clinical and 12 VASARI features .Our model utilizing clinical and VASARI features achieved accuracies of 88% (AUC=0.85) in the training cohort and 75% (AUC=0.67) in the validation cohort.

CONCLUSION

Using machine-learning algorithms, we achieved high accuracy in prediction of IDH genotype in LGGs with preoperative clinical and conventional MRI features.

CLINICAL RELEVANCE/APPLICATION

Pre-treatment identification of IDH status has important clinical value. Although biopsies can be performed at relatively low-risk, an approach using MRI imaging to predict IDH genotype preoperatively can provide a less expensive and non-invasive alternative.

RC205-05 Semi--Automated Assessment for Distinguishing Glioblastoma, Solitary Brain Metastasis and CNS Lymphoma on MRI: A Machine Learning Approach

Monday, Nov. 27 9:30AM - 9:40AM Room: S406B

Participants
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PURPOSE

To investigate whether machine learning (ML) evaluation of multimodal brain MRI can reliably differentiate glioblastoma, solitary brain metastasis, and CNS lymphoma.

METHOD AND MATERIALS

Preoperative MRI including FLAIR, DWI, dynamic contrast enhanced (DCE), dynamic susceptibility contrast (DSC) perfusion and post-contrast T1 (T1C+) in patients with solitary enhancing lesions were retrospectively reviewed. Conventional (T1C+, FLAIR), relative cerebral blood volume (rCBV) and relative cerebral blood flow (rCBF) from DSC, volume transfer constant from plasma to extravascular extracellular space (EES) (Ktrans), rate constant between EES to plasma (Kep), plasma volume per unit tissue volume (Vp) and EES-volume per unit tissue volume (Ve) from DCE, and apparent diffusion coefficient (ADC) maps were then further processed using the fMRI Software Library (Analysis Group, Oxford, UK) Version 5.0. Steps included histogram normalization and coregistration. Two separate volumes of interest (VOIs) were drawn manually on enhancing tumor and non-enhancing T2 hyperintense (NET2) region using coregistered T1C+ and FLAIR images, respectively. These preprocessed data were utilized for supervised training of a Gaussian processing classifier (GPC) using the Pattern Recognition for Neuroimaging Toolbox (UCL, London, UK) v2.0. Training entailed evaluation of labeled MRI data for creation of a GPC model, which was validated on unlabeled cases using the leave-one-subject-out method.

RESULTS

Twenty-one patients (13 male, 8 female; age 56.7 ± 8.9 years) with biopsy-proven glioblastoma (n=7), metastasis (n=6; lung carcinoma=2, esophageal carcinoma=1, melanoma=1, neuroendocrine carcinoma=1, rectal carcinoma=1), and CNS lymphoma (n=8) were identified. The trained GPC discriminated with 51.8% balanced accuracy (BA) between glioblastoma [class accuracy (CA) 66.7%], metastasis (CA 57.1%), and lymphoma (CA 44.4%) with the highest accuracy achieved from combined evaluation of ADC, rCBV, ktrans and Vp using NET2-based VOIs.

CONCLUSION

Given a set of VOIs defined by lesional NET2, a trained GPC can differentiate glioblastoma, brain metastasis, and CNS lymphoma with 51.8% BA utilizing ADC, rCBV, ktrans and Vp.

CLINICAL RELEVANCE/APPLICATION

A trained Gaussian process classifier can differentiate glioblastoma, solitary brain metastasis, and CNS lymphoma on brain MR with 51.8% accuracy, significantly better than random chance (33.3%).

RC20506 The Impact of Large-Scale Research Trials on Clinical Practice

Monday, Nov. 27 9:40AM - 10:10AM Room: S406B

Participants
Pratik Mukherjee, MD, PhD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company Medical Adivisory Board, General Electric Company

RC20507 From Efficacy to Effectiveness: The Pragmatic Clinical Trial

Monday, Nov. 27 10:20AM - 10:50AM Room: S406B

Participants
Jeffrey G. Jarvik, MD, MPH, Seattle, WA (*Presenter*) Co-founder, PhysioSonics, Inc; Stockholder, PhysioSonics, Inc; Consultant, HealthHelp, LLC; Consultant, UpToDate, Inc; Royalties, Springer Nature

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LEARNING OBJECTIVES

1) Compare pragmatic with explanatory trials. 2) Review the Pragmatic-Explanatory Continuum Index Summary (PRECIS) tool. 3) Describe the rationale and design of the Lumbar Imaging with Reporting of Epidemiology (LIRE) study, a pragmatic randomized trial. 4) Introduce the NIH Healthcare Systems Collaboratory and Patient Centered Outcomes Research Institute (PCORI).

ABSTRACT

Pragmatic Clinical Trials (PCTs) differ from traditional, explanatory trials in a number of important aspects. Thorpe et al. followed by Loudon et al.1,2 developed a tool to categorize trials along a pragmatic-explanatory spectrum, the Pragmatic-Explanatory Continuum Index Summary (PRECIS) tool. The Lumbar Imaging with Reporting of Epidemiology (LIRE)3 trial is a multicenter, pragmatic, cluster randomized trial examining the impact of inserting into lumbar spine imaging reports the prevalence of common imaging findings in patients without back pain. Using LIRE, I will review key aspects of the PRECIS tool and discuss the roles that the NIH Healthcare Systems Collaboratory and the Patient Centered Outcomes Research Institute (PCORI) play in promoting PCTs. 1. Thorpe K, Zwarenstein M, Oxman A, et al. A pragmatic-explanatory continuum indicator summary (PRECIS): a tool to help trial designers. CMAJ 2009. 2. Loudon K, Treweek S, Sullivan F, Donnan P, Thorpe KE, Zwarenstein M. The PRECIS-2 tool: designing trials that are fit for purpose. BMJ 2015;350:h2147. 3. Jarvik JG, Comstock BA, James KT, et al. Lumbar Imaging With Reporting Of Epidemiology (LIRE)-Protocol for a pragmatic cluster randomized trial. Contemp Clin Trials 2015;45:157-63.

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/ Jeffrey G. Jarvik, MD, MPH - 2017 Honored Educator

RC205-08 Using Low-Frequency Oscillations to Predict Temporal Lobe Epilepsy with Machine Learning

Monday, Nov. 27 10:50AM - 11:00AM Room: S406B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Recent evidence suggests that functional integration between brain regions at rest occurs over multiple frequency bands. Here we investigate the predictive ability of slow-4 (0.027 - 0.073 Hz) and slow-5 (0.01 - 0.027Hz) bands to differentiate between temporal lobe epilepsy (TLE) patients and healthy controls, using machine learning (ML).

METHOD AND MATERIALS

Data from 42 TLE patients (age=39.6 years, 26 females), and 37 healthy controls (age=29.7 years, 19 females) were analyzed. FMRI data were acquired on 3T GE 750 scanners using whole-brain simultaneous multi-slice imaging (8 bands, 72 slices, TR=802ms, voxel size 2mm isotropic). Four 5-minute resting state scans were combined. T1-weighted images were acquired for spatial alignment using a magnetization prepared gradient echo sequence (0.8mm isotropic). Data were processed using the Human Connectome Project (HCP) processing pipeline. 360 time series from brain regions defined by HCP's Glasser parcellation were extracted per subject. Pearson's correlations between every pair of parcels were computed and normalized with Fisher transformation to generate connectivity matrices. Unique pairwise correlations were reshaped into a row matrix with 64,620 features. During feature selection, we computed a t-test for each feature between patients and controls. Only a pre-defined number of 'top features' with the lowest p-values were fed into the ML classifiers. The optimal number of top features was found by sweep search. Two ML classifiers were used: support vector machine (SVM) and random forest (RF). Training and cross validation were done using MATLAB. Leave-one-out-cross-validation (LOOCV) was used for performance estimation.

RESULTS

Slow-5 band data outperformed slow-4 and all LFO at the classification. Using SVM, slow-5 produced the best LOOCV accuracy of 91.1% using 69 top features, followed by slow-4 at 73.4% and LFO at 65.8%. Using RF, they were 79.7% using 58 top features, 67.1% and 64.6% in the same order.

CONCLUSION

Slow-5 band data consistently produced superior classification results between TLE and controls than slow-4 and all LFO. This suggests that the difference in brain signals between the groups would be best characterized at this frequency band.

CLINICAL RELEVANCE/APPLICATION

Using machine learning, this paper shows how the slow-5 low frequency oscillation band in resting-state brain signals can differentiate temporal lobe epilepsy (TLE) patients from healthy controls.

RC205-09 Revealing Tumor Heterogeneity Using Machine Learning and Independent Component Analysis of Dynamic Susceptibility Contrast (DSC) Enhanced MRI

Monday, Nov. 27 11:00AM - 11:10AM Room: S406B

Participants
Silun Wang, MD, PhD, Atlanta, GA (*Presenter*) Nothing to Disclose
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PURPOSE

Dynamic susceptibility contrast enhanced (DSC) magnetic resonance imaging (MRI) is an important functional imaging method that enables quantitative assessment of blood perfusion in tumors. We used independent component analysis (ICA) to identify temporal characteristics of DSC MRI time course data, followed by applying a panel of machine-learning approaches to evaluate their predictive performance for high vs. low grade glioma classifications.

METHOD AND MATERIALS

Study approval was obtained from the IRB. Patients with high grade glioma (grade III and above, n=21) and low grade glioma (Grade II, n=8) were selected. All patients were imaged on a 3T MR imaging unit (TrioTim; Siemens) with a routine brain perfusion protocol. Prepressed time course data were processed using data-driven single ICA (FSL 4.1.4 MELODIC). The heterogeneity index of tumor was defined as the numbers of components generating from ICA. We used a supervised learning task with training data. Classifiers were trained using the repeated (3 repeat iterations) 10 fold cross validation of training cohort and their predictive performance was evaluated in the validation cohort using area under ROC curve (AUC).

RESULTS

Figure 1 shows the four time course components decomposing from the data collected from a patient with grade II gliomas. ICA allows for extracting tie course features for machine learning classifications, which were then used to evaluate the predictive power of different machine learning algorithms. Machine learning classier indicated that the best classification accuracy between high and low grade glioma could be obtained using by Medium Gaussian SVM (with total diagnostic accuracy of 64%, AUC = 0.71). Brain tumors, especially high grade glioblastoma multiforme (GBM), are highly heterogenous. Interestingly, the number of decomposed independent components reflects the degree of heterogeneity of the tumor. In average, high grade gliomas have significantly higher heterogeneity index compared to low grade gliomas (10 ± 5 vs. 5 ± 2, p=0.03, Figure 2).

CONCLUSION

Medium gaussian SVM model shows best diagnostic accuracy to differentiate between high / low grade tumor based on ICA-classified tumor perfusion.

CLINICAL RELEVANCE/APPLICATION

Using ML in combination with ICA method to analyze the MR perfusion signal enabled better characterization of heterogeneities of glioma.

RC205-10 Machine Learning Classification to Identify the Stage of Brain-Computer Interface Intervention for Stroke Rehabilitation based on Functional Connectivity in Chronic Stroke Subjects

Monday, Nov. 27 11:10AM - 11:20AM Room: S406B

Participants
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PURPOSE

Rehabilitation interventional therapy using brain computer interface (BCI) has been shown to contribute to motor function recovery post stroke. However, the impact of such an intervention on networks other than the motor network is not well understood. In this study, we use resting-state functional connectivity (rs-FC) of stroke subjects undergoing BCI therapy across two stages, pre- and post-intervention, to categorize subjects as belonging to one of the two stages of therapy using a machine learning classifier.

METHOD AND MATERIALS

A total of 28 chronic stroke subjects, with persistent upper-extremity motor deficits, received the rehabilitation therapy using a closed-loop neurofeedback BCI device. Over the entire course of the therapy, rs-functional MRI were collected at four stages: pre-, mid-, post- and one month post-therapy. In this work, we focus on two specific stages, pre- and post-therapy, to study the peak effects. Rs-FC involving 264 seed regions of interest (ROI) spanning the whole brain were computed at each stage, providing 56 samples for the analysis. A linear binary support vector machine (SVM) classifier was used to classify each subject into the stage they belonged to, using rs-FC as input features. A leave-one-out cross-validation was implemented to test the performance and optimize parameters of the classifier.

RESULTS

The machine learning classifier classified subjects correctly with a reasonable accuracy of 71%, as determined by cross-validation. In addition to the seed ROIs in the motor network, seed ROIs from the default mode, visual and fronto-parietal task control networks emerged as important contributors to the classification according to the feature weights assigned by the SVM.

CONCLUSION

SVM classifier can differentiate between pre- and post-therapy stages based on rs-FC and track specific brain networks that are reorganized across the two stages. FC in both motor and non-motor networks appear among the features that differentiate the two stages of the interventional therapy. Although the BCI-therapy is targeted at recovery of upper-extremity motor function, the results of this study suggest that BCI-therapy may also promote neural reorganization in non-motor networks as well.

CLINICAL RELEVANCE/APPLICATION

BCI therapy for recovery in motor functions post stroke is an image-guided intervention which allows for rehabilitation of not only motor systems but also may benefit non-motor systems as well.

RC205-11 Deep Learning for Gender Differentiation

Monday, Nov. 27 11:20AM - 11:30AM Room: S406B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

The purpose of this study was to develop an automated method to distinguish between man and woman based on head FLAIR magnetic resonance (MR) images.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board, and written informed consent was waived. A total of 400 patients (8650 slices) were sequentially enrolled and split into man (43.6%) or woman (56.4%) groups according to DICOM metadata. Two convolutional neural networks (CNNs) were trained from scratch with optimized parameters: (1) one was general purpose 2D CNN (8 layers, AlexNet) and the other (2) was a specific 3D CNN (4 layers, in-house development, using tensorflow). Subjects were split into training (70%), validation (5%) and test (25%) subsets. After that, another 960 patients were added and the total of 1360 patients were used to train only the 3D CNN, with varying training subset size (up to 1000), 60 patients in validation and 300 in test group.

RESULTS

For the 400 patients group, AlexNet yielded 77,19% top-1 accuracy (per-class accuracy for male: 59.96%; and female: 88.64%) and our in-house 3D CNN yielded 96.00% top-1 accuracy (per-class accuracy for male: 96.33%; and female: 95.74%). For the 1360 patients group, the 3D CNN yielded the following accuracies/training subset size: 58.33%/5; 73%/10; 88%/20; 89.33%/30; 92.33%/50; 94.66%/70; 95.33%/100; 96.33%/500; 98%/1000.

CONCLUSION

To date, no specific anatomic landmark (seen by human eye) has been identified to properly distinguish between gender in seccional images. Our 3D deep learning method appears to better differentiate gender based on FLAIR images when compared to a 2D CNN. This may be due to the higher level of features extracted in 3D CNNs. Although 98% accuracy may convince there may be image landmarks for gender differentiation, this result is not enough for clinical use yet. A bigger dataset should improve performance, according to the experiment with varying training subset size.

CLINICAL RELEVANCE/APPLICATION

An accurate tool to differentiate between man and woman based on head magnetic resonance (MR) images could aid in the diagnosis of gender phenotype, besides other secondary sex characteristics.

RC20512 Machine Learning: Approaches to Using Large Imaging Data Sets

Monday, Nov. 27 11:30AM - 12:00PM Room: S406B

Participants
Mark H. Michalski, MD, Boston, MA (*Presenter*) Nothing to Disclose

RC206

Everything You Need to Know about the Cervical Lymph Nodes

Monday, Nov. 27 8:30AM - 10:00AM Room: E353A

HN NR

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

Sub-Events

RC206A Nodal Levels and Criteria for Significance

Participants
Peter M. Som, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learn why the cervical lymph nodes are so important. 2) Learn why the anatomic location of the cervical nodes and the difference between nodal classification and nodal staging. 3) Learn what the criteria is for assessing when a node is suspected to be malignant.

RC206B Differential Diagnosis of Cervical Lymphadenopathy

Participants
Karen L. Salzman, MD, Salt Lake City, UT (*Presenter*) Consultant, Reed Elsevier; Author, Reed Elsevier

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LEARNING OBJECTIVES

1) Understand the differential diagnosis of cervical lymphadenopathy. 2) Review the imaging features of inflammatory/infectious etiologies of cervical lymphadenopathy. 3) Review the classic features of metastatic thyroid cancer and lymphomatous adenopathy.

RC206C Techniques for Imaging the Cervical Lymph Nodes

Participants
Ashok Srinivasan, MD, Canton, MI (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To understand the pros and cons of different techniques for imaging the cervical lymph nodes.

RC206D Types of Neck Dissections and the Post-operative Neck

Participants
Hilda E. Stambuk, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the general principles of neck dissection for head and neck cancers. 2) Define the terminology of various types of neck dissection. 3) Understand the implications of radiographic imaging in planning extent of neck dissection. 4) Identify radiographic features of the post-treatment neck.

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Explore Invent Transform

RC207

Renal Cell Carcinoma: How Imaging Can Be Used To Select Among Treatment Options and Monitor Response

Monday, Nov. 27 8:30AM - 10:00AM Room: N226

GU

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

Participants
Erick M. Remer, MD, Cleveland, OH (*Coordinator*) Nothing to Disclose
Erick M. Remer, MD, Cleveland, OH (*Moderator*) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (*Presenter*) Nothing to Disclose
Raghunandan Vikram, MBBS, FRCR, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) The attendee will learn how CT and MRI are used to distinguish indolent and agressive renal tumors, including identification of tumor subtypes. 2) Imaging findings that guide renal tumor management toward percutaneous tumor ablation, partial, and radical nephrectomy will be described. 3) The use of imaging to evaluate patients after tumor ablation and nephrectomy will be reviewed. Assessment methods, including MRI with DWI, CT, and contrast-enhanced US will be compared and treatment complications will be illustrated. 4) Methods for assessing for metastatic disease and tumor response after chemotherapy will be illustrated. Imaging appearances of post therapy complications will be reviewed.

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/ Raghunandan Vikram, MBBS, FRCR - 2012 Honored Educator

RC208

Emergency Radiology Series: Contemporary Topics in Imaging of Trauma

Monday, Nov. 27 8:30AM - 12:00PM Room: E451B

ER GI

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

Participants
Clint W. Sliker, MD, Ellicott City, MD (*Moderator*) Nothing to Disclose
Kathirkamanathan Shanmuganathan, MD, Baltimore, MD (*Moderator*) Nothing to Disclose
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LEARNING OBJECTIVES

1) Present the current state of the art imaging of blunt bowel injury. 2) Present the spectrum of MDCT findings seen following blunt bowel injury. 3) Asscess the potential application of Dual-Energy CT in bowel injury. 4) Emphasize the importance of communication between radiologist and patient provider to enhance timely diagnosis and treatment.

Sub-Events

RC208-01 Imaging of Facial Injuries

Monday, Nov. 27 8:30AM - 9:00AM Room: E451B

Participants
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Active Handout:Clint W. Sliker

http://abstract.rsna.org/uploads/2017/17000819/Imaging Facial Fractures_Sliker Handout.pdf

LEARNING OBJECTIVES

1) Demonstrate a systematic approach to evaluating CT images of patients with acute facial fractures. 2) Discuss how recognition of several facial fracture patterns simplifies injury characterization and facilitates clear, clinically relevant reporting.

RC208-02 Effect of Implementation of Institutional Triaging Algorithms on MDCT Usage in Blunt Head and Neck Trauma

Monday, Nov. 27 9:00AM - 9:10AM Room: E451B

Participants
Chad W. Farris, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of our study is to investigate the effect of implementation of triaging algorithms on the rate of MDCT utilization for evaluation of blunt head and neck trauma over a 20-month period at a Level 1 trauma center.

METHOD AND MATERIALS

This retrospect HIPAA compliant study was approved by our IRB; Informed consent was waived. All patients admitted for blunt head and neck trauma (BHNT) to a level I trauma center from 8/2009-3/2011 were included (n=2653). Based on a review of the PACS, trauma patients who had a head CT (CTH), cervical spine CT (CTCS), and/or CT angiogram of the head and neck (CTAHN) were identified for positive findings. BHNT patients were divided into two groups: pre-algorithm (8/2009-6/2010, n=1505) and post-algorithm (7/2010-3/2011, n=1148), based on an implementation date of 7/1/2010 when clinical triaging algorithms were introduced to determine the need for imaging in patients with BHNT. Chi-squared analysis with Yates corrections was used to determine statistical significance.

RESULTS

The percentage of BHNT admissions that received a CTH in the post-algorithm group was significantly less than the pre-algorithm group (53% vs. 64%, p<0.0001). The percentage of BHNT admissions that received a CTCS in the post-algorithm group was significantly less than the pre-algorithm group (43% vs. 59%, p <0.0001). The percentage of BHNT admissions that received a CTAHN was not significantly different between the post-algorithm group and the pre-algorithm group (7% vs. 8%, p=0.24). The percentage of positive CTH, CTCS, and CTAHN in the post-algorithm group was not significantly different from the pre-algorithm group (38% vs. 37%, p=0.7789; 9% vs. 10%, p=0.9115; 7% vs. 8% p=0.9614; respectively).

CONCLUSION

Implementation of institutional clinical triaging algorithms for MDCT usage in BHNT significantly reduced the percentage of trauma patients undergoing CTH and CTCS at a Level 1 trauma center. However, the percentage of trauma patients undergoing CTAHN was unchanged by implementation of these clinical triaging algorithms, which may be due to CT angiograms being performed based on positive findings on CTH and CTCS and not based solely on clinical evaluation.

CLINICAL RELEVANCE/APPLICATION

Implementation of institutional clinical triaging algorithms for MDCT usage in BHNT can significantly reduce utilization of MDCT in patients with BHNT.

RC208-03 Acute Head Trauma Detected on Whole-body CT of Traffic Accident Victims with No Physical and Neurological Findings

Monday, Nov. 27 9:10AM - 9:20AM Room: E451B

Participants
Keiji Kitatani, MD, Miyazaki, Japan (*Presenter*) Nothing to Disclose
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Yoshihito Kadota, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the incidence of acute head trauma findings on whole-body CT scans of traffic accident victims with no physical or neurological evidence suggestive of head injury.

METHOD AND MATERIALS

A review of the electronic medical records identified patients who met the following criteria: 1) patients with traffic trauma, 2) performance of head CT and chest-, abdominal- and pelvic CT, 3) direct referral to our emergency department from August 2015 to July 2016, and 4) the presence of records for physical and neurological examination. We recorded their age, sex, Glasgow Coma Scale (GCS), systolic blood pressure, injury severity score (ISS), the type of traffic accident, and the presence/absence of visible trauma above the clavicles and of traumatic brain injury (TBI) on CT scans. The relationship between TBI findings by CT and physical and neurological study results was assessed by univariate analysis. Independent predictors of TBI on CT scans were assessed by multivariate logistic regression analysis.

RESULTS

Of 398 patients who had undergone whole-body CT studies, 124 (31%; 81 males, 43 females; age 4 to 92 years, mean 47.7 years) were included. Of these, 34 (27%) manifested TBI on CT scans. Univariate analysis identified the age, GCS, visible trauma above the clavicles, ISS, and the accident type as statistically significant (p<0.05). Multivariate analysis showed that visible trauma above the clavicles, GCS deterioration, and a higher ISS were significant independent predictors of TBI on CT (p<0.05, <0.05, and <0.01, respectively). With the non-TBI group as a reference, the odds ratio was 15.1 (95% CI, 1.79 - 128.0) for trauma above the clavicles; 6.45 (95% CI, 1.22 - 34.0) for GCS deterioration, and 0.94 for a higher ISS (95% CI, 0.90 - 0.98). No patient without both GCS deterioration and visible trauma above the clavicles had TBI on CT scans.

CONCLUSION

Head CT rarely demonstrates acute TBI in traffic accident victims with no evidence suggestive of head injury on physical and neurological studies.

CLINICAL RELEVANCE/APPLICATION

Head CT studies may not be needed in accident victims with no evidence of head injury at physical and neurological examination.

RC208-04 Imaging of Diaphragmatic Injuries

Monday, Nov. 27 9:20AM - 9:50AM Room: E451B

Participants
Michael N. Patlas, MD, FRCPC, Hamilton, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To describe direct and indirect signs of blunt and penetrating diaphragmatic injury. 2) To highlight factors affecting detection of diaphragmatic injury. 3) To discuss pitfalls in diagnosis of diaphragmatic injury.

RC208-05 CT Angiograms of the Neck in Strangulation Victims: Incidence of Positive Findings at Our Level One Trauma Center Over a 7 Year Period

Monday, Nov. 27 9:50AM - 10:00AM Room: E451B

Participants
James T. Dixon, MS,MD, Louisville, KY (*Abstract Co-Author*) Nothing to Disclose
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Alexander M. Richardson, MD, Louisville, KY (*Abstract Co-Author*) Nothing to Disclose
Jonathan K. Joshi, MD, Louisville, KY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the incidence of acute findings diagnosed with computed tomography angiography (CTA) of the neck among emergency department patients presenting with strangulation injury.

METHOD AND MATERIALS

This institutional review board-approved, HIPAA-compliant retrospective review was performed at our academic urban level 1 trauma center. The PACS database was queried for all consecutive patients who had CTAs of the neck performed for the exam indication of strangulation between January 1, 2009 and April 30, 2016, resulting in 142 included patients. Analysis of the individual cases was then performed, recording any positive results, with clinical findings classified using, when possible, standardized terminology found in the literature. Frequency of acute injury in the CTA Neck examinations was determined with the calculation of 95% confidence interval (CI) and positive clinical findings were evaluated by calculation of PPV.

RESULTS

There were 142 patients who met inclusion criteria (average age, 32.6 years) and 116 (81.7%) patients were female. CTA of the neck revealed 22 patients to have acute injuries (15.5%, 95% CI: 9.5, 21.4) including 6 questionable vascular injuries (4.2%, 95% CI: 0.9, 7.5) either found to be artifactual or unconfirmed by lack of follow-up visits. Although neck pain (73, 51.4%), loss of consciousness (67, 47.2%), and headache (31, 21.8%) were frequently reported in the ROS, their predictive value of vascular injury was weak (PPV, 4.1%, 4.5%, and 3.2%, respectively). On physical exam, redness/bruising of the neck (73, 51.4%) and neck tenderness (47, 33.1%) were both the most common and had the highest PPV (19.2% and 12.8%, respectively), however when selecting for vascular injuries alone were found to have low predictive yield (vascular injury PPV, 4.1% and 2.1%, respectively).

CONCLUSION

Performing CTA of the neck after acute strangulation injury rarely identifies clinically significant findings, with vascular injuries proving exceedingly rare. As positive findings could not be clinically predicted, prospective validation of a clinical prediction rule in this population is warranted.

CLINICAL RELEVANCE/APPLICATION

In this study, 142 patients who had experienced acute strangulation underwent a CT angiogram of the neck examination per protocol to identify occult injury, but few, if any, of these examinations revealed acute clinically significant injury.

RC208-06 Intimate Partner Violence and Sexual Assault: Clinical and Radiologic Findings

Monday, Nov. 27 10:00AM - 10:10AM Room: E451B

Participants
Elizabeth George, MD, Boston, MA (*Presenter*) Nothing to Disclose
Catherine Phillips, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Nandish Shah, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Annie Lewis-O'Connor, PhD, MPH, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Intimate partner violence (IPV) and sexual assault (SA) are under-recognized entities in Emergency Radiology even though 1 in 4 women in the US experiences physical abuse or sexual assault by their intimate partner. We aim to study the demographics, clinical presentation, and radiologic findings in these patients.

METHOD AND MATERIALS

Patients referred to the domestic abuse (n=87) and sexual assault programs (n=35) from January to October 2016 were identified. Demographics, clinical presentation, and radiologic studies performed within 5 years of presentation were reviewed from the electronic medical record.

RESULTS

Majority of the IPV victims were female (95%) and African-American (40%), with a mean age of 34.7 (±12.0) years. Almost all (97.7%) patients presented to the ED, presenting symptom was unrelated to IPV in 44.8%, and 83% endorsed prior history of

violence. A total of 665 radiology exams were performed, for a median number of 4 studies per patient (IQR: 0-10; maximum=65). The most commonly performed exam was chest radiograph, followed by obstetric ultrasound (US), and musculoskeletal (MSK) radiographs. The common traumatic injuries were extremity fractures (n=6), nasal bone fractures (acute/chronic, n=4), orbital fractures (n=2), soft tissue injury (hematoma/laceration, n=7), and spinal fracture/compression (n=3). Other findings potentially related to violence were subchorionic hematoma (n=5), pregnancy failure (n=6), and intrauterine growth retardation (n=2). SA victims were younger (27.3±7.7 years), majority female (91%), and African-American (46%). A total of 109 radiology exams were performed, for a median number of 4 studies per patient (IQR: 1.75-12.25; maximum=25). The most commonly performed exam was chest radiograph, followed by CT head, pelvic US and MSK radiographs. There were fewer traumatic injuries in this population; orbital wall deformity (n=1), soft tissue swelling (n=2), and spinal compression fracture (n=1).

CONCLUSION

A wide range of imaging studies are performed on IPV patients and radiologists can potentially play a role in early detection by identifying patterns of injury.

CLINICAL RELEVANCE/APPLICATION

Intimate partner violence is challenging to identify due to variable presentation and often coexisting psychiatric history; identification of radiologic patterns of injury may enable early establishment of care.

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/ Bharti Khurana, MD - 2014 Honored Educator

RC208-07 Update on Imaging Bowel Injuries

Monday, Nov. 27 10:20AM - 10:50AM Room: E451B

Participants
Kathirkamanathan Shanmuganathan, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Present the current state of the art imaging of blunt bowel injury. 2) Present the spetrum of MDCT findings seen following bowel injury. 3) Asscess the potential application of Dual-Energy CT in bowel injury. 4) Emphasize the importance of communication between radiologist and the provider to enhance timely diagnosis and optimal management.

RC208-08 Additive Value of Arterial Phase in CT Evaluation of Splenic Injuries in Blunt Abdominal Trauma

Monday, Nov. 27 10:50AM - 11:00AM Room: E451B

Awards
Trainee Research Prize - Resident

Participants
Naren Hemachandran, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose
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Raju Sharma, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Despite routine use of computed tomography (CT) in the evaluation of blunt abdominal trauma (BAT), the protocol has not been optimised. This study was done to evaluate the additive role of arterial phase (AP) in detection and management of splenic vascular injuries like active contrast extravasation (AE) and pseudoaneurysms (PA), which are indications for angioembolisation

METHOD AND MATERIALS

Consecutive hemodynamically stable, FAST positive BAT patients above 18 years of age were recruited over a period of 23 months. All patients underwent a dual phase [AP followed by portal venous phase (PVP)] CT and the images were analysed in 3 blinded ways - AP alone, PVP alone and AP + PVP together for the presence of AE/PA with findings categorised as present / absent / equivocal and compared with digital subtraction angiography (DSA) wherever possible. Data from patients with splenic injury was separately analysed. The grade of organ injury and the treatment strategy were also noted

RESULTS

Among the 527 patients with BAT recruited in a larger study, splenic injuries were found in 154 patients (15 grade 1, 33 grade 2, 52 grade 3, 44 grade 4 and 10 grade 5) and splenic vascular injuries were identified in 52/154 (33.7 %) patients which included 25 PA and 27 AE when both the AP and PVP were seen together. Of these 22 (17 PA and 5 AE) were identified only on AP, 4 (all AE) only on PVP and the remaining 26 (8 PA and 17 AE) on both AP and PVP. This resulted in a sensitivity of 92.3 % for AP and 57.6 % for PVP. 17 of the 25 PA (68 %) were identified only on AP. 33 of the 154 (21.4 %) patients underwent angioembolisation which included 22/52 (42.3%) patients with vascular injuries detected on CT. With the incorporation of AP, the management changed in 9 patients, 7 who underwent angioembolisation and 2 underwent surgery. The diagnostic accuracy of CT in detecting splenic vascular injuries was 67.3 % for portal venous phase and increased to 85.5 % with the addition of arterial phase (p value < 0.05)

CONCLUSION

Addition of arterial phase improved the detection rate and diagnostic accuracy of splenic vascular injuries, and had an impact on management

CLINICAL RELEVANCE/APPLICATION

Arterial phase CT increases detection of splenic vascular injuries in blunt abdominal trauma leading to increased usage of angioembolisation and improved patient outcome with non-operative management

RC208-09 Segmented Abdominopelvic Fluid Volumes Predict Urgency of Decompressive Laparotomy in Traumatic Abdominal Compartment Syndrome

Monday, Nov. 27 11:00AM - 11:10AM Room: E451B

Awards
Student Travel Stipend Award

Participants
Thomas Battey, Baltimore, MD (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate the utility of computed tomography (CT) signs for predicting the need for urgent (<24 hour) decompressive laparotomy in post-traumatic abdominal compartment syndrome (ACS).

METHOD AND MATERIALS

This IRB-approved, HIPAA-compliant retrospective study included 64 patients >18 years presenting with traumatic injury who developed ACS requiring surgical decompression and had pre-operative CT between 2004-2014. Patients were excluded if not preoperatively diagnosed with ACS by clinical criteria; if the diagnosis of ACS was made during management of the open abdomen; or if there was a concurrent indication (hollow viscus or major vascular injury) for exploratory laparotomy. Abdominopelvic fluid volumes were determined quantitatively using semi-automated segmentation. Additional imaging parameters recorded included largest single bowel wall, smallest inferior vena cava, and smallest aortic diameters; abdominal anteroposterior:transverse (AP:T) ratio; presence or absence of hydronephrosis, inguinal herniation; and mesenteric and body wall edema. Common laboratory values were abstracted at the time of CT and surgery. Patients were separated into early (<24 hours from CT to surgery) and late surgical decompression groups for outcome analysis. Correlation analysis, comparison of means, and multivariate logistic regression was performed.

RESULTS

Comparison of means revealed higher abdominal fluid volumes (p=0.001), increased AP:T ratio (p=0.009) and decreased inferior vena cava diameter (p=0.009) in the early surgery group compared to the late surgery group. For laboratory values, base deficit was increased (p=0.038), and pH (p=0.024) and bicarbonate level (p=0.043) were decreased in the early surgery group. Multivariate analysis including laboratory and imaging variables revealed abdominal fluid volumes (p=0.012;OR:1.002/milliliter) as an independent predictor of early surgery.

CONCLUSION

Segmented abdominopelvic free fluid volumes may aid in identifying patients in need of urgent surgical decompression for post-traumatic ACS.

CLINICAL RELEVANCE/APPLICATION

These data suggest that segmented abdominopelvic fluid volumes are an independently predictive quantitative imaging biomarker for urgency of surgical decompression in post-traumatic ACS.

RC208-10 Penetrating Abdominal and Pelvic Injuries

Monday, Nov. 27 11:10AM - 11:40AM Room: E451B

Participants
Felipe Munera, MD, Miami, FL (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1. To discuss the role of MDCT in patients with penetrating abdominal and pelvic trauma 2. Describe MDCT protocols 3. Review MDCT findings of penetrating abdominal and pelvic trauma

RC208-11 Hemoglobin and Systolic Blood Pressure Predict Subsequent Positive Conventional Angiography in Patients with Positive CTA for Pelvic Trauma

Monday, Nov. 27 11:40AM - 11:50AM Room: E451B

Participants
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PURPOSE

Hemodynamically stable patients presenting to the ED for pelvic trauma often receive CTA of the pelvis to assess for major vascular injury. Despite the high sensitivity and specificity of pelvic CTA in diagnosing arterial bleeding, these findings do not always correlate with subsequent positive conventional angiography for embolization. The purpose of this study is to evaluate clinical parameters that can predict subsequent positive conventional angiography in patients with CTA showing active pelvic arterial extravasation.

METHOD AND MATERIALS

An IRB-approved, retrospective analysis was conducted of 45 consecutive patients who had CTA for pelvic trauma that revealed arterial extravasation and subsequently received conventional angiography for intended embolization. The presenting clinical parameters of heart rate, systolic and diastolic blood pressure were obtained for each patient. Additionally, the presenting laboratory values of hemoglobin, lactate, BUN, and creatinine were also obtained. These parameters were compared between those patients who had positive conventional angiography and those who had negative conventional angiography using a single tailed T-test.

RESULTS

Of the 45 patients with arterial extravasation on CTA, 28 had arterial extravasation on conventional pelvic angiography whereas arterial extravasation could not be redemonstrated in 17 patients. Patients with active extravasation on pelvic CTA and angiography had an average presenting hemoglobin of 11.7 compared to 13.4 g/dl in patients with negative angiography (p=0.01). Patients with active extravasation on pelvic CTA and angiography had systolic blood pressure of 97 compared to 134 mmHg in patients with negative angiography (p=0.01). The clinical parameters of heart rate and diastolic blood pressure did not correlate with positive conventional angiography. The laboratory values of lactate, BUN and creatinine did not correlate with positive conventional angiography.

CONCLUSION

In patients presenting with pelvic trauma and a CTA showing active arterial extravasation, a lower hemoglobin and lower systolic blood pressure predict positive findings at conventional angiography performed for embolization.

CLINICAL RELEVANCE/APPLICATION

These findings can assist emergency physicians and interventional radiologists in estimating the yield of conventional angiography for embolization of traumatic active pelvic arterial extravasation.

RC208-12 Indications for Trauma Radiology Studies: Assesing Differences in Beliefs versus Practice among Surgeons and Radiologists

Monday, Nov. 27 11:50AM - 12:00PM Room: E451B

Participants
Crystal L. Piper, MD, New Haven, CT (*Presenter*) Nothing to Disclose
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James M. Healy, MD,MS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Previous reviews have demonstrated that clinical information leads to improved diagnostic interpretation. Transmission of clinical information to radiologists is particularly challenging in the emergency department and trauma bays where the stress of the environment often lead to communication breakdowns. This analysis examines attitudes and beliefs regarding proper ordering indications amongst trauma surgeons and their emergency radiology counterparts.

METHOD AND MATERIALS

An anonymous survey was sent to all general surgery and emergency radiology residents and selected faculty within a large academic hospital in the Northeast. The survey evaluated perception of appropriate radiologic study indications for provided patient scenarios. These results were then compared to actual indications given for all studies performed on full-trauma patients during the same period.

RESULTS

A total of 89 surveys were completed (60% response rate). A significant difference was found between surgeons and radiologists in

terms of perceived clinical information that should be communicated about trauma patients. When given a clinical scenario, surgeons were more likely to feel that more clinical information was preferable. However, of 41 CT scans of full-trauma patients, only 7 orders contained information other than "trauma," and there was no case of an order including all relevant signs, symptoms, mechanism of injury or clinical question.

CONCLUSION

Although when surveyed surgical residents and staff report providing an excess of clinical information for emergency radiology procedures, in practice they often underreport. Surgeons may not understand the importance or appropriateness of clinical information that should be communicated to emergency radiologists. Educating surgeons and tracking their ordering behavior may be a productive way to improve communication.

CLINICAL RELEVANCE/APPLICATION

Understanding barriers to communication between trauma surgeons and emergency radiologist can guide interventions and improve the quality of clinical information received by radiologists. This may in turn improve the accuracy and impact of radiology reports.

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RC209

Gastrointestinal Series: Pancreas Imaging

Monday, Nov. 27 8:30AM - 12:00PM Room: E350

GI

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

Participants
Atif Zaheer, MD, Baltimore, MD (*Moderator*) Nothing to Disclose
Zhen J. Wang, MD, Hillsborough, CA (*Moderator*) Stockholder, Nextrast, Inc
Bhavik N. Patel, MD,MBA, Stanford, CA (*Moderator*) Consultant, General Electric Company; Research support, General Electric Company

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Sub-Events

RC209-01 Pancreas Cancer

Monday, Nov. 27 8:30AM - 8:50AM Room: E350

Participants
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LEARNING OBJECTIVES

1) Review mimics of pancreatic adenocarcinomas2) Become familiar with imaging findings of subtle pancreatic adenocarcinomas3) Review other cancers that are misdiagnosed as pancreatic adenocarcinomas and understand key imaging features that can prevent the misdiagnoses

RC209-02 Imaging Structural Heterogeneity in Pancreatic Cancer Using the ADC Value

Monday, Nov. 27 8:50AM - 9:00AM Room: E350

Participants
Sebastian Ziegelmayer, Munchen, Germany (*Presenter*) Nothing to Disclose
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Fabian Lohoefer, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Petia Jeliazkova, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Helmut Friess, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Markus Schwaiger, MD, Munich, Germany (*Abstract Co-Author*) Research Grant, Siemens AG; Speaker, Siemens AG
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Ernst J. Rummeny, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Bjoern Menze, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose
Jens Siveke, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Rickmer Braren, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Tumor cellularity has been demonstrated to be an independent prognostic parameter in pancreatic cancer (PDAC), with highly cellular tumors showing worse survival than stroma-rich ones. Diffusion weighted imaging (DWI) and the apparent diffusion coefficient (ADC) have been shown to correlate with tumor cellularity and survival. In this retrospective study, we applied manual analysis and computational methods to ADC maps of therapy-naïve PDAC tumors to test the value of this imaging parameter for subtype identification and clinical outcome prediction.

METHOD AND MATERIALS

82 patients were retrospectively analysed. Tumors were identified in standard abdominal mpMRI data sets (CE-T1w VIBE, T2w, DWI), manually segmented in DWI (b=600) and segmentations were transferred to ADC maps. Manual analysis was performed by identifying the lowest ADC region of the tumor and obtaining the corresponding mean ADC value. Histogram analysis, Haralick feature analysis and convolutional neural network (CNN) analysis were applied to both the entire tumor region segmentations and to the lowest ADC regions ("ADC-blob analysis"). Results were correlated with patient survival (above/ below median).

RESULTS

Using the median ADC value as cutoff, manual analysis yielded strong separation between groups with higher-than-median (ADChigh) and lower-than-median (ADClow) survival when applied to the lowest ADC tumor region. CNN analysis was superior to both Haralick feature analysis and histogram analysis in distinguishing between groups with different survival but inferior to manual analysis when applied to the entire tumor. "ADC-blob analysis" yielded the best separation among the computational analysis methods.

CONCLUSION

The ADC value can be used to stratify patients into distinct subgroups with above/below median survival using manual analysis of the lowest ADC region in the tumor, rendering it a potential biomarker for risk assessment. Deep learning methods hold the potential for additional subgroup identification.

CLINICAL RELEVANCE/APPLICATION

The presented study demonstrates the ADC value as a promising biomarker for subgroup identification in PDAC.

RC209-03 Pancreatic Neuroendocrine Tumors

Monday, Nov. 27 9:00AM - 9:20AM Room: E350

Participants
Desiree E. Morgan, MD, Birmingham, AL (*Presenter*) Research Grant, General Electric Company

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LEARNING OBJECTIVES

1) Identify imaging features of pancreatic endocrine tumors that differentiate it from pancreatic ductal adenocarcinoma. 2) Compare specific clinical utilities of the different imaging modality choices in patients with pancreatic endocrine tumors. 3) Understand World Health Organization grading and implications for staging pancreatic endocrine tumors.

RC209-04 Pancreatic Neuroendocrine Tumor: Correlations between MRI Features, Biology and Clinical Outcome

Monday, Nov. 27 9:20AM - 9:30AM Room: E350

Participants
Rodrigo Canellas, MD, Boston, MA (*Presenter*) Nothing to Disclose
Grace C. Lo, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Sreejita Bhowmik, MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Dushyant V. Sahani, MD, Boston, MA (*Abstract Co-Author*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

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PURPOSE

To assess whether MRI features of pNETs (pancreatic neuroendocrine tumors) can predict WHO tumor grade and disease progression after surgical resection.

METHOD AND MATERIALS

In this IRB approved study, CE-MRI scans of 80 patients with surgically verified pNETs were assessed. The images were evaluated for tumor location; size; pattern; predominant signal intensity on T1/T2-WI, enhancement pattern on dynamic-T1WI; pancreatic duct dilatation; pancreatic atrophy; DWI signal; vascular involvement by the tumor; extra-pancreatic tumor spread; and synchronous liver metastases. Tumors were graded based on WHO classification (G1 vs G2/G3) and patients were followed-up with CT or MRI after surgical resection. Data were analyzed with Student's t and chi-square tests, logistic regression and Kaplan Meier curves. Interobserver agreement between the readers was assessed with Cohen's kappa statistics.

RESULTS

A total of 80 patients and 82 pNETs were included in the study. Among the pNETs, 43 were G1 and 39 were G2/G3, according to the WHO classification system. The MRI features that were associated with more aggressive tumors (n=39) were: size > 2.0 cm (OR=4.8, p=0.002), "non-bright lesions" on T2 weighted images (OR=4.6, p=0.008), presence of pancreatic ductal dilatation (OR=4.9, p=0.024) and restricted diffusion within the lesion (OR=4.9, p=0.013). Of note, extra-pancreatic spread, vascular involvement and presence of synchronous liver metastases were only observed in G2/G3 tumors. Differences in progression-free survival distribution were found for patients whose pNETs were associated with the following MRI features: size > 2.0 cm (X2 (1)=6.0, p=0.014), "non-bright lesions" on T2 weighted images (X2 (1)=6.8, p=0.009) and presence of pancreatic duct dilatation (X2 (1)=10.9, p=0.001). Moreover, vascular involvement (X2 (1)=21.4, p<0.001), extra-pancreatic spread (X2 (1)=11.1, p=0.001) and presence of synchronous liver metastases (X2 (1)=26.5, p<0.001) also showed statistically significant differences in the progression free survival curves.

CONCLUSION

MRI features can be used to assess pNETs aggressiveness and identify patients at risk for early disease progression after surgical resection.

CLINICAL RELEVANCE/APPLICATION

MRI features can be used as imaging biomarkers to select patients who would benefit from surgery or from the "wait-and-watch" approaching.

Honored Educators

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RC209-05 Image Characteristic of Simultaneous-Multislice (SMS)-Accelerated Diffusion-Weighted Image with Higher Spatial Resolution: A Comparison with Conventional DWI in Neuroendocrine Neoplasms Liver Metastases Patients

Monday, Nov. 27 9:30AM - 9:40AM Room: E350

Participants
Jia Xu, Beijing, China (*Presenter*) Nothing to Disclose
Xuan Wang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Shi Tian Wang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Zheng Yu Jin, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Jin Cheng, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Tianyi Qian, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Huadan Xue, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the image characteristics of simultaneous-multislice (SMS)-accelerated diffusion-weighted image (DWI) with thinner slice thickness compared to conventional DWI in neuroendocrine neoplasms (MEN) liver metastasis patients.

METHOD AND MATERIALS

15 patients with MEN liver metastasis underwent conventional DWI (b-values 50, 800s/mm2, slice thickness(SL) 4mm, scan time 2'53min), SMS-DWI with and without motion correction (SMS-MoBvS, SMS) (b-values 50, 800s/mm2, SL 2mm, scan time 2'44min). Other sequences include T2WI, T1WI, and post-contrast sequences. Datasets acquired with the b-value 800s/mm2 were evaluated. Numbers of high signal lesions detected in DWI, SMS and SMS-MoBvS were calculated. The subjective image quality (i.e. sharpness of the liver edge and the vessel contour, artifacts, overall image quality, the detectability and delineation of lesions) were evaluated using a 5 grade scale (1 = poor to 5 = excellent). ADC values were measured in all three datasets. Signal-to-noise ratio (SNR) and lesions-to-liver contrast-to-noise ratio (CNR) were calculated and compared between SMS and SMS-MoBvS using paired T test. Qualitative image parameters and ADC were compared among the three datasets using the Dunn-Bonferroni post hoc test for pairwise comparisons in case of significant p-values in the Friedman test for overall comparison.

RESULTS

The number of high signal lesions detected in DWI, SMS and SMS-MoBvS were 348, 504 and 523 respectively. The detectability and delineation of lesions were significantly superior in SMS [4.18 (3-5)] and SMS-MoBvS [4.42 (3-5)] than DWI [3.04 (2-4)] (all P<001). The sharpness of the liver edge and the vessel contour, artifacts, overall image quality were significant superior in SMS-MoBvS than DWI (all P < 0.005). No significant difference were found in SNR and CNR between SMS and SMS-MoBvS. ADC were significant lower in SMS (858.7±121.2) and SMS-MoBvS (813.9±240.4) compared to conventional DWI (984.8±93.4) (P<0.001, P=0.024).

CONCLUSION

SMS and SMS-MoBvS with higher spatial resolution can detect more lesions, provide better lesion delineation than DWI at a comparable scanning time. SMS-MoBvS showed significant better image quality than DWI.

CLINICAL RELEVANCE/APPLICATION

SMS-DWI provide accelerated data and has the advantage to obtain image with higher spatial resolution at a same acquisition time, which help to detect more lesions and provide better image quality.

RC209-06 Feasibility of Using Virtual Touch Quantification Technology to Differentiate Between Benign and Malignant Solid Small Pancreatic Tumors

Monday, Nov. 27 9:40AM - 9:50AM Room: E350

Participants
Wenping Wang, MD, PhD, Shanghai, China (*Presenter*) Nothing to Disclose
Yi Dong, MD, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Feng Mao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Jiaying Cao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of this retrospective study was to evaluate the feasibility of using virtual touch quantification (VTQ) shear wave technology in the characterization and differentiation between pancreatic ductal adenocarcinomas (PDA) and other solid benign pancreatic tumors.

METHOD AND MATERIALS

Over a period of two years, 96 patients with unclassified solid small pancreatic lesion <= 20 mm were prospectively evaluated.

ACUSON S2000 HELX US system (Siemens Medical Solutions, Mountain View, CA, USA), equipped with a C6-1 transducer was used. VTQ was performed of small solid pancreatic lesion allowing comparison with surrounding pancreatic parenchyma to obtain shear wave veloc¬ity (SWV) measurements. The differences in SWV and SWV ratio of solid pancreatic lesion to surrounding parenchyma were evaluated, and the cut off values were investigated. Receiver operating characteristic (ROC) curve was plotted to evaluate the diagnostic performance. In all patients VTQ elastography results were compared with cytology or histology findings as the gold standard.

RESULTS

A total of 96 lesions including 79 (82.3 %) PDA, 6 (6.2 %) pancreatic neuroendocrine tumors (NET) and 11 (11.5 %) solid pseudopapillary tumors (SPT) of pancreas were analysed. The mean SWV values obtained were (3.96 ± 0.51) m/s in PDA, (2.70 ± 0.13) m/s in SPT and (2.54 ± 0.79) m/s in NET. Significant difference between mean SWV values of PDA and benign lesions was found ($P < 0.05$). The SWV ratio of each small solid pancreatic lesion to the surrounding parenchyma was 2.57 ± 0.41 for PDA and 1.25 ± 0.19 for benign lesions ($P < 0.05$). For the diagnosis of small solid pancreatic lesion, while using the cut off value 3.98 m/s for SWV and 2.65 for SWV ratio, good sensitivity (80.7%) and specificity (78.6%) were obtained for the characterization of PDA.

CONCLUSION

VTQ elastography is helpful in the non-invasive characterization and differentiation between benign and malignant solid small pancreatic tumors during conventional ultrasound examinations. Increasing tissue stiffness of PDA is represented by greater SWV values.

CLINICAL RELEVANCE/APPLICATION

VTQ is a new elastography method that shows promising application for the quantification of PDA elasticity.

RC209-07 Panel Discussion-MRI versus CT When to Choose and How to Use

Monday, Nov. 27 9:50AM - 10:10AM Room: E350

RC209-08 Approach to Cystic Pancreatic Lesions

Monday, Nov. 27 10:10AM - 10:30AM Room: E350

Participants
Bhavik N. Patel, MD,MBA, Stanford, CA (*Presenter*) Consultant, General Electric Company; Research support, General Electric Company

LEARNING OBJECTIVES

1) Be familiar with the spectrum of common pancreatic cystic lesions. 2) Describe the radiologic findings associated with pancreatic cystic lesions. 3) Understand the management of pancreatic cystic lesions.

LEARNING OBJECTIVES

1) Be familiar with the spectrum of common pancreatic cystic lesions. 2) Describe the radiologic findings associated with pancreatic cystic lesions. 3) Understand the management of pancreatic cystic lesions.

RC209-09 Long-Term Single Institution Imaging Follow Up in a Large Cohort of Incidentally Detected Pancreatic Cystic Neoplasms: Do Baseline Imaging Features Predict Cyst Growth?

Monday, Nov. 27 10:30AM - 10:40AM Room: E350

Awards
Trainee Research Prize - Fellow

Participants
Pallavi Pandey, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Ankur Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Farnaz Najmi Varzaneh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Yan Luo, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Mounes Aliyari Ghasabeh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Nanna Shao, MBBS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pegah Khoshpouri, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Manijeh Zarghampour, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Daniel Fadaei Fouladi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Anne M. Lennon, MD, Baltimore, MD (*Abstract Co-Author*) Consultant, Boston Scientific Corporation
Marcia I. Canto, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

To assess the growth of incidentally detected pancreatic cystic neoplasms (PCNs) and its association with baseline features on long term imaging follow up.

METHOD AND MATERIALS

This retrospective IRB approved HIPAA compliant study with waived patient consent included incidentally detected PCNs with at least 2 abdominal MRI/CT studies performed at least 12 months apart. Single largest diameter was measured for each cyst using T2W MR or CT axial and coronal images at baseline and follow up (F/U) using standardised technique. Cyst features including location, septations and mural nodules were noted. Histological diagnosis for resected cysts was available. Size change of cyst was defined as change from baseline size of >=100%, >=2.5 mm and >=20% for baseline size groups of <=5mm, 6-10 mm and >10 mm,

respectively. Fisher's exact and Kruskal-Wallis test were used to test association of size change groups (stable, increased or decreased) with cyst and patient characteristics.

RESULTS

A total of 260 cysts in 167 patients (mean age, 69±11 yrs; 57 men) were included with a median baseline cyst size of 14 mm (IQR, 9-23 mm). Over a median F/U of 55 months (IQR, 33-76 months), 127 (48.9%) cysts changed in size (87 [33.5%] increased, 40 [15.4%] decreased, 133 [51.1%] remained stable). In the baseline size groups of <=5 mm, 6-10 mm and > 10 mm, size increase was noted in 2 (11.8%), 28 (41.8%) and 57 (32.4%) cysts, respectively. Seventy seven (30%) had septation and 4 (1.5%) cysts had a mural nodule. While age (P=0.58), gender (P=0.22), cyst location (P=0.69) or the presence of a septation (P=0.11) were not associated with size change, baseline size (P=0.02) and presence of mural nodule (P=0.02) were associated with size change. F/U duration was similar in those cysts with and without a change in size (P=0.32) and the baseline size groups (P=0.18). Overall, 13 cysts underwent surgical resection (median baseline size, 24 mm; IQR, 21-32 mm; median size increase, 5 mm; IQR, 2-11 mm) with no case of high-grade dysplasia/invasive cancer.

CONCLUSION

Majority of small, incidentally detected PCNs in this study remained stable over F/U of 55 months. Baseline cyst size and presence of a mural nodule were predictive of size change.

CLINICAL RELEVANCE/APPLICATION

5 year median imaging follow up identified growth only in a small proportion of cysts <=5mm. The presence of mural nodule warrants close attention.

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RC209-10 MRI Imaging of IPMN: Is Gadolinium Administration Mandatory in the Follow-Up?

Monday, Nov. 27 10:40AM - 10:50AM Room: E350

Participants
Luisa Bertuzzo, MD, Verona, Italy (*Presenter*) Nothing to Disclose
Giulia A. Zamboni, MD, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
Roberto Pozzi Mucelli, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess whether non-Gadolinium enhanced MRI can be safely used to follow-up patients with intraductal papillary mucinous neoplasia (IPMN).

METHOD AND MATERIALS

We retrospectively evaluated 100 patients (37 M, 63 F, average age 67.05 years) with an initial diagnosis of pancreatic IPMN without signs of malignancy (93 branch duct IPMN, 7 combined IPMN). All patients underwent follow-up with MRI-MRCP in our center, with a second follow-up at average 12 months, and last available follow-up at average 31 months. For each patient, one reader evaluated, in two separate sessions, in the non-contrast and in the post-contrast scans: cyst size, wall/internal septa thickening, solid mural nodules, dilation of the main pancreatic duct (MPD) and contrast enhancement.

RESULTS

Patients had a median of 2 cysts >5 mm each (range 1-10; mean 2.73), and 273 cystic lesions were reviewed, with a mean size of 10.8 mm (5-29 mm). The MPD was dilated in 7 patients, with a mean caliber of 5.7 mm (5-9 mm). At the first follow-up 261 lesions (96%) did not show any signs of malignancy at non-contrast MRI: this was confirmed in the post-contrast phases in all patients. In 10 lesions non-contrast MRI detected endoluminal defects: 9 were classified as debris in relation to their gravity-dependent position, 1 was classified as mural nodule. In 2 lesions non-contrast MRI detected thickened walls. After contrast administration none of these demonstrated enhancement.At the next available follow-up MRI, in the non-contrast scans 259 (94,8%) lesions did not show any changes, 10 (3.7%) showed a slight increase in size and 4 (1,5%) showed signs of progression. This was confirmed in the post contrast scans.

CONCLUSION

In 98.5 % of the cases the non-contrast MRI scan would have been enough to exclude signs of malignant evolution. We believe that this supports a conservative approach for follow-up, with routine non-contrast MRI-MRCP, followed by Gd-administration when signs suspicious for degeneration are identified.

CLINICAL RELEVANCE/APPLICATION

Non-contrast MRI-MRCP could be sufficient for the follow-up of IPMNs in up to 98.5% of the cases based on our experience, allowing for a potential significant reduction in costs.

RC209-11 The Secretory Flow of Pancreatic Juice in the Main Pancreatic Duct in Patients with Intraductal Papillary Mucinous Neoplasm (IPMN): Evaluation with Cine Dynamic MRCP Using Spatially Selective Inversion-Recovery (IR) Pulse

Monday, Nov. 27 10:50AM - 11:00AM Room: E350

Participants

Kazuya Yasokawa, Kurashiki, Japan (*Presenter*) Nothing to Disclose
Katsuyoshi Ito, MD, Okayama, Japan (*Abstract Co-Author*) Nothing to Disclose
Akira Yamamoto, MD, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose
Hidemitsu Sotozono, MD, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose
Tsutomu Tamada, MD, PhD, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Non-pharmacological, cine dynamic MRCP using spatially selective IR pulse has the potential for evaluating pancreatic exocrine insufficiency by visualizing the secretory flow of the pancreatic juice directly. However, there was a concern that, with this technique, pancreatic exocrine function may be underestimated in patients with IPMNs because of excretion of mucin production originated from IPMN. The purpose of this study was to evaluate whether the secretory flow of pancreatic juice within the main pancreatic duct in cine dynamic MRCP using spatially selective IR pulse is affected by the presence of IPMN.

METHOD AND MATERIALS

115 patients with IPMN of the pancreas without evidence of pancreatitis and age-matched 92 subjects without a history of pancreatic diseases underwent cine-dynamic MRCP with spatially selective IR pulse. The secretion grading score (5-point scale) based on the moving distance of pancreatic juice inflow in the main pancreatic duct on cine-dynamic MRCP was assessed, and compared between the two groups. The secretion grade of cine-dynamic MRCP images in each patient was defined as follows: (total of grading score in 20 images)/20.

RESULTS

The secretion grade in IPMN group was significantly lower than that in the group without a history of pancreatic diseases (0.52±0.60 vs 0.83±0.76, P<0.001), suggesting that the flow of the pancreatic juice will be impaired probably due to the excretion of mucin production from IPMN. In IPMN group, there were no significant associations between secretion grade and IPMN features such as size and location. In the subgroup of more than 70 years, there were no significant differences in the secretion grade between the two groups (0.47±0.55 vs 0.44±0.33, P=0.351), probably due to the age-related reduction of pancreatic juice flow in both groups.

CONCLUSION

The flow of the pancreatic juice was impaired or became slow in patients with IPMN, probably due to mixture of mucinous component in the pancreatic duct. In cine-dynamic MRCP, it would be important to be aware of the alteration in the secretory flow of the pancreatic juice in patients with IPMN even though pancreatic exocrine function is normal.

CLINICAL RELEVANCE/APPLICATION

It is important to understand that pancreatic exocrine function may be underestimated by cine-dynamic MRCP with spatially selective IR pulse in patients with IPMN even though its function is normal.

RC209-12 Acute Pancreatitis

Monday, Nov. 27 11:00AM - 11:20AM Room: E350

Participants
Nikolaos Kartalis, MD,PhD, Stockholm, Sweden (*Presenter*) Nothing to Disclose

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Active Handout:Nikolaos Kartalis

http://abstract.rsna.org/uploads/2017/17000372/Active RC209-12.pdf

LEARNING OBJECTIVES

1) To understand the terminology of the Atlanta 2012 classification of acute pancreatitis. 2) To learn about how to report imaging findings. 3) To avoid pitfalls in the evaluation of acute pancreatitis.

RC209-13 Correlation between CT Severity Index on MDCT and Clinical Severity in Acute Pancreatitis

Monday, Nov. 27 11:20AM - 11:30AM Room: E350

Participants
Keum-Nahn Jee, MD, Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Mi-Hyun Park, MD, Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Mi Ran Jung, MD, Cheonan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hee Jeong Kim, MD, Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

to evaluate correlation between CT severity including modified CT severity index (MCTSI), and CT severity index (CTSI) and clinical severity including Modified Glasgow severity criteria (MGSC), Revised Atlanta Criteria (RAC), and clinical events during hospitalization period

METHOD AND MATERIALS

387 patients diagnosed as acute pancreatitis by clinical and CT findings from Mar. 2006 to Dec. 2016 were included. Initial laboratory data and MDCT scans were obtained within 48 hours of their symptom onset. The initial CT scans were analyzed according to CTSI and MCTSI by consensus of two abdominal radiologists. Assessment of clinical severity was done by MGSC based

on initial laboratory data, RAC on clinical endpoint results, and other clinical events of sepsis/ infection, treatment of intervention or surgery, mortality, hospitalization period, and underlying chronic disease. Correlation between CT severity indices and clinical severity were evaluated by statistical analyses of Fisher's exact test, ANOVA, Kruskal-Wallis test and simple logistic regression.

RESULTS

Both CTSI and MCTSI were significantly correlated with MGSC, RAC, and clinical evaluation items of mortality, ICU care, hospitalization period ($p < 0.05$) except underlying chronic disease of hepaticf, cardiovascular, or endocrine systems ($p > 0.3$). However better correlation between MCTSI and clinical evaluation items than CTSI ($p < 0.01$). MCTSI showed significant correlation with clinical evaluation items of sepsis/infection, treatment choice of surgery or intervention, and mortality ($p < 0.001$).

CONCLUSION

Statistical significant correlation was observed between MDCT severity indices of MCTSI and CTSI and clinical severity. MCTSI is considered to be more effective for the prediction of sepsis/infection, treaatment choice of intervention or surgery and mortality in the clinical course of acute pancreatitis than CTSI.

CLINICAL RELEVANCE/APPLICATION

In the management of acute severe pancreatitis, both CTSI and MCTSI are well correlated with clinical severity. Especially, MCTSI could more helpful for the prediction of clinical courses of sepsis, infection, treatment choice and mortality.

RC209-14 Development and External Validation of a CT Diagnostic Index for the Differentiation of Autoimmune Pancreatitis from Pancreatic Ductal Adenocarcinoma

Monday, Nov. 27 11:30AM - 11:40AM Room: E350

Participants
Angela Cheung, Toronto, ON (*Abstract Co-Author*) Advisory Board, Amgen Inc Advisory Board, Eli Lilly and Company Institutional Grant support, Amgen Inc Institutional Grant support, Eli Lilly and Company
Tae Kyoung Kim, MD, PhD, Toronto, ON (*Presenter*) Nothing to Disclose
Mashael Bandar, MBBCh, FFR(RCSI), Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
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Korosh Khalili, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Jin Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Young Jang, Daejeon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Alice Wei, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Jess Rhee, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Ravi Menezes, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop and externally validate a diagnostic model to differentiate autoimmune pancreatitis (AIP) from pancreatic ductal adenocarcinoma (PDAC).

METHOD AND MATERIALS

The institutional review boards of each center approved this retrospective study; informed consent was waived. Two retrospective cohorts of patients with AIP and PDAC were used to develop and validate a CT diagnostic index. CT scans were reviewed by two radiologists, with a third for consensus. The final index was developed using multivariable logistic regression and area under the receiver operating characteristic (AUROC) curves and validated in the external cohort.

RESULTS

There were 115 AIP patients (development cohort: 68, validation cohort: 47) and 204 PDAC patients (development cohort: 104, validation cohort: 100). No clinical parameters independently predicted a diagnosis of AIP after multivariable analysis. The final index included 5 CT parameters: the presence of peri-pancreatic halo, multifocal strictures, extra-pancreatic IgG4 disease, the absence of discrete pancreatic mass, and absent/tapered pancreatic duct stricture (development: c-statistic 0.902 [95% confidence interval [CI], 0.855-0.950], validation: 0.862 [95%CI, 0.797-0.926]). A score > 4 had a sensitivity of 75.8% (95%CI, 63.6-85.5) and specificity of 100% (95%CI, 89.1-100). Adding serum IgG4 > 2 times the upper normal limit improved the sensitivity to 86.4% (95%CI, 75.7-93.6), with specificity 100% (95%CI, 89.1-100).

CONCLUSION

The externally validated *** CT diagnostic Index can reliably distinguish AIP and PDAC, allowing for rapid, accurate and non-invasive diagnosis. This may reduce unnecessary pancreatic resections and biopsies. IgG4 may improve the sensitivity of the index.

CLINICAL RELEVANCE/APPLICATION

A simple, externally validated radiologic index (Toronto CT Index) comprised of 5 imaging findings on computed tomography (CT) has a sensitivity and specificity of 75.8% (95%CI 63.6 - 85.5) and 100% (95%CI 89.1 - 100). This increases to 86.4% (95%CI 75.7 - 93.6), with specificity 100% (95%CI 89.1 - 100) with the addition of serum IgG4 greater than two times the upper limit of normal. The *** CT Index provides a simple score by which AIP and PDAC can be distinguished by baseline imaging and serology, thereby expediting therapy. The index does not require invasive testing and can easily be applied, thereby avoiding unnecessary pancreatic resection or biopsies.

RC209-15 Autoimmune Pancreatitis

Monday, Nov. 27 11:40AM - 12:00PM Room: E350

Participants
Atif Zaheer, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List all the organs that maybe involved with hyper IgG4 disease. 2) Describe the typical and atypical pancreatic and extrapancreatic manifestations of hyper IgG4 disease. 3) Discuss features that may help differentiate hyper IgG4 disease from pancreatic adenocarcinoma.

Honored Educators

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RC210

Vascular Doppler

Monday, Nov. 27 8:30AM - 10:00AM Room: N230B

VA US

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

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC210A Beyond Peak Velocities: Waveform Interpretation in Carotid Doppler

Participants
Mark A. Kliewer, MD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Be familiar with how carotid waveforms change with systemic, regional and local vascular disease. 2) Be able to recognize common waveform variants and their attendant clinical significance.

ABSTRACT

At the conclusion of the refresher course, the learners should be familiar with how carotid waveforms change with systemic, regional and local vascular disease. They should also be able to recognize common waveform variants and their attendant clinical significance.

RC210B Vertebral Artery Ultrasound: A Gateway to the Great Vessels

Participants
Mindy M. Horrow, MD, Philadelphia, PA (*Presenter*) Spouse, Employee, Merck & Co, Inc

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LEARNING OBJECTIVES

1) Identify the anatomy of the vertebral arterial circulation. 2) Describe the spectrum of subclavian steal syndrome. 3) Describe the findings in the vertebral artery and carotid circulation which indicate brachiocephalic disease.

Honored Educators

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RC210C Upper Extremity Arterial and Venous Doppler: Beyond the Basics

Participants
Gowthaman Gunabushanam, MD, New Haven, CT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review qualitative and quantitative criteria for diagnosing arterial abnormalities in the upper extremity. 2) Describe the technique for dynamic testing using provocative maneuvers. 3) Describe the pitfalls and limitations of Doppler ultrasound in diagnosing arterial and venous diseases of the upper extremity.

RC210D Leg Pain and Swelling: The Unusual Suspects

Participants
Leslie M. Scoutt, MD, New Haven, CT (*Presenter*) Speaker, Koninklijke Philips NV

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LEARNING OBJECTIVES

1) Review pelvic causes of leg pain and swelling. 2) Discuss arterial vascular pathology that can cause leg pain and swelling. 3) Describe how to diagnose musculoskeletal causes of leg pain and swelling.

Honored Educators

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RC211

Advances in Cardiac Nuclear Imaging: SPECT/CT and PET/CT

Monday, Nov. 27 8:30AM - 10:00AM Room: S504CD

CA CT NM

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

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

RC211A Advances in Cardiac SPECT

Participants
E. Gordon Depuey, MD, New York, NY (*Presenter*) Steering Committee, Adenosine Therapeutics, LLC;

LEARNING OBJECTIVES

1) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 2) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 3) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 4) Review myocardial perfusion SPECT scans systematically to avoid artifacts and maximize diagnostic accuracy.

ABSTRACT

There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The following technical advancements described facilitate implementation of patient-centered imaging. New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such 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.

RC211B 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.

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 advanced clinical tool of the 2016. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.

RC212

Open and Endovascular Aortic Repair: Imaging Essentials

Monday, Nov. 27 8:30AM - 10:00AM Room: S504AB

VA IR

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

FDA Discussions may include off-label uses.

Participants
Constantino S. Pena, MD, Miami, FL (*Moderator*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation;

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC212A Aortic Root: Surgical Procedures and Complications

Participants
Kate Hanneman, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kate.hanneman@uhn.ca

LEARNING OBJECTIVES

1) Describe various surgical techniques for repair of the aortic root. 2) Differentiate between normal and abnormal imag-ing findings after aortic root surgery. 3) Identify post-operative complications including dehiscence and pseudoaneurysms.

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 Educator

RC212B New Thoracic and Abdominal Endografts

Participants
Constantino S. Pena, MD, Miami, FL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation;

LEARNING OBJECTIVES

1) Understand the need and use of fenestrated, branched and parallel grafts in the aorta. 2) Identify and understand the use endovascular sealing devices in the abdominal aorta. 3) Recognize new generation abdominal aortic devices on CT imaging. 4) Identify and understand the use of aortic endoanchors in aortic endograft procedures.

RC212C Aortic Repair Complications: CT Imaging Findings You Need to Know

Participants
Terri J. Vrtiska, MD, Rochester, MN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

vrtiska.terri@mayo.edu

LEARNING OBJECTIVES

1) Determine the significance of early versus delayed endograft complications. 2) Describe types of endoleaks, prevalence and significance. 3) Summarize imaging follow-up versus treatment of endograft complications.

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/ Terri J. Vrtiska, MD - 2016 Honored Educator

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RC213

Pediatric Series: Musculoskeletal Imaging

Monday, Nov. 27 8:30AM - 12:00PM Room: N228

MK PD

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Diego Jaramillo, MD, MPH, Miami, FL (*Moderator*) Nothing to Disclose
Jie C. Nguyen, MD,MS, Philadelphia, PA (*Moderator*) Nothing to Disclose
Stephan D. Voss, MD, PhD, Boston, MA (*Moderator*) Nothing to Disclose
Arthur B. Meyers, MD, Orlando, FL (*Moderator*) Author with royalties, Reed Elsevier; Editor wiith royalties, Reed Elsevier

Sub-Events

RC213-01 Imaging of Developing Skeleton

Monday, Nov. 27 8:30AM - 8:50AM Room: N228

Participants
Diego Jaramillo, MD, MPH, Miami, FL (*Presenter*) Nothing to Disclose

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Active Handout:Diego Jaramillo

http://abstract.rsna.org/uploads/2017/17000759/Active RC213-01.pdf

LEARNING OBJECTIVES

1) Identify the main changes in the skeleton that occur during skeletal maturation and their implications for imaging. 2) Recognize those anatomic structures that are unique to children and adolescents. 3) Be familiar with the main pathologies of the child's skeleton. 4) Know the role of the various imaging modalities in detecting specific pediatric pathologies.

ABSTRACT

From birth to adolescence, the skeleton undergoes two main changes: the cartilaginous structures ossify and the marrow becomes progressively fatty. The epiphysis, initially entirely cartilaginous, develops a secondary center of ossification. The epiphyseal cartilage is hypoechoic on ultrasound and is traversed by epiphyseal vascular canals. Epiphyseal cartilage is of low signal intensity (SI) on T2-weighted images. Endochondral ossification and longitudinal growth take place at the physis, which lays down new bone at the zone of provisional calcification. This zone is sclerotic on radiographs and of low SI on MRI. Membranous growth occurs at the surface of the bone where a very vascular inner layer of the periosteum, called the cambium, or osteogenic periosteum, can be seen in children as a high T2 SI structure that enhances. Although at birth the entire skeleton is hematopoietic, the marrow undergoes a transformation from hematopoietic to fatty marrow that is detectable on MR images. On T1-weighted images hematopoietic marrow is of intermediate SI and fatty marrow of high SI. The conversion to fatty marrow begins in the epiphyseal ossification centers that become fatty on MR imaging approximately six months after the radiographic appearance of these centers. The second segment of the bones to transform is the diaphysis, followed by the metaphyses. In each extremity, marrow is transformed from the most peripheral to the most central structures, beginning at the fingers and toes and ending in the shoulders and hips. The more highly vascularized regions are the metaphysis and the osteogenic perichondrium, which are prone to seeding by bacteria and neoplasms, whereas the epiphyseal ossification center has the poorest blood supply and is susceptible to osteonecrosis. This session will review the main anatomic structures of the growing skeleton, their imaging appearance, and the implications for diagnosis of disease.

RC213-02 T2-Weighted MR Imaging in Children with Musculoskeletal Concerns: Can it Be Used to Select Patients Who Can Benefit From a Full Contrast-Enhanced Study?

Monday, Nov. 27 8:50AM - 9:00AM Room: N228

Participants
Paul H. Yi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Kaitlin Woo, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Jie C. Nguyen, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

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PURPOSE

To determine if T2W images can be used to screen for pathology when applied to a cohort of children with MSK complaints.

To determine if T2W images can be used to screen for pathology when applied to a cohort of children with MSK complaints.

METHOD AND MATERIALS

A retrospective review of PACS identified 105 consecutive full MR studies evaluating either or both bony pelvis and appendicular skeleton from 99 patients between 2 and 18 years of age (mean: 11.1 years, 50 girls and 49 boys). Patients with a known history of infection, arthritis, fracture, instrumentation, or hardware were excluded. All studies were retrospectively reviewed by both pediatric and musculoskeletal radiologists blinded to history and diagnosis, and discrepancies were settled through a consensus read. Each study was reviewed twice, one month apart, first using only T2W sequences and subsequently using all sequences. Abnormal signal was sub-classified into that involving the skin, subcutaneous fat, fascial plane, muscle, bone, periosteum, joint effusion, and/or fluid collection. Final diagnosis was determined through chart review. Kappa analysis was used to determine inter-reader agreement. The ability to detect pathology using T2W sequences was compared to using the full study.

RESULTS

105 MR studies included 26 bony pelvis, 20 knee, and 18 thigh studies with the remainder distributed throughout lower and upper extremities. 53 studies (50.5%) were normal and the remainder were positive for infection, inflammation, or overuse/altered biomechanics. The inter-reader agreement for each finding was very high for both T2W (96.2-100%) and full studies (96.2-100%). For studies with normal findings on T2W, the addition of pre and post-contrast T1W did not provide added value or change diagnosis.

CONCLUSION

T2W sequences were highly sensitive in the detection of abnormal MR signal and can be used as a tool to identify children (> 2 years) who can benefit from a full contrast-enhanced study.

CLINICAL RELEVANCE/APPLICATION

The use of MR in children is often limited by the need for sedation. The inability to elicit a complete history, to objectively assess the site of concern, and/or the fear of missing a treatable pathology have led to a high rate of negative studies, hospital admissions, and delayed discharge. High-quality multi-planar T2W images can be obtained in less than 10 minutes without sedation. Prior studies used both T1W and T2W sequences to determine the need for a full contrast study, but no study examined the accuracy of using only T2W images to screen for pathology.

RC213-03 Avascular Necrosis of the Femoral Head after Closed Reduction for Developmental Dysplasia of the Hip: Predictive Value of Spica MRI

Monday, Nov. 27 9:00AM - 9:10AM Room: N228

Participants
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Won Joon Yoo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
In-One Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Yeon Jin Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Young Ha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Avascular necrosis (AVN) of the femoral head or proximal femoral growth disturbance remains a major complication in the treatment of developmental dysplasia of the hip (DDH) in infants. We performed a retrospective analysis to look at the predictive ability of contrast-enhanced magnetic resonance imaging (MRI) for AVN after closed reduction in DDH.

METHOD AND MATERIALS

70 hips in 69 infants (aged 3-18 months) with DDH who had failed brace treatment underwent closed reduction and spica cast application under general anesthesia. Spica MRI was obtained immediately after closed reduction of DDH in all patients and gadolinium contrast enhancement was performed for evaluation of epiphyseal perfusion in 58 patients (84%). Patients were followed with serial radiographs for a minimum of 18 months after closed reduction. Anatomical assessment of the hip joint was performed on unenhanced MRI. All the hips were divided into deep or incomplete concentric reduction according to medial joint space distance. Contrast enhancement of the femoral head was graded as normal, focal decreased enhancement, global decreased enhancement by 2 radiologists. Presence of AVN was determined by the presence of any one of the 5 Salter criteria by 2 readers.

RESULTS

Fifteen (22%) of 69 patients developed AVN after a mean follow-up period of 63. 8 months (range 19- 134 months). (M:F=2:13, mean age at closed reduction, 11.3 months ± 4.4). Mean value of medial joint space distance was 5.5 ± 1.3 mm in patient with AVN and 4.5 ± 1.2 mm in patient with no AVN (p=0.007). ROC analysis depicted cut-off value of 5 mm with 70% in sensitivity and 70% in specificity. Global perfusion defect was demonstrated in 9 hips with AVN (9/13, 69%) whereas 6 hips out of 46 hips (13%) without AVN. Multivariate logistic regression indicated that a global decreased enhancement was associated with a significantly higher risk of developing AVN ($P < 0.01$).

CONCLUSION

In addition to accurate anatomical assessment of a closed reduction in DDH, gadolinium-enhanced MRI provides information about femoral head perfusion that may be predictive for future AVN.

CLINICAL RELEVANCE/APPLICATION

Gadolinium-enhanced MRI provides information about femoral head perfusion that may be predictive for future AVN

RC213-04 Participants

Well-Founded Practice or Personal Preference? A Comparison of Techniques for Measuring Ulnar Variance in Children

Monday, Nov. 27 9:10AM - 9:20AM Room: N228

Laura S. Kox, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Sjoerd Jens, MD, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Kenny Lauf, BSC, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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Rick R. Van Rijn, MD,PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Royalties, Springer Science+Business Media Deutschland GmbH; Royalties, Thieme Medical Publishers, Inc
Mario Maas, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the inter- and intrarater agreement and the intermethod agreement between the perpendicular method and the Hafner method for measuring ulnar variance in a pediatric population.

METHOD AND MATERIALS

A musculoskeletal radiologist and a musculoskeletal radiology resident measured ulnar variance of the left hand of 231 boys and girls on anteroposterior hand radiographs. Three ulnar variance values were measured: one using the perpendicular method and two using the Hafner method, being the distance between the most proximal points of the ulnar and radial metaphysis (PRPR) and the distance between the most distal points of both (DIDI). The intraclass correlation coefficient (ICC) was calculated using a two-way ANOVA model for intermethod agreement and for interrater agreement of both methods. Variability and limits of agreement were determined using the Bland-Altman method.

RESULTS

Participants' mean calendar and skeletal ages were 12.7 ± 3.1 years and 13.0 ± 3.2 years, and 52% were female. The ICC for interrater agreement was 0.37 for the perpendicular method, 0.88 for PRPR and 0.92 for DIDI. The ICC for intermethod agreement was 0.55 for perpendicular versus PRPR and 0.61 for perpendicular versus DIDI in rater 1, and 0.67 and 0.75 in rater 2. The ICC for intrarater agreement of rater 1 was 0.88 for the perpendicular method, 0.90 for PRPR and 0.80 for DIDI. The perpendicular method could not be used in 14 cases (all with skeletal age <= 9 years) and the Hafner method could not be used in 65 cases (all with skeletal age >= 12 years).

CONCLUSION

The intermethod agreement of the perpendicular and Hafner methods is fair to good. The DIDI of the Hafner method is preferred for measuring ulnar variance in children with a skeletal age younger than 12 years, with excellent inter- and intrarater agreement. The perpendicular method is recommended in children with a skeletal age of 12 years or older.

CLINICAL RELEVANCE/APPLICATION

The results from this study can aid clinicians in choosing the appropriate measurement method for ulnar variance in pediatric patients, which is used to define various conditions of the wrist.

RC213-05 Physeal Overuse Injury: Is Radial Epiphysitis A Misnomer? 3T MRI of the Distal Radial Growth Plate in Young Gymnasts Compared to Non-Gymnastic Controls

Monday, Nov. 27 9:20AM - 9:30AM Room: N228

Awards
Student Travel Stipend Award

Participants
Laura S. Kox, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Rik B. Kraan, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Valentina Mazzoli, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Marieke A. Mens, BSC, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Aart J. Nederveen, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Mario Maas, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To define MRI characteristics of the distal radial and ulnar growth plates in young gymnasts with and without wrist pain, and in non-wrist-loading controls.

METHOD AND MATERIALS

In this ongoing study, 23 young gymnasts with wrist pain, 10 asymptomatic gymnasts and 12 non-gymnastic controls (23 boys, 22 girls) underwent MRI of the wrist on a 3T scanner. Sequences included coronal PD images with and without fat saturation, 3DWATSc, and coronal T1 and T2 Dixon series. Skeletal age was determined using hand radiographs. An experienced musculoskeletal radiologist assessed all images for abnormalities.

RESULTS

The respective median calendar and skeletal ages were 14.5 (12.09-16.89) and 12.92 years (9.51-17.28) for symptomatic gymnasts, 14.05 (12.0-17.77) and 13.3 years (11.43-17.22) for asymptomatic gymnasts and 13.5 (12.38-16.97) and 13.6 years

(11.32-17.56) for non-gymnastic controls. Symptomatic gymnasts showed physeal widening (17%), physeal bridging (39%), metaphyseal widening (35%), metaphyseal cartilage intrusions (43%), metaphyseal edema (70%) and irregularity of the metaphyseal-physeal border (83%) in the radius and/or ulna. In 30% of asymptomatic gymnasts and in 8% of non-gymnastic controls, three or more of these abnormalities were seen. Edema was best visualized using T2 Dixon and fat-saturated PD images, while physeal widening, bridges, intrusions and irregular borders were best seen on T2 Dixon and 3D WATSc series.

CONCLUSION

In gymnasts with wrist pain multiple abnormalities of both the radial and ulnar physis and distal metaphysis were found, for which the new term 'wrist (meta)physitis' is proposed. For visualization of these changes, T2 Dixon, 3D WATSc and fat-saturated PD sequences are recommended. On 3T MRI, isolated changes were also found in asymptomatic gymnasts and in non-gymnastic controls, warranting MRI characteristics of the healthy physis to be redefined.

CLINICAL RELEVANCE/APPLICATION

This study offers information on MRI characteristics of gymnastic physeal stress injury and of healthy physes, as well as recommendations for 3T MRI sequences to help identify these characteristics.

RC213-06 Predictors of Successful Treatment for Propranolol Therapy in Patients with Infantile Hemangioma

Monday, Nov. 27 9:30AM - 9:40AM Room: N228

Participants
So-Yeon Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hee Jin Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Myung Ho Rho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Chul Chung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Lim Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To explore predictors of successful treatment for propranolol therapy in patients with infantile hemangioma

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board, and written informed consent was waived. Forty consecutive patients (26 women and 14 men; mean age ± standard deviation, 2.3 years ± 5.4) who underwent propranolol treatment for infantile hemangioma were included. Prospectively collected data included age, sex, size of hemangioma, pre-treatment ultrasound findings including color Doppler images and muscle involvement of hemangioma. Mann-Whitney U, chi-square and Fisher's exact tests were used to compare clinical and ultrasound parameters between patients with and without successful treatment. Logistic regression was used to assess the association between clinical and ultrasound parameters and successful treatment.

RESULTS

A total of 50% patients showed successful treatment. There were significant differences between patients with and without successful treatment in age (4.1 months ± 3.4 vs. 52.2 months ± 86.3, P = .021), sex (female: 17/20 vs. 10/20, P = .018), and prominent vascularity on ultrasound (13/20 vs. 6/20, P = .027). Maximum length (3.3 cm ± 2.6 vs. 4.3 cm ± 3.4, P = .301) and muscle involvement of hemangioma (1/20 vs. 5/20, P = .182) were not significantly different. Univariate analysis showed age (odds ratio [OR], 6.0; 95% confidence interval [CI]: 1.5, 24.7; P = .013), female (OR, 5.7; CI: 1.3, 25.6; P = .024) and prominent vascularity on ultrasound (OR, 4.3; CI: 1.2, 16.3; P = .030) were significant associated with successful treatment. Maximum length and muscle involvement of hemangioma were not significantly associated with successful treatment (P >= .108). Multivariate analysis showed independent predictors of successful treatment were female (OR, 10.9; CI: 1.4, 82.6; P = .034) and prominent vascularity on ultrasound (OR, 7.0; CI: 1.2, 42.8; P = .021).

CONCLUSION

Age and prominent vascularity on pre-treatment ultrasound were independent predictors of successful treatment for propranolol therapy in patients with infantile hemangioma.

CLINICAL RELEVANCE/APPLICATION

Color Doppler US provides independent prognostic information in patients undergoing propranolol therapy for infantile hemangioma and is recommended in the initial evaluation in patients with infantile hemangioma

RC213-07 Imaging of Patellofemoral Instability in Children and Adolescents

Monday, Nov. 27 9:40AM - 10:00AM Room: N228

Participants
Arthur B. Meyers, MD, Orlando, FL (*Presenter*) Author with royalties, Reed Elsevier; Editor wiith royalties, Reed Elsevier

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LEARNING OBJECTIVES

1). Describe the main osseous and soft tissue stabilizers of the patella. 2). Identify the osseous, cartilaginous and soft tissue injuries seen after patellar dislocation. 3). Recognize the normal postoperative appearances after patellar stabilizing surgeries and postoperative complications.

ABSTRACT

Patellofemoral instability is common in children and adolescents. Abnormalities of the osseous and soft tissue stabilizers of the patella, particularly deficiencies of the medial stabilizers are risk factors for patellar dislocations. Some of the more common risk factors for instability assessed on imaging include: trochlear dysplasia, excessive lateral patellar tilt, patella alta, and lateralization

of the tibial tuberosity. Radiographs, computed tomography and MRI can all be used in the evaluation of these risk factors. Evaluation of acute patellar dislocations typically begins with radiographs but MRI is needed to fully evaluate the variety of injuries that can occur such as: bone contusions, cartilage injury and tears of the medial soft tissue stabilizers. After a first patellar dislocation surgery is considered if there is a major injury to the medial stabilizers or if there is an intra-articular body. Medial patellofemoral ligament reconstruction is the mainstay of patellar stabilizing surgery with a variety of different techniques used by different surgeons. Lateral retinacular release and tibial tubercle repositioning may also be performed. Postoperative imaging allows for assessment of post surgical complications, e.g., patellar fractures, and medial patellofemoral ligament graft tears after a repeat injury.

Active Handout:Arthur Benjamin Meyers

http://abstract.rsna.org/uploads/2017/17000758/Active RC213-07.pdf

RC213-08 Sonography of Inflammatory/Infectious Arthropathies

Monday, Nov. 27 10:20AM - 10:40AM Room: N228

Participants
Jie C. Nguyen, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Be familiar with the normal sonographic appearance of an immature skeleton. 2) Identify the various sonographic manifestations of juvenile idiopathic arthritis (JIA). 3) Recognize the uses and limitations of ultrasound (US) in the evaluation of osteoarticular infection (OAI).

ABSTRACT

Juvenile idiopathic arthritis (JIA) and osteoarticular infection (OAI) can cause non-specific articular and periarticular complaints in children. Although contrast-enhanced magnetic resonance imaging (MRI) is the "gold-standard" imaging modality, musculoskeletal (MSK) ultrasound (US) is emerging as an important adjunct, that can provide valuable information relatively quickly without radiation or the need for sedation. However, diagnostic accuracy requires a systemic approach, familiarity with various sonographic techniques, and an understanding of maturation-related changes. Specifically, in the evaluation of JIA and OAI, the ability to perform dynamic, Doppler, and multifocal assessments are particular advantages, which can confirm sites of disease, monitor therapy response, and guide interventions. In JIA, chronic inflammation can lead to articular and periarticular changes, including synovitis, tenosynovitis, cartilage damage, bony changes, and enthesopathy. Although these findings can present in rheumatoid arthritis (RA), important differences and pitfalls exist because of the unique changes associated with a maturing skeleton. In clinically suspected OAI, the inability to evaluate the bone marrow hinders the sensitivity of US. Therefore, the interpretation of the sonographic findings should be made with caution as juxtacortical inflammation is suggestive, but neither sensitive nor specific, for underlying osteomyelitis. Similarly, the absence of a joint effusion makes septic arthritis extremely unlikely, but not impossible. Often, sonographic findings of JIA and OAI overlap. However, the combination of clinical, laboratory, and imaging results can favor a particular diagnosis.

RC213-09 Validation of Contrast-Enhanced MRI Scores On (Teno)synovitis of the Wrist in Juvenile Idiopathic Arthritis Patients By Comparison with Unaffected Children

Monday, Nov. 27 10:40AM - 10:50AM Room: N228

Participants
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Robert Hemke, MD,PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Contrast-enhanced MRI increasingly guides clinical management of juvenile arthritis. The objective of this study was to assess the validity of two reliable MRI scores for the assessment of synovitis and tenosynovitis respectively in the wrist of children by comparing clinically active juvenile idiopathic arthritis (JIA) patients with unaffected children.

METHOD AND MATERIALS

An axial T1-weighted MRI sequence with contrast enhancement and fat saturation was performed on the wrist of 25 children who had no joint complaints or signs of joint inflammation at clinical examination and who were already subjected to contrast-enhanced MR enterography. Wrist MRI scans of 25 clinically active JIA patients were matched based on interval between contrast injection and start of the MRI wrist sequence. Two radiologists, blinded for clinical status, scored synovitis and tenosynovitis in consensus. Synovitis was scored on 5 locations for the degree of synovial enhancement (0-2 scale) and overall inflammation (0-3 scale). Tenosynovitis was scored on a 0-3 scale for the degree of inflammation in the extensor (compartments II, IV and VI) and flexors tendons. Multiple Mann-Whitney U tests were performed to analyze differences between the groups.

RESULTS

Unaffected children had a significantly lower total enhancement (median=4 vs 5, p=0.047) and total inflammation-synovitis (median=4 vs 5, p=0.021) score compared to clinically active JIA patients. There was no difference between the groups in total tenosynovitis score (median=0 vs 0, p=0,220). Fifteen out of 25 (60%) clinically active JIA patients had a total tenosynovitis score of 0.

CONCLUSION

The MRI score for the assessment of wrist synovitis appears valid for both total enhancement and total overall inflammation scores. Currently, the MRI-based tenosynovitis score cannot easily be used to distinguish clinically active JIA patients from unaffected children. These findings further establish MRI as diagnostic and disease activity monitoring tool for synovitis as the primary target of disease in JIA patients.

CLINICAL RELEVANCE/APPLICATION

Validation of pediatric scores on wrist (teno)synovitis will improve patient care by optimizing the use of contrast-enhanced MRI in diagnosing and monitoring disease activity in JIA patients.

RC213-10 Spotting the Difference: Distribution and Extent of CRMO Lesions in Children on Baseline Whole Body MRI

Monday, Nov. 27 10:50AM - 11:00AM Room: N228

Participants
Thomas Mendes da Costa, BMBS, Bristol, United Kingdom (*Presenter*) Nothing to Disclose
Savvas Andronikou, MBBS, Cape Town, South Africa (*Abstract Co-Author*) Nothing to Disclose
Mohamed Hussien, Bristol, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Athimalaipet Ramanan, Bristol, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine lesion distribution and extent of signal abnormality on baseline whole body MRI (WBMRI) via retrospective panel review of all patients clinically diagnosed with Chronic Recurrent Multifocal Osteomyelitis (CRMO), and to determine any patterns of involvement that could facilitate earlier radiological diagnosis.

METHOD AND MATERIALS

All patients diagnosed with CRMO since December 2009 were identified and their baseline WBMRI reviewed. All three reviewers were blinded to the original report and any previous investigations. A dedicated skeletal proforma was formulated, and each MRI reviewed for the presence of high signal focal lesions consistent with CRMO. The extent of any metaphyseal and epiphyseal lesions was categorized into involvement of thirds of the width of the structure.

RESULTS

Forty cases were reviewed by the panel using a majority decision rule. 303 lesions were recorded, with a patient average of 7.6 lesions. The tibia was most affected, primarily the distal tibial metaphysis. Lesions within the ribs, metatarsals and distal femoral epiphysis were common. Humeral, hand and skull lesions were few. Complete metaphyseal involvement, the 'smouldering physis', was most prevalent within the proximal and distal tibial, and the distal radial and ulna metaphyses. Although clavicular lesions are reported to be highly prevalent in CRMO, these were seventh in our study, however they were the site of the most florid lesions with bone expansion and periosteal reactions demonstrated. Two clear patterns of involvement were observed. In patients with clavicular lesions, fewer total body lesions were observed, these mainly affecting the axial skeleton and feet. Patients with any tibial involvement had a higher number of overall lesions, but few lesions outside the lower limbs. Only four patients had a combination of clavicular and tibial lesions.

CONCLUSION

Our series of 40 cases of CRMO with baseline WBMRI, one of the largest in the published literature, identifies the common sites that should be interrogated for involvement. This study also demonstrates potential as-yet undescribed patterns of skeletal involvement that can be used to aid radiological diagnosis and highlights a non-infective cause for spondylo-discitis.

CLINICAL RELEVANCE/APPLICATION

A radiological guide for common sites and previously unreported patterns of involvement in Chronic Recurrent Multifocal Osteomyelitis.

RC213-11 T1rho Mapping in the Assessment of Articular Cartilage Integrity of the Knee in Children with Juvenile Idiopathic Arthritis

Monday, Nov. 27 11:00AM - 11:10AM Room: N228

Participants
Anouk M. Barendregt, BSC, MSc, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Valentina Mazzoli, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Charlotte van Gulik, MD,MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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Aart J. Nederveen, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Robert Hemke, MD,PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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Koert M. Dolman, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To study feasibility of T1ρ mapping for assessment of articular cartilage integrity in children with juvenile idiopathic arthritis (JIA) and study correlation between T1ρ relaxation time and the Juvenile Arthritis MRI score (JAMRIS) for disease activity.

METHOD AND MATERIALS

After IRB approval and informed consent, the knee of patients with JIA or suspected JIA was imaged at 3.0 T MRI using 3D T2W SPAIR, pre and post contrast 3D T1W SPAIR sequences and a sagittal T1ρ sequence with 400 Hz and spin lock time of 5, 10, 20, 40 and 50 milliseconds (ms). To quantify T1ρ decay, a pixel-wise mono-exponential curve fit was performed. A region of interest (ROI) was drawn in articular cartilage of the knee (patella, femur, tibia) on the T1ρ images using ITK-SNAP, resulting in a mean T1ρ value of cartilage per patient. Using regular T2W and T1W pre and post contrast scans, JAMRIS was assigned to discriminate inflamed knees (JAMRIS>=1) from non-inflamed knees (JAMRIS 0). In SPSS, Mann-Whitney U test and Spearman correlation coefficient were used to compare the mean T1ρ value between patients with and without arthritis on MRI and to correlate T1ρ values with JAMRIS score. ROI drawing was performed twice in 5 subjects. Intraclass correlation coefficient (ICC) was used to study intra-reader reliability.

RESULTS

Of all 13 patients (median age 13.7 years), 7 patients had inflammation in the knee. No cartilage lesions were observed on standard MRI sequences. Acquisition of the T1ρ was successful and without artifacts in 100% of the children. Patients with inflammation in the knee had a significantly longer T1ρ value than did patients without inflammation in the knee: 36.3 ms (IQR 29.0-40.4) versus 27.7 ms (IQR 25.8-30.2), p=0.02. Correlation between T1ρ value and JAMRIS score was 0.76 (p=0.003). Repeatability of ROI drawing was characterized by ICCs >0.99, p<0.05.

CONCLUSION

T1ρ mapping is feasible in children with JIA. This pilot study indicates that, even in the absence of cartilage erosions, significant differences are seen in cartilage integrity with higher T1ρ relaxation times in patients with knee arthritis. This might indicate loss of glycosaminoglycan content in actively inflamed knees.

CLINICAL RELEVANCE/APPLICATION

Our pilot data suggest that T1ρ could serve as an imaging biomarker for cartilage integrity aiming to prevent irreversible cartilage damage and long-term disability in this young JIA population.

RC213-12 Adaptation of Medial Epicondyle in Adolescent Baseball Player Observed on MRI

Monday, Nov. 27 11:10AM - 11:20AM Room: N228

Participants
Yoshikazu Okamoto, MD, Tsukuba, Japan (*Presenter*) Nothing to Disclose
Manabu Minami, MD, PhD, Yokohama, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We have performed the elbow screening since 2013 for adolescent baseball player, and found apparent laterality of morphology and signal intensity in the medial epicondyle including cartilage and endochondral ossification in spite of no clinical manifestation. We hypothesize this laterality might be not abnormal findings but adaptation of medial epicondyle as a baseball player.

METHOD AND MATERIALS

Open-type 0.2 T MRI was used. 80 adolescent baseball players were enrolled. Subjects divided into 4 grades. The number of subjects was 13, 28, 24, 15 in 9-10, 11, 12, 13-14 years old groups, respectively. Long and short axis of the endochondral ossification, distance between ossification and medial margin of cartilage, and that between ossification and distal margin of cartilage in medial epicondyle were measured bilaterally in axial image. Signal intensity of endochondral ossification was also evaluated visually. We compared size of ossification, that of cartilage, and intensity of ossification between dominant and contra-dominant.

RESULTS

Size of cartilage and ossification showed larger tendency in dominant side owing to subject's age with statistical significance.Size of ossification showed 10.9×5.7 mm in contra-dominant and 11.9×7.0 mm in dominant elbow with statistical significance in all subjects (P<0.01). There was also statistical significance (P<0.01) in medial margin × distal margin of cartilage showing 1.1×1.6mm in contra-dominant and 1.3×2.2mm in dominant. These tendencies of larger cartilage and ossification in dominant elbow were also observed in all age groups (P<0.01). Moreover, Signal intensity of ossification showed apparent lower intensity in dominant side (P<0.01).

CONCLUSION

Larger cartilage and ossification of medial epicondyle in dominant elbow suggested it might be induced excessive repetitive extension stress by medial collateral ligament to medial epicondyle despite subject showed no clinical symptom. Tendency of lower signal of ossification in dominant elbow might be induced by functional or micro-anatomical damage of medial epicondyle resulting in producing ossification with less water molecule.

CLINICAL RELEVANCE/APPLICATION

MRI findings of larger cartilage and ossification, and lower signal of ossification in medial epicondyle of the dominant elbow in adolescent baseball player might not be abnormal findings because these might be 'adaptation' as a baseball player.

RC213-13 Diagnostic Value of Magnetic Resonance Imaging in Differentiating Between Initial Acute Leukaemia and Juvenile Idiopathic Arthritis in Children

Monday, Nov. 27 11:20AM - 11:30AM Room: N228

Participants
Lin Xu, Shanghai, China (*Presenter*) Nothing to Disclose
Yumin Zhong, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the magnetic resonance imaging (MRI) features of bone marrow in the lower extremities and present diagnostic value of MRI in differentiating initial acute leukaemia from juvenile idiopathic arthritis (JIA) in children presenting with lower limb pain.

METHOD AND MATERIALS

Clinical data and MRI from patients referred for lower limb pain in 2014-2016 was retrospectively reviewed. Thirty-three patients were enrolled, who underwent MRI examination before any treatment. MR imaging was performed on a 1.5 Tesla whole-body scanner (Achiva, Philips Medical Systems, the Netherlands) using a 16-channel phased-array Torso coil. MR images were obtained T1W, T2W and SPAIR (Spectral Attenuated Inversion Recovery) sequences and bilateral knee joints scanning were requested. The MRI features of bone marrow were assessed by the signal intensity, morphological features and the extent.

RESULTS

The age range of total 33 patients were from 6 to 16 years-old, twenty boys and thirteen girls. Fifteen patients were diagnosed with initial acute leukaemia and eighteen patients were JIA clinically. Abnormal signal intensity of bone marrow in bilateral knee joints were demonstrated in all 15 patients with initial acute leukaemia patients. Among them, 8/15 patients showed diffuse homogeneous low signal intensity on T1W images and high signal intensity on SPAIR images; 5/15 patients showed diffuse heterogeneous patchy iso- or low signal intensity on T1W images and high signal intensity on SPAIR images; 2/15 patients had normal results of MRI. In 18 patients with JIA , 15 patients showed ill-defined patchy areas in the metaphysis and epiphysis with low signal intensity on T1W images and high signal intensity on SPAIR images; other 3 cases of JIA patients had normal results of MRI. The diagnostic accuracy of acute leukaemia and JIA were 86.7% and 83.3%, respectively.

CONCLUSION

MRI show diffuse abnormal signal intensity on bilateral knee joints are more likely to be acute leukaemia. MRI may serve as a noninvasive method to help discrimination of acute leukaemia from JIA in children presenting with lower limb pain.

CLINICAL RELEVANCE/APPLICATION

MRI may serve as a noninvasive method to help discrimination of acute leukaemia from JIA in children presenting with lower limb pain.

RC213-14 Ulnar Collateral Ligament Insertional Injuries in Pediatric Athletes: Can MRI Predict Symptoms or Need for Surgery?

Monday, Nov. 27 11:30AM - 11:40AM Room: N228

Participants
Tony T. Wong, MD, New York, NY (*Presenter*) Nothing to Disclose
Dana Lin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Jonathan K. Kazam, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine if variable UCL insertion exists in the pediatric population and if MRI features can identify UCL injuries in overhead athletes that are symptomatic or require surgery.

METHOD AND MATERIALS

IRB-approved retrospective review of non-contrast MR elbow exams in patients under 21 yrs. old from 2011-2017 was performed. Exclusion criteria were non-insertional UCL injury, complete UCL tear, prior surgery or trauma, and poor image quality. 26 non-overhead athletes (mean age 15) and 97 overhead athletes (mean age 16) were enrolled. Overhead athletes were asymptomatic (n=47) or symptomatic (n=50) with regard to clinically diagnosed UCL injury. Two radiologists evaluated the UCL in consensus for mid-substance thickness, presence of fluid or intermediate signal intensity deep to the insertion ("T sign"), insertion distance, and any adjacent marrow/soft tissue edema. Insertion distance was the coronal length of any "T sign" measured from the articular cartilage margin. A t-test and chi squared test were used for statistical analysis.

RESULTS

Overhead athletes vs. non-overhead controls: mean UCL thickness was 2.64 mm vs. 1.74 mm (p=<0.000010); mean insertion distance was 1.42 mm vs. 0.23 mm (p=0.00071); presence of marrow edema was 27% vs. 0% (p=0.010); and presence of soft tissue edema was 15% vs. 0% (p=0.032). Asymptomatic vs. symptomatic overhead athletes: mean UCL thickness was 2.41 mm vs. 2.84 mm (p=0.0048); mean insertion distance was 1.44 mm vs. 1.41 mm (p=0.47); presence of marrow edema was 13% vs. 40% (p=0.0025); and presence of soft tissue edema was 6% vs. 24% (p=0.016). Symptomatic athletes requiring surgery vs. no surgery: mean UCL thickness was 3.40 mm vs. 2.70 mm (p=0.034); mean insertion distance was 2.38 mm vs. 1.17 mm (p=0.171). In all overhead athletes, any abnormal signal intensity at the UCL insertion had 50% sensitivity and 51% specificity for predicting a symptomatic injury. With fluid signal only, there was 30% sensitivity and 72% specificity.

CONCLUSION

UCL insertion below the articular margin ("T sign") is likely not anatomic variation, but cannot predict symptoms or need for surgery. Ligamentous thickening and marrow/soft tissue edema are seen more in symptomatic injuries and those requiring surgery.

CLINICAL RELEVANCE/APPLICATION

Insertional abnormalities of the UCL in pediatric overhead athletes should be interpreted with caution as they do not correlate with symptoms or need for surgery.

RC213-15 Update in Nuclear Imaging of the Pediatric Skeleton

Monday, Nov. 27 11:40AM - 12:00PM Room: N228

Participants
Stephan D. Voss, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

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Active Handout:Stephan Dieter Voss

http://abstract.rsna.org/uploads/2017/17000761/Active RC213-15.pdf

LEARNING OBJECTIVES

1) To understand the role of scintigraphic imaging in non-oncologic and oncologic pediatric musculoskeletal disorders. 2) To identify indications for use of 18F-fluoride PET in pediatric musculoskeletal disease. 3) To review indications and strategies for hybrid imaging, including SPECT/CT and PET/MRI in pediatric skeletal disorders.

RC214

Interventional Series: Embolotherapy

Monday, Nov. 27 8:30AM - 12:00PM Room: N227B

IR

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Robert A. Morgan, MD, London, United Kingdom (*Moderator*) Proctor, Medtronic plc
Laura K. Findeiss, MD, Knoxville, TN (*Moderator*) Speakers Bureau, Bayer AG

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LEARNING OBJECTIVES

1) Describe rationale of bariatric embolization. 2) Explain the rationale and treatment of high flow malformations. 3) Describe the preparation of cyanoacrylates for embolization. 4) List two complications related to embolization. 5) Recognize the significance of Type III endoleaks. 6) Describe approach to treatment of visceral aneurysms.

Sub-Events

RC214-01 Iatrogenic Injuries: I Can Fix That!

Monday, Nov. 27 8:30AM - 8:45AM Room: N227B

Participants
Robert A. Morgan, MD, London, United Kingdom (*Presenter*) Proctor, Medtronic plc

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LEARNING OBJECTIVES

View Learning Objectives under the main course title.

RC214-02 The Increase in Use of Percutaneous Embolization by Radiologists and Other Specialists from 2005-2015

Monday, Nov. 27 8:45AM - 8:55AM Room: N227B

Participants
David R. Hansberry, MD,PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
David Guez, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Laurence Parker, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
David J. Eschelman, MD, Bryn Mawr, PA (*Abstract Co-Author*) Nothing to Disclose
Robert Adamo, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Carin F. Gonsalves, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
David C. Levin, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Advances in minimally invasive treatment strategies have helped increase percutaneous embolization as an intervention compared to traditional techniques when managing various disorders including hemorrhage, tumors, and vascular malformations. We evaluate utilization trends of percutaneous embolization amongst radiologists and other non-radiologist providers.

METHOD AND MATERIALS

The nationwide Medicare Part B fee-for-service databases for 2005 through 2015 were used to evaluate percutaneous embolization codes. 6 codes (primary procedure only, no add-on codes) were reviewed, that describe various embolization procedures. Head and neck embolization codes were not included in the analysis. Medicare specialty codes were used to group physician providers as radiologists, vascular surgeons, cardiologists, nephrologists, obstetricians/gynecologists, neurosurgeons, other surgeons, and all other providers.

RESULTS

The total volume of percutaneous embolization by all providers has increased from 20,265 in 2005 to 50,529 in 2015 (+149%).

Radiologists have been performing the majority of percutaneous embolization procedures with 13,872 (68% of the total volume) in 2005 and 30,742 (61% of the total volume) in 2015, accounting for a 122% increase in volume. Percutaneous embolization volume has increased across all specialties from 2005 to 2015: vascular surgery from 2,538 to 6,284 (+148%); other surgeons 1,590 to 5,668 (+256%); cardiologists 759 to 2,374 (+253%); nephrologists 300 to 1,530 (+410%); obstetricians/gynecologists 50 to 71 (+42%); neurosurgeons 13 to 29 (+123%); and all others providers 1,140 to 3,787 (+232%).

CONCLUSION

The volume of percutaneous embolization in the Medicare population has continued to increase from 2005 to 2015. This increase in volume has been seen in all specialties including radiologists, reflecting the trend towards minimally invasive/non operative interventions. Radiologists performed almost 5 times as many percutaneous embolization procedures in 2015 compared to vascular surgeons, who had the second highest volume. However, while there has been continued growth in volume for radiologists, there has also been rapid progression amongst non-radiologists who collectively performed 39% of all percutaneous embolization procedures in 2015.

CLINICAL RELEVANCE/APPLICATION

Percutaneous embolization has increased as a treatment strategy in recent years with radiologists performing the majority of the procedures.

RC214-03 Advanced Endoleak Treatment

Monday, Nov. 27 8:55AM - 9:10AM Room: N227B

Participants
Laura K. Findeiss, MD, Knoxville, TN (*Presenter*) Speakers Bureau, Bayer AG

LEARNING OBJECTIVES

View learning objectives under main course title.

RC214-04 AVM Embolization

Monday, Nov. 27 9:10AM - 9:25AM Room: N227B

Participants
Brian S. Funaki, MD, Chicago, IL (*Presenter*) Data Safety Monitoring Board, Novate Medical Ltd

LEARNING OBJECTIVES

View learning objectives under main course title.

RC214-05 Imaging Biomarkers That Predict Somatic Mutations in Genes That Control Cell Signaling and Growth in Vascular Overgrowth Malformations

Monday, Nov. 27 9:25AM - 9:35AM Room: N227B

Participants
Patricia E. Burrows, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

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PURPOSE

Pharmacologic treatment is effective in aleviating symptoms of patients with cmplex vascular overgrowth malformations caused by mutations in PI3K/AKT/MTOR pathways. This study was undertaken to identify imaging biomarkers or phenotypes predictive of somatic genetic mutations in patients with vascular malformations and tissue overgrowth.

METHOD AND MATERIALS

Under an IRB approved multiinstitutional protocol, 57 tissue samples from patients with vascular malformations and tissue overgrowth were analized with next generation sequencing using a panel enriched for cancer related pathways and hybrid capture approach. Imaging studies of patients from one of the instutions were reviewed by one radiologist blinded to the genetic findings. Data tabulated from imaging studies included anatomic location, tissue plane involvment, visceral involvement, presence or abscence of overgrowth of fat, bone, and muscle, muscle infiltration, enlargement of arteries, veins, lymphatic malformations and anomalies of digits. After all data was tabulated, it was analyzed and compared with mutations identified.

RESULTS

71.9% of tissue samples harbored pathogenic or likely pathogenic variants. 28 patients from one institution had appropriate imaging to evaluate for overgrowth and vascular anomalies. Several patterns were identified. Among 15 patients with fat overgrowth, 11 had somatic activating mutations: 7 PIK3CA, 1 PIK3R1, 1 RASA1 2 GNAQ. Among 13 patients with microcystic lymphatic malformations, 10 had PIK3CA mutations and 3 had no detected mutations. Among 10 patients with increased fat and microcystic LM, seven had PIK3CA mutations and three had none.

CONCLUSION

Patients with vascular malformation and tissue overgrowth have a high incidence of postzygotic activating somatic mutations in genes that control cell signaling and growth. Imaging findings consistent with fat overgrowth combined with microcystic lymphatic malformation correlate strongly with the presence of PIK3CA mutations.

CLINICAL RELEVANCE/APPLICATION

Identification of fat tissue overgrowth with microcystic lymphatic malformation, with or without other vascular malformation elements is strongly predictive of a PIK3CA related vascular overgrowth syndrome. These conditions often respond to mTOR

inhibition.

RC214-06 Bariatric Embolization

Monday, Nov. 27 9:35AM - 9:50AM Room: N227B

Participants
Jafar Golzarian, MD, Minneapolis, MN (*Presenter*) Chief Medical Officer, EmboMedics Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

RC214-07 Splenic Artery Embolization

Monday, Nov. 27 9:50AM - 10:05AM Room: N227B

Participants
Christopher Stephens, MD, Knoxville, TN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe indications for splenic angiography and embolization.2) Describe techniques for proximal and distal splenic artery embolization in the setting of trauma.3) Describe technique for distal splenic artery embolization for thrombocytopenia or portal hypertension.

RC214-08 Endovascular Treatment in 100 Patients Affected by Visceral Artery Aneurysms (VAAs) and Pseudoaneurysms (VAPAs): Comparison between Transcatheter Embolization (TE) and Covered Stenting (CS)

Monday, Nov. 27 10:05AM - 10:15AM Room: N227B

Participants
Giulia Agostini, Milan, Italy (*Presenter*) Nothing to Disclose
Massimo Venturini, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Paolo Marra, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Gianpiero Cardone, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Giuseppe Balconi, Ornago, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To report early and mid-term outcomes of 100 cases of endovascular treatments of VAAs and VAPAs. We compared CS and TE, considering CS as first therapeutic option and focusing on its feasibility and technical aspects.

METHOD AND MATERIALS

The following data were retrospectively collected from a prospectively acquired database (from 2000 to 2015): aneurysm type and features, involved artery, elective/emergent procedure, technical success, clinical success, complications, thirty-day mortality and mid-term follow up (aneurysm exclusion and stent graft patency). TE was mainly performed with coils, CS by using the Viabahn self-expandable, peripheral-stent-graft (coronary stent-graft).

RESULTS

TE was performed in 70 cases, CS in 30 cases (26 trans-femoral, 4 trans-axillary; 27 Viabahn, 3 coronary stent-grafts). 49/100 were post-operative (post-traumatic) VAPAs. 59/100 procedures were elective and 41/100 emergent involving the following arteries: 31 splenic, 21 hepatic, 14 renal, 12 superior mesenteric, 11 gastroduodenal, 8 pancreaticoduodenal and 3 left gastric. Technical success was 96% (97% CS, 96% TE), clinical success 83% (87% CS, 81% TE). Major complications were 4%. Thirty-day mortality was 7% mainly due to septic shock following pancreatic surgery. Mid-term follow-up was 18.9 months and 22.8 months in total population and CS group, respectively. At more than 6 months after (CS), 100% aneurysm exclusion and 88% stent patency were achieved. In 8 CS patients with a 3-year follow-up aneurysm exclusion and stent patency was 100%.

CONCLUSION

In VAAs (VAPAs) endovascular treatment, CS feasibility was 30%. CS showed a slightly better efficacy than TE, with high mid-term patency rate. The Viabahn covered stent, flexible and without shape memory seems to be suitable for endovascular repair of tortuous visceral arteries.

CLINICAL RELEVANCE/APPLICATION

The Viabahn covered stent, flexible and without shape memory seems to be suitable for endovascular repair of tortuous visceral arteries.

RC214-09 Prophylactic Embolization Pre-Y90

Monday, Nov. 27 10:30AM - 10:45AM Room: N227B

Participants
Naganathan B. Mani, MD, Chesterfield, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the rationale behind prophylactic embolization Pre-Y90. 2) To become up-to-date with the literature pertaining to this practice. 3) To learn different tips and techniques as well as factors to consider when doing prophylactic embolization.

RC214-10 Prostate Embolization: Lessons Learned

Monday, Nov. 27 10:45AM - 11:00AM Room: N227B

Participants
Alex Kim, MD, Washington, DC (*Presenter*) Research Grant, Surefire Medical, Inc; Speakers Bureau, Surefire Medical, Inc; Advisory Board, Surefire Medical, Inc; Stockholder, Surefire Medical, Inc; Speakers Bureau, Sirtex Medical Ltd; Proctor, Sirtex Medical Ltd; Advisory Board, Bayer AG; Stockholder, Pfizer Inc; ;

LEARNING OBJECTIVES

1) To understand the technique of prostate artery embolization. 2) To understand the current published literature on the outcomes of prostate artery embolization. 3) To understand the limits of our knowledge about outcomes and the areas still needing additional investigation.

RC214-11 Correlation of Transabdominal Contrast-Enhanced Ultrasound and Magnetic Resonance Imaging for Evaluation of Prostate Artery Embolization Procedures

Monday, Nov. 27 11:00AM - 11:10AM Room: N227B

Participants
Alexander Massmann, MD, Homburg/Saar, Germany (*Presenter*) Nothing to Disclose
Christina Niklas, Homburg/Saar, Germany (*Abstract Co-Author*) Nothing to Disclose
Paul S. Raczeck, MD, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose
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Guenther K. Schneider, MD, PhD, Homburg, Germany (*Abstract Co-Author*) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;
Arno Buecker, MD, Homburg, Germany (*Abstract Co-Author*) Research Grant, Siemens AG Consultant, Bracco Group Speaker, Bracco Group Consultant, Medtronic plc Speaker, Medtronic plc Research Grant, Novartis AG Research Grant, GlaxoSmithKline plc Research Grant, Biotest AG Research Grant, OncoGenex Pharmaceuticals, Inc Research Grant, Bristol-Myers Squibb Company Research Grant, Eli Lilly & Company Research Grant, Pfizer Inc Research Grant, F. Hoffmann-La Roche Ltd Research Grant, sanofi-aventis Group Research Grant, Merrimack Pharmaceuticals, Inc Research Grant, Sirtex Medical Ltd Research Grant, Concordia Healthcare Corp Research Grant, AbbVie Inc Research Grant, Takeda Pharmaceutical Company Limited Research Grant, Merck & Co, Inc Research Grant, Affimed NV Research Grant, Bayer AG Research Grant, Johnson & Johnson Research Grant, Seattle Genetics, Inc Research Grant, Onyx Pharmaceuticals, Inc Research Grant, Synta Pharmaceuticals Corp Research Grant, Siemens AG Research Grant, iSYMED GmbH Research Grant, St. Jude Medical, Inc Co-founder, Aachen Resonance GmbH
Reinhard I. Kubale, MD, Pirmasens, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate transabdominal contrast-enhanced ultrasound (CE-US) and MRI (CE-MRI) of the prostate prior and after prostate artery embolization (PAE).

METHOD AND MATERIALS

After examination and dose optimization of CE-US in five patients, fifteen patients (mean age 69; range 51-88 years) underwent pre- and postinterventional dynamic CE-US (Siemens Acuson S2000 Helx: 9L4, 4C1 and 6C1) using twice-time bolus sulphur hexafluoride microbubble (Bracco SonoVue) injection for evaluation of midgland prostate and Gadolinium-BOPTA CE-MRI including multiparametric prostate imaging (Siemens Magnetom Aera 1.5 T) one day before and after PAE. Perfusion characteristics (time-to-peak intensity TTP; mean transit time, MTT) of regions-of-interest (ROI) placed in PI-RADS region 3, 4, 10, 14, prostate capsula, and iliac artery were measured. Planimetry after PAE of ischemic areas in CE-US and CE-MRI were analyzed. Spearman's correlation, Bland-Altman and intraclass correlation coefficient (ICC) were analyzed.

RESULTS

Best imaging quality was achieved using 6C1 and 2 ml SonoVue in full bladder technique. In 13/15 patients sufficient, homogeneous contrast was achieved for evaluation with a significant correlation of CE-US and CE-MRI perfusion (Spearman $r=0.77$, $p<0.01$; ICC=0.831, $p<0.01$). Extension of infarction after PAE correlated highly with CE-MRI and diffusion restriction on MRI (Spearman r=0.79?<0.01; ICC=0.831, $p<0.01$).

CONCLUSION

This is a first proof-of-concept study for determining prostate tissue infarction after PAE by transabdominal CE-US perfusion imaging with excellent correlation to CE-MRI.

CLINICAL RELEVANCE/APPLICATION

Easy-to-use and fast contrast-enhanced ultrasound may be used instead of time-consuming and expensive contrast-enhanced magnetic resonance imaging for postinterventional evaluation of prostatic artery embolization.

RC214-12 Embolization: New Tools and Techniques

Monday, Nov. 27 11:10AM - 11:25AM Room: N227B

Participants
D. T. Johnson, MD, PhD, San Francisco, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the concept of liquid emulsions in embolization. 2) Describe the mechanism of release of drugs and drugs that can be

bound to drug eluting beads. 3) Understand the physical differences among embolic materials. 4) Understand the new occlusion devices available presently for vascular occlusion. 5) What devices/coils are in current clinical trials.

RC214-13 Could We Defrost a Shoulder? Arterial Embolization as a New Treatment in Adhesive Capsulitis

Monday, Nov. 27 11:25AM - 11:35AM Room: N227B

Participants
Ana Maria Fernandez Martinez, MD, Leon, Spain (*Presenter*) Nothing to Disclose
Maria Jose Fernandez Bermudez, DMD, Leon, Spain (*Abstract Co-Author*) Nothing to Disclose
Oscar Balboa Arregui, Leon, Spain (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Adhesive capsulitis, commonly called 'frozen shoulder', is defined as thickening of the joint capsule that causes chronic pain an functional limitation. Its a prevalence of 2-3%, mostly young women. Its origin is uncertain. One of the pathophysiological explanation is a hypervascularization that causes a state of inflammation and a stimulation on the adjacent nerve fibers. Our goal is to propose arterial embolization as a therapeutic alternative.

METHOD AND MATERIALS

Were included patients with clinical diagnosis of adhesive capsulitis: nocturnal pain, functional limitation and no response conservative treatment for 3 months. The pain was measured on the numerical scale being 0 none and 10 maximum. In all cases MRI was used to rule out other possible lesions. An arteriography was performed to identify the arterial contribution to the joint capsule. Local anesthesia was used in the area of the arterial punction. The material used to embolize was a 50% mixed solution of imipenem and cilastatin sodium to which contrast was added. Clinical follow-up was at month, six months and one year after procedure.

RESULTS

Were included 15 patients (5 males, 10 females). The mean age was 54 years. The median time of clinical evolution was 16 months. The patients rated their pain between 6 and 10 points. The procedure was performed by femoral access in 8 cases and humeral in remaining 7. In all cases hypervascularization of the articular capsule was identified. The artery responsible most frequent was the anterior humeral circumflex (33.4%). In 7 cases (46.7%) more than one target artery was identified. Embolization was performed with an average amount of 1.6 ml solution. The radiation time employed was 29.48 minutes. No immediate complications were noted. The procedure was well tolerated and none required hospitalization. In annual review 14 of 15 patients (93.3%) had completely recovered their mobility and the pain disappeared in 10 of them (66.7%); remaining 5 patients reported disconfort with specific movements.

CONCLUSION

Although our results are preliminary on a small sample, arterial embolization in patients with adhesive capsulitis has good clinical and functional results and should be considered as an alternative therapeutic.

CLINICAL RELEVANCE/APPLICATION

There is a high index of refractory adhesive shoulder capsulitis to medical an physiotherapeutic treatment. We present an innovate treatment with good clinical and functional results.

RC214-14 Novel Class of Shear Thinning Biomaterials for Vascular Embolization

Monday, Nov. 27 11:35AM - 11:45AM Room: N227B

Participants
Rahmi Oklu, MD, PhD, Scottsdale, AZ (*Presenter*) Nothing to Disclose
Reginald Avery, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Hassan Albadawi, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose
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Ali Khademhosseini, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop a new class of bioengineered embolics for vascular embolization. This new embolic agent was designed and developed with the end user in mind, i.e., easy to use and rapidly deployable, no cross-sectional imaging artifacts, demonstrate utility in high risk scenarios such as in DIC and other coagulopathy conditions, not require a specific catheter or wire for use and have low cost.

METHOD AND MATERIALS

Detailed testing include rheological analysis, thermal stability, creep measurement, sterilization, hemocompatibility, injection force testing in clinical catheters, in vitro/ex vivo and in vivo occlusion testing, extensive micro-CT, CT phantom studies and in vivo pig embolization studies were performed. Pigs were allowed to survive up to 24 days. Significant imaging, histology, immunohistochemistry and biocompatibility studies were also performed.

RESULTS

The optimized biomaterial was shown to be injectable through a range of clinical catheters without a time restriction or require any pre-treatment. The embolic could withstand extreme non-viable blood pressures without fragmentation or displacement in

elastomeric channels in vitro and in explant vessels ex vivo. It was capable in achieving complete occlusion in anti-coagulated state, i.e.., it did not rely on intrinsic thrombosis as coils do for occlusion. CT imaging showed the biomaterial to fully occlude murine and porcine blood vessels in vivo and remain at the site of injection without fragmentation upto 24 days.

CONCLUSION

The unique properties of the bioengineered embolic and its ease of use suggest that it can be a low cost efficacious alternative coil embolization.

CLINICAL RELEVANCE/APPLICATION

Current coil technology has significant limitations in its utility and outcome. Our disruptive biocompatible embolic agent addresses these limitations and exceeds expected outcomes in animal models.

RC214-15 Anatomy and Basic Technique for BRTO/BATO

Monday, Nov. 27 11:45AM - 12:00PM Room: N227B

Participants
Ron C. Gaba, MD, Chicago, IL (*Presenter*) Research Grant, Guerbet SA

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LEARNING OBJECTIVES

1) To recognize standard variceal inflow and outflow anatomy. 2) To understand to basic principles that underlie variceal obliteration. 3) To be familiar with standard technical approaches to variceal obliteration.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
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McCormick Place, Chicago
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RC215

Breast Series: Hot Topics in Breast Imaging

Monday, Nov. 27 8:30AM - 12:00PM Room: Arie Crown Theater

BR

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Research Grant, Hologic, Inc; Research Grant, General Electric Company; Research Grant, GlaxoSmithKline plc
Linda Moy, MD, New York, NY (*Moderator*) Nothing to Disclose

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Sub-Events

RC215-01 Screening

Monday, Nov. 27 8:30AM - 8:50AM Room: Arie Crown Theater

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the underpinning evidence and new directions for population-based breast cancer screening. 2) Demonstrate that the burden of breast cancer continues to motivate population-based breast cancer screening, particularly in distinct sub-populations. 3) Realize that supplemental screening is increasingly important and dissemination strategies are largely based on risk. 4) Illustrate the importance of the Radiology Community's role in advancing breast cancer screening policy and practice.

RC215-02 Screening Mammography: Trends in Utilization From 2005 to 2015

Monday, Nov. 27 8:50AM - 9:00AM Room: Arie Crown Theater

Awards
Student Travel Stipend Award

Participants
Gilda Boroumand, MD, Hamden, CT (*Presenter*) Nothing to Disclose
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Laurence Parker, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Elizabeth S. Hsu, MD, Ambler, PA (*Abstract Co-Author*) Nothing to Disclose
Vijay M. Rao, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Previous research has demonstrated a decrease in screening mammography utilization in the year immediately following the 2009 revision of the U.S. Preventive Services Task Force (USPSTF) breast cancer screening guidelines. This study aims to examine more longitudinal trends in screening mammography utilization in the Medicare population from 2005 to 2015 in order to obtain a better understanding of the potential long-term influence of the USPSTF guidelines.

METHOD AND MATERIALS

The national Medicare Part B Physician/Supplier Procedure Summary Master Files were used to determine the annual utilization rate of screening mammography from 2005 to 2015. Procedure codes for film and digital screening mammography were selected and analyzed. Utilization rates were calculated per 1000 Medicare beneficiaries. A utilization rate trend line was plotted.

RESULTS

The utilization rate of screening mammography per 1,000 women in the Medicare fee-for-service population rose gradually every year from 311.6 in 2005 to its peak of 322.9 in 2009. This represented a compound annual growth rate of 0.9%. In 2010, following the release of the USPSTF recommendations, the utilization rate abruptly decreased by 4.3% to 309.2. Though the rate of screening slightly increased in 2011, 2012, and 2015 (by 0.6%, 1%, and 1%, respectively), utilization rates have not recovered to pre-2010 levels and the long-term trend demonstrates a decline in screening. The rate of screening mammography utilization in 2015 was 300.9, compared to the 2009 peak of 322.9, representing a 6.8% decrease. In 2015, 97% of all screening mammograms were performed digitally.

CONCLUSION

Long-term trends in screening mammography utilization demonstrate a decline in screening between 2009 to 2015, in contrast to the steady annual increase in utilization from 2005 to 2009. The abrupt change in utilization trends beginning in 2010 suggests that the updated USPSTF recommendations of 2009 play a role in continued decreasing utilization.

CLINICAL RELEVANCE/APPLICATION

Although there are uncertainties in attributing change to a particular historical event, it appears the USPSTF recommendations may have led to a reduction in use of Medicare screening mammography.

RC215-03 The Association between Screening Mammography Recall Rate and Interval Cancers in the UK Breast Cancer Service Screening Program

Monday, Nov. 27 9:00AM - 9:10AM Room: Arie Crown Theater

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Presenter*) Nothing to Disclose
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Roger G. Blanks, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Substantial variation in recall rates within and between breast cancer screening programs suggests uncertainty about optimal ranges. The purpose of this prospective cohort study was to determine whether low levels of recall lead to increased interval cancer in a service-screening program and the magnitude of this effect.

METHOD AND MATERIALS

We analyzed prospectively collected data from the UK National Health Service Breast Screening Programme (NHSBSP) during a 36-month period (4/1/2005-3/31/2008) and outcomes for the 3-year intervals following screening in these years, in women 50-70 from England, Wales, and Northern Ireland. Data on recall, cancers detected at screening, and interval cancers (cancers arising within the 36 months after a negative screening mammogram) were available for each of the 84 Breast Screening Units (BSU) and for each year (N=252). We modeled the association between interval cancer as the outcome variable and recall rate as the explanatory variable using Poisson regression on aggregated data and for the following subsets: age (5-year intervals) and prevalent versus incident screens.

RESULTS

We analyzed 5,126,689 screening episodes demonstrating an average recall to assessment rate (RAR) of 4.56% (range 1.64-8.42, SD 1.15); cancer detection rate of 8.1 per 1,000 women screened, and interval cancer rate (ICR) of 3.1 per 1,000. Overall, there was a significant negative association between RAR and the ICR (Poisson regression coefficient -0.039 [95% CI -0.054 to -0.024]; $p<0.001$) with approximately one fewer interval cancer for every additional 80 recalls-Figure. Subset analysis revealed similarly negative correlations in women 50-54 ($p<0.001$); 60-64 ($p<0.05$); and 65-69 ($p<0.01$); as well as in incident screens ($p<0.01$) and a trend toward significance in prevalent screens ($p=0.051$). No significant correlation was found in 55-59 years age range ($p=0.34$).

CONCLUSION

We show a statistically significant negative correlation between RAR and ICR in the UK breast cancer screening program, a relationship that is preserved over most age subgroups as well as in prevalent and incident screening rounds.

CLINICAL RELEVANCE/APPLICATION

Demonstration of the association between increasing RAR and decreasing ICR in a service-screening program is an important step in establishing the evidence to support a minimum threshold for recall.

RC215-04 Longitudinal Changes in Digital Breast Tomosynthesis Recall Rates and Recalled Abnormalities: 5 Consecutive Years of Experience

Monday, Nov. 27 9:10AM - 9:20AM Room: Arie Crown Theater

Participants
Maryam Etesami, MD, New Haven, CT (*Presenter*) Nothing to Disclose
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Reni S. Butler, MD, Madison, CT (*Abstract Co-Author*) Research Grant, Seno Medical Instruments, Inc.
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PURPOSE

To assess effect of experience with digital breast tomosynthesis (DBT) on recall rate and recalled mammographic abnormalities.

METHOD AND MATERIALS

Retrospective analysis of all DBT screening mammograms from an academic breast center, interpreted by 7 radiologists, during 5

Retrospective analysis of all DBT screening mammograms from an academic breast center, interpreted by 7 radiologists, during 5 consecutive years from 10/1/2011 - 10/1/2016 was performed. Overall screening recall rates (RR), RR for each type of abnormality, and percentage of recalled cases and abnormalities resulting in a cancer diagnosis (PPV1) were determined and compared for each year.

RESULTS

23269 DBT screening mammograms were reviewed. Overall DBT RR was 7.77% over the 5-year period, with a small spike from year-1 to year-2, subsequent decrease in year-3 and stabilization through year-5 (8.17%, 9.20%, p=.10: years 1-2; 7.36%, 7.09%, and 7.30%: years 3-5, respectively). RR for asymmetries and architectural distortions (AD), similarly increased from year-1 to year-2, with subsequent decrease in year-3 and no significant change through year-5 (asymmetry: 3.61% to 4.65%, p=.01: years 1-2; 3.61%, 3.08%, and 3.34%: years 3-5 and AD: 0.50% to 1.01%, p=.007: years 1-2; 0.61%, 0.68%, and 0.62%: years 3-5). RR for masses decreased from year-1 through year-3, with subsequent increase in year-4 and no change in year-5 (2.90%, 2.47%, 1.72%; p<.001: years 1-3; 2.66%, 2.64%: years 4-5). RR for calcifications showed a descending trend over the 5-year period, despite nonsignificant increases from year-1 to year-2 and year-4 to year-5 (2.88%, 3.06%, 2.35%, 2.09%, and 2.12%: years 1-5; Pearson r=-0.88, p=.046). Overall PPV1 per patients was 6.52% over the 5-year period, with a decrease from year-1 to year-2 and subsequent sustained increase through year-5 (8.59%, 5.39%; p=.09: years 1-2; 5.48%, 6.21%, and 6.94%: years 3-5). Recalled AD had the highest yield for cancer detection among the recalled abnormalities (AD: 16/159: 10.06%, asymmetry: 24/845: 2.84%, calcification: 50/573: 8.73%, mass: 34/582: 5.84%).

CONCLUSION

DBT screening recall rates remain sustainably low with long-term experience, despite initial spikes early after implementation, particularly for asymmetries and AD. A reverse trend was noted for PPV1 with an initial decrease followed by sustained increase over time.

CLINICAL RELEVANCE/APPLICATION

A learning curve exists for DBT, with benefits that include reduced recalled rates and improved PPV1, which are sustainable over time.

RC215-05 Patient Perceptions of Breast Cancer Risk and Thresholds for Intervention: A Multi-Institution Survey

Monday, Nov. 27 9:20AM - 9:30AM Room: Arie Crown Theater

Participants
Lars J. Grimm, MD, Durham, NC (*Presenter*) Advisory Board, Medscape, LLC; Research funded, General Electric Company
Rebecca Shelby, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Emily E. Knippa, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

A 2% malignancy rate separates the recommendation for short-term follow up from a biopsy, but patients' perceptions regarding this threshold are currently unknown. The purpose of this study is to understand patients' breast cancer risk perceptions and acceptable risk thresholds following a recommendation for short-term follow up or biopsy.

METHOD AND MATERIALS

After IRB approval, patients from five medical centers representing four states in both private and academic practices were surveyed. Patients were asked to quantify their perceived risk of breast cancer at baseline and in two hypothetical scenarios based on an abnormality seen on mammography. In scenario 1 the radiologist recommended short-term follow up imaging and in scenario 2 the radiologist recommended a biopsy but stated there was a low risk of malignancy. Patients were also queried regarding their baseline mood and their emotional state following these two hypothetical scenarios.

RESULTS

There were 3,031 surveys available for analysis. Women estimated their baseline breast cancer risk as 27% (more than twice the average woman's breast cancer risk of 12.4%) and reported at least brief thoughts of developing breast cancer on average 3.3 times in the last month (95% CI: 2.9-3.6%). Women who at baseline reported being more tense, upset, and worried had higher estimates of breast cancer risk (p<0.001) and more frequent thoughts of cancer (p<0.001) than women who reported being more calm, relaxed, and content. Following a recommendation for short-term follow up, women estimated their cancer risk at 33% (95% CI: 32-34%) with 54% of women reporting they would never want short-term follow up if there was any chance of breast cancer. When a biopsy was recommended, women estimated their cancer risk as 43% (95% CI: 41-43%) and 66% reported they would want a biopsy if there was any chance of breast cancer. Women were more likely to report regret and anxiety with the recommendation for short-term follow up but relief and confidence following the biopsy recommendation (p<0.001).

CONCLUSION

Women overestimate their personal risk of breast cancer and desire conservative thresholds for intervention. More than half of women prefer a biopsy if there was any chance of cancer.

CLINICAL RELEVANCE/APPLICATION

Women overestimate their risk of breast cancer and express increased regret and anxiety following a recommendation for short-term follow up, with more than half of women preferring biopsy.

RC215-06 Overstated Harms of Breast Cancer Screening: A Large Outcomes Analysis of Complications Associated with 9-gauge (9G) Stereotactic Vacuum Assisted Breast Biopsy (SVAB)

Monday, Nov. 27 9:30AM - 9:40AM Room: Arie Crown Theater

Awards
Trainee Research Prize - Resident

Participants
Leng Leng Young Lin, MD, New York, NY (*Presenter*) Nothing to Disclose
Yiming Gao, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess rate, type, and severity of complications related to 9G SVAB, and to delineate associated factors.

METHOD AND MATERIALS

This IRB-approved HIPPA compliant study included 4776 patients (mean age 56, range 28-89) who underwent a 9G SVAB from 2003-2016, yielding 28% (1337) malignant, 51% (2436) benign, and 21% (1003) high risk lesions, with a false-negative biopsy rate of 1.2% (57 lesions). Patients with documented post biopsy complications were identified (n=319), which were subcategorized into bleeding/hematoma, pain/discomfort, lightheadedness, bruising/ecchymosis, & classified as minor, moderate and severe as per prior literature (see table). Hematoma volumes were correlated with biopsy location and severity of complications. The complication group was compared to a matched control group who underwent SVAB without complications, in terms of age, biopsy location, lesion type, and pathology.

RESULTS

Of 4776 patients who underwent SVAB, 319 (6.7%) had documented complications, of which 307 (96.2%) were minor, 12 (3.8%) moderate, and none (0%) severe. The most common complication was bleeding/hematoma (89.3%; 285/319), followed by pain/discomfort 6.9% (22/319), lightheadedness 0.9% (3/319), bruising/ecchymosis 0.9% (3/319), and other 1.9% (6/319). There was no significant difference between patients with (study group) and without complications (control group) in age (p=0.474), biopsy location (p=0.065), pathologic results (p=0.056), or lesion type (p=0.568). Hematoma volume (median, 7.5 cm3) did not correspond to severity of complication. Median hematoma size was significantly larger when biopsy location was posterior within the breast (p=0.008).

CONCLUSION

Clinically significant complications associated with SVAB were exceedingly rare (0.3%) in this large study of stereotactic biopsy spanning 13 years. SVAB was well tolerated across age groups regardless of lesion type or biopsy location. Although bleeding was the most common complication following SVAB, it was rarely clinically significant. Posterior biopsies resulted in significantly larger hematomas, but hematoma size was not an indicator of severity of complication.

CLINICAL RELEVANCE/APPLICATION

SVAB is safe with minimal risks in exchange for potentially life saving diagnosis. Overstating the risks of screening is detrimental to women's health, and public education and advocacy are needed.

RC215-07 Identifying Mammographic Imaging Biomarkers of Breast Cancer Risk: Beyond Breast Density and Textures

Monday, Nov. 27 9:40AM - 9:50AM Room: Arie Crown Theater

Awards
Student Travel Stipend Award

Participants
Aly A. Mohamed, PhD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
Wendie A. Berg, MD, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
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Jules H. Sumkin, DO, Pittsburgh, PA (*Abstract Co-Author*) Institutional research agreement, Hologic, Inc Advisory Board, General Electric Company
Margarita L. Zuley, MD, Pittsburgh, PA (*Abstract Co-Author*) Research Grant, Hologic, Inc;
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PURPOSE

Mammographic percentage breast density is an established risk marker for breast cancer. Texture measures of dense breast tissue have also been shown relevant to breast cancer risk. Going beyond these existing imaging descriptors, we investigated using deep learning approach to automatically identify new imaging markers associated with breast cancer risk.

METHOD AND MATERIALS

A retrospective case-control study was performed on a cohort of 226 patients (1:1 case-control ratio) who underwent general population breast cancer screening in 2013. Asymptomatic cancer-free controls (60.1±10.0 YO) are matched to the cancer cases

(61.3±10.3YO; newly diagnosed and confirmed by pathology) by age and year of imaging. All studied women did not have any prior biopsy or recall on mammography. For all cohort, a most recent negative mammogram examination prior (1.46±0.63 [1-3] and 1.48±0.76 [1-4] years earlier for cancers and controls, respectively) to the outcome (cancer vs cancer-free) was analyzed. A deep learning approach using convolutional neural network was used to interpret the automatically pre-segmented dense tissues in the whole-breast region and to classify the corresponding images in the case-control groups in terms of the prediction of outcome, during the process deep learning automatically identifies imaging treats associated with the prediction. For comparison purposes, representative Haralick texture features and area-based percentage breast density (PD) were computed using automated computer algorithms. The area under the receiver operative characteristic curves (AUC) was used to assess the classification accuracy.

RESULTS

81% of cancers and 82% of controls were post- with the rest pre-menopausal. The deep learning approach achieved a significantly ($p<0.05$) higher accuracy (AUC=0.88) than the measures of the best-performed texture feature (i.e., maximal correlation coefficients; AUC=0.56) and PD (AUC=0.54). Neither menopausal status nor family history of breast cancer was associated with the outcome.

CONCLUSION

In this cohort deep learning-based approach that automatically identified imaging markers associated with breast cancer risk substantially outperformed existing risk markers of PD and texture features.

CLINICAL RELEVANCE/APPLICATION

Deep interpretation of dense breast tissues in screening digital mammograms can identify different from or complementary imaging biomarkers to established ones to potentially improve risk prediction.

RC215-08 Intrinsic Phenotypes of Breast Parenchymal Complexity: Implications Beyond Mammographic Density in Breast Cancer Risk Assessment

Monday, Nov. 27 9:50AM - 10:00AM Room: Arie Crown Theater

Participants
Despina Kontos, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
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PURPOSE

Studies suggest that refined quantitative measures of mammographic parenchymal patterns may augment breast density in cancer risk estimation. We identify intrinsic phenotypes for mammographic parenchymal complexity using quantitative radiomic feature analysis and evaluate their associations with breast density and established breast cancer risk factors.

METHOD AND MATERIALS

Fully-automated software was used to quantify breast density (LIBRA, v.1.0.2) and extract a range of texture features to characterize parenchymal complexity, including gray-level histogram, co-occurrence, run-length, and fractal dimension descriptors (N=29), from a cohort of women undergoing screening digital mammography (N=2029). BI-RADS 4th edition density assessment was available from the screening reports. Unsupervised clustering was applied to the extracted features, using a split-sample approach, to identify intrinsic phenotypes of parenchymal complexity. Differences across phenotypes by age, body mass index (BMI), breast density, and breast cancer risk estimates by the Breast Cancer Surveillance Consortium (BCSC) model were assessed using Fisher's exact/Chi-square and Kruskal-Wallis tests.

RESULTS

Unsupervised clustering identified four intrinsic phenotypes, ranging from low to high parenchymal complexity, which were reproducible in the independent training and test sets ($p<0.0001$). Age, BMI, and breast density differed across phenotypes ($p<0.001$), however, density was not strongly correlated with phenotype category ($R2=0.24$, for linear trend). The low/intermediate complexity phenotype (prevalence 19%) had the lowest proportion of high-density women (2.1%), while similar proportions of high-density women were observed across other phenotypes (48.1%-53.8%). The low/intermediate complexity phenotype had the lowest proportion of women (35%) at 5-year breast cancer risk >1.67%, compared to the low (43%), intermediate/high (49%) and high complexity phenotypes (45%).

CONCLUSION

Intrinsic phenotypes for mammographic parenchymal complexity capture information that differs from breast density and established risk factors. Independent validation is needed to determine phenotype reproducibility and associations to breast cancer risk and screening outcomes.

CLINICAL RELEVANCE/APPLICATION

Intrinsic phenotypes of mammographic parenchymal complexity may ultimately augment breast cancer risk prediction models to help guide personalized screening and prevention strategies.

RC215-09 Radiomics

Monday, Nov. 27 10:10AM - 10:30AM Room: Arie Crown Theater

Participants
Cherie M. Kuzmiak, DO, Chapel Hill, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the definition of radiomics and how it is being applied to breast imaging. 2) Describe its potential clinical use and benefits.

RC215-10 Radiomics: A New Approach to Enable Early Diagnosis of Non-Specific Breast Nodules in CE-MRI

Monday, Nov. 27 10:30AM - 10:40AM Room: Arie Crown Theater

Participants
Natascha Claudia D'Amico, MSc, Milan, Italy (*Presenter*) Nothing to Disclose
Enzo Grossi, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Bernardo Colombo, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesca Rigiroli, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Massimo Buscema, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Deborah Fazzini, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Gianpaolo Cornalba, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Sergio Papa, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

NataschaClaudia.D'Amico@cdi.it

PURPOSE

To characterize, through a radiomic approach, the nature of nodules considered non-specific by expert radiologists, recognized in magnetic resonance mammography (MRm) with T1-weighted (T1w) sequences with paramagnetic contrast.

METHOD AND MATERIALS

47 cases out of 1200 undergoing MRm, in which the MRm assessment gave uncertain classification (non-specific nodules), were admitted to the study. The clinical outcome of the non-specific nodules was later found through follow-up or further exams (biopsy), finding 35 benign and 12 malignant. All MR Images were acquired at 1.5T, a first basal T1w sequence and then four T1w acquisitions after the paramagnetic contrast injection. After a manual segmentation of the lesions, done by a radiologist, and the extraction of 150 radiomic features (30 features per 5 subsequent times) a machine learning (ML) approach was used. An evolutionary algorithm (TWIST system based on KNN algorithm) was used to subdivide the dataset into training and validation test and to select features yielding the maximal amount of information. After this pre-processing, different machine learning systems were applied to develop a predictive model based on a training-testing crossover procedure. 10 cases with a benign nodule (follow-up older than 5 years) and 18 with an evident malignant tumor (clear malignant histological exam) were added to the dataset in order to allow the ML system to better learn from data.

RESULTS

NaïveBayes algorithm working on 79 features selected by a TWIST system, resulted to be the best performing ML system with a sensitivity of 96% and a specificity of 78% and a global accuracy of 87% (average values of two training-testing procedures ab-ba). The results showed that in the subset of 47 non-specific nodules, the algorithm predicted the outcome of 45 nodules which an expert radiologist couldn't identify.

CONCLUSION

In this pilot study we identified a radiomic approach allowing ML systems to perform well in the diagnosis of a non-specific nodule at MR mammography. This algorithm could be a great support for the early diagnosis of malignant breast tumor, in the event the radiologist is not able to identify the kind of lesion and reduces the necessity for long follow-up.

CLINICAL RELEVANCE/APPLICATION

This machine learning algorithm could be essential to support the radiologist in early diagnosis of non-specific nodules, in order to avoid strenuous follow-up and painful biopsy for the patient.

RC215-11 Radiomics Nomogram: Prediction of Recurrence-Free Survival in Patients with Invasive Breast Cancer

Monday, Nov. 27 10:40AM - 10:50AM Room: Arie Crown Theater

Participants
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To develop a radiomics signature based on preoperative MRI to estimate the recurrence-free survival (RFS) in patients with invasive breast cancer and to further establish a radiomics nomogram that incorporated both the radiomics signature, MR imaging and clinicopathologic findings for individual preoperative prediction of recurrence outcomes

METHOD AND MATERIALS

We identified 299 patients with invasive breast cancer who underwent preoperative MR imaging. 156 texture features were extracted from four different MR imaging series (T2-weighted, pre-enhanced T1-weighted, contrast-enhanced T1-weighted and

contrast-enhanced T1-weighted subtraction MR images). Patients were randomly divided into training set (n = 194) and validation set (n = 100). A radiomics signature was generated by using the least absolute shrinkage and selection operator (LASSO) in the training set. To dichotomize radiomics signature for survival analysis, the cutoff points was determined in the receiver operating characteristic curve analysis. Univariate and multivariate Cox proportional hazards model and Kaplan-Meier analysis were used to determine the association of MR imaging texture parameters, morphologic or volumetric information obtained from MR imaging, or clinicopathological variables with RFS in the training set. A radiomics nomogram combining radiomics score, MR imaging and clinicopathologic findings was constructed to validate the significance of the radiomics signature for individualized RFS estimation.

RESULTS

The higher radiomics score was significantly associated with a worse RFS in both training and validation set. Incorporating the radiomics signature into the radiomics-based nomogram resulted in better performance for the estimation of RFS (C-index: 0.81; 95% confidence interval [CI]: 0.79, 0.83) than with the clinical-pathologic nomogram (C-index; 0.72; 95% CI: 0.70, 0.74), as well as a better calibration.

CONCLUSION

The radiomics signature is an independent biomarker for the estimation of RFS in patients with invasive breast cancer. Combination of the radiomics signature and other MR imaging and clinical-pathologic findings performed better for individualized RFS estimation.

CLINICAL RELEVANCE/APPLICATION

Radiomics signature may predict the recurrence outcome.

RC215-12 Quantitative Radiogenomics of MR Imaging for Predicting High-Risk Group of Recurrence in Estrogen Receptor-Positive Breast Cancer: Correlation with Results of Multi-Gene Classifier for Prognosis

Monday, Nov. 27 10:50AM - 11:00AM Room: Arie Crown Theater

Participants
Yukiko Tokuda, Suita, Japan (*Presenter*) Nothing to Disclose
Masahiro Yanagawa, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Kaori Minamitani, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Yasuto Naoi, Md, PhD, Suita, Japan (*Abstract Co-Author*) Research grant and Honoraria, Sysmex Corporation
Shinzaburo Noguchi, Suita, Japan (*Abstract Co-Author*) Research funded, Sysmex Corporation Speaker, Sysmex Corporation
Noriyuki Tomiyama, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To examine the correlation of quantitative magnetic resonance imaging (MRI) features with results of multi-gene classifier for prognostic prediction in estrogen receptor-positive breast cancer (ERPBC).

METHOD AND MATERIALS

This study included 78 patients with ERPBC who were classified into high-risk (n=33) and low-risk (n=45) groups of recurrence by using the Multi-Gene classifier: Curebest® 95GC. All patients had undergone a dynamic contrast-enhanced breast MRI (DE-MRI). Kinetic curve assessments of DE-MRI were performed using two types of software [DynaCAD (Philips) and Synapse Vincent (Fuji film medical)] according to the BI-RADS MRI. The following DE-MRI features were measured: each volume ratio of fast, medium and slow to whole mass in initial phase; each volume ratio of washout, plateau and persistent to whole mass in delayed phase; and both kurtosis and skewness of intensity histogram in whole mass on each phase. Mass size and volume was measured on the software. Differences of quantitative data between high and low-risk groups were analyzed using Mann-Whitney test. The value of quantitative data in examining associations with high and low-risk groups were analyzed by univariate logistic regression (ULR). Significant parameters identified by the ULR analysis were included in the multiple logistic regression (MLR) analysis. Each binary group of quantitative data was designated by the cutoff value decided by receiver-operating characteristic analysis.

RESULTS

There were significant differences in volume ratio of medium in initial phase between high and low-risk groups (p=0.005). ULR analysis revealed that size, volume ratio of medium, volume ratio of slow-persistent, and kurtosis in delayed phase were significant indicators associated with high-risk group (p<0.026). MLR analysis revealed that volume ratio of medium ratio>38.9% and kurtosis in delayed phase>3.31 was significant indicator associated with high-risk group (Odds ratio, 5.83 and 3.55; 95% confidence interval, 1.58-21.42 and 1.24-10.15; p=0.008 and p=0.018, respectively).

CONCLUSION

Volume ratio of medium>38.9% in initial phase and/or kurtosis in delayed phase>3.31 were found to be independent indicators associated with high-risk group.

CLINICAL RELEVANCE/APPLICATION

In estrogen receptor-positive breast cancer, quantitative data of dynamic contrast-enhanced breast MRI might contribute the prediction of high-risk group of recurrence using multi-gene classifier.

RC215-13 Treatment

Monday, Nov. 27 11:00AM - 11:20AM Room: Arie Crown Theater

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Presenter*) Research Grant, Hologic, Inc; Research Grant, General Electric Company; Research Grant, GlaxoSmithKline plc

LEARNING OBJECTIVES

A Appreciate the latest developments in MRI techniques for assessing treatment response particularly with chemotherapy B Be aware of the different methods of undertaking diffusion weighted imaging in assessing chemotherapy response C Contrast Enhanced Spectral Mammography has the potential to be used to assess treatment response

ABSTRACT

Breast cancer is a heterogeneous disease requiring tailored treatment strategies. The development of targeted therapies relies on biomarkers which can be used to assess the effectiveness of promising agents as early and accurately as possible. Imaging has the potential to provide in vivo biomarkers of response that can facilitate the development of new therapeutics. MRI has used single longitudinal 2D measurement for RECIST criteria and this has shown to be a reliable measurement compared to mammography and ultrasound. Meta-analysis of 44 MRI studies showed pooled estimates of sensitivity and specificity of 83-87% and 54-83% However more recently volume measurements have become more widely used especially using 70% enhancement thredhold to create a 'Functional Tumour Volume' measurement. This is able to predict pathological complete response after one cycle of chemotherapy with 80% sensitivity and also predict recurrence free survival. MRI is able to detect residual disease with around 80% sensitivty and specificity and is more likely to undercal thsi in non mass like enhancement and when the rumour responds by fragmenting. MRI is most reliable tool in Triple negative breast cancer (TNBC), hormone negative (HR-) disease and when the original tumour is less than 50mm. MRI Functional Paramets derived from Dynamic Contrast Enhancement such as ktrans can also predict early response and predict survival. Diffusion Weighted Imaging is becoming more widely used and the I-SPY2 trial reported that the Apparent Diffusion Coefficent (ADC) at mid and end treatment and the change from baseline to mid treatment point predicts pCR. However the ADC at baseline or post cycle 1 NOT predictive of response to treatment. Again there were differences for tumour subtypes in this study with Mid treatment ADC better for HR+ tumours than TNBC. MR Spectroscopy has been reported recently but it is concluded that this is a particularly challenging technique to implement in multiple centres. This suggests that this is unlikely to be used in routine practice at present. Contrast Enhanced Spectral Mammography assessment of 54 patients with MRI at baseline, mid and end chemotherapy 8 patients had pCR sensitivity CESM 8/8 and specificity 32/38 87% with both techniques underestimating the real extent of residual disease. This study concluded that CESM is a reliable alternative to MRI in assessing treatment response.

RC215-14 The Development of a Novel PTX Delivery System and Real-Time Monitoring of Its Anti-Cancer Effect By DCE-MRI

Monday, Nov. 27 11:20AM - 11:30AM Room: Arie Crown Theater

Participants
Xiaoxuan Zhou, BS,MD, Hangzhou, China (*Presenter*) Nothing to Disclose
Yuxin Han, PhD , Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Yu'e Qian, MD, Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Hongjie Hu, MD, Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Jianbin Tang, Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Youqing Shen, Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

By utilizing Dynamic-contrast-enhanced (DCE) MRI and a novel PMAN-PEG/PTX drug delivery system, a new methodology was developed to monitor chemotherapies with nanomedicines.

METHOD AND MATERIALS

PEG-PMAN carrier consisted of PEG and a hydrophobic block derived from HEMA and niacin, was obtained via atom transfer radical polymerization (ATRP). PEG-PMAN/PTX nanoparticle was prepared through a thin-film hydration method, and its drug loading and release properties was carefully measured. Mice injected with 4T1 breast cancer were randomly assigned into three groups; PMAN-PEG/PTX nanoparticle, free paclitaxel(PTX), as well as control group (PBS). DCE-MRI were performed using a clinical 3T-scanner at 6 and 12 day post inoculation. Ktrans values of tumor, peri-tumor and normal tissue were analyzed to assess therapeutic effects by Omni-Kinetics. All animal studies were performed in accordance with the guidelines established by the Institute for Experimental Animals of Zhejiang University.

RESULTS

PEG-PMAN/PTX nanoparticle with a diameter of 40 nm and drug loading content of 6% was successfully prepared, and acted as a novel drug delivery system. The nanoparticle exhibited excellent therapeutic efficacy in comparison with free PTX, and PBS in vivo (fig 1a), as well as its good safety(fig 1b). Ktrans values was measured in the tumor region. The Ktrans values measured by DCE-MRI had no difference of statistical significance among all the groups on 6 days after inoculation. In contrast, the Ktrans value of tumor in the PMAN-PEG/PTX-treated group was significant lower than that in PTX-treated group on 12 days after inoculation, indicating a enhanced anticancer efficacy of PMAN-PEG/PTX.

CONCLUSION

The novel drug delivery system with minimized side effects, exhibited its significant anti-tumor activity that surpassed free PTX. Meanwhile, tumor Ktrans level measured by DCE-MRI was observed to be negatively correlated with tumor progress, which gave a new prospective in evaluating the efficacy of chemotherapies.

CLINICAL RELEVANCE/APPLICATION

The novel drug delivery system with minimized side effects, exhibited much higher anti-tumor activity than free PTX. Meanwhile, tumor Ktrans level measured by DCE-MRI was found negatively correlated with tumor progress, which gave a new method in evaluating the efficacy of chemotherapies.

RC215-15 Contrast-Enhanced Digital Mammography is Comparable to Breast MRI in Assessing Tumor Response for Breast Cancer Patients Following Neoadjuvant Chemotherapy

Monday, Nov. 27 11:30AM - 11:40AM Room: Arie Crown Theater

Awards
Student Travel Stipend Award

Participants
Matthew Covington, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

Mark D. Sugi, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose
Talal Hilal, MD, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose
Heidi Kosiorek, MS, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose
Donald Northfelt, MD, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose
Barbara A. Pockaj, MD, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose
Bhavika K. Patel, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Evaluate the performance of contrast-enhanced digital mammography (CEDM) compared to MRI in detecting tumor response in breast cancer patients following neoadjuvant therapy.

METHOD AND MATERIALS

Following IRB approval, retrospective review identified all patients who had both CEDM and MR imaging pre- and post-neoadjuvant therapy and pathologic assessment after surgical management between September 2014 and June 2016. Surgical management for the treatment of primary breast cancer included either segmental mastectomy or mastectomy. Size of residual malignancy (if any) on post-neoadjuvant CEDM and MRI was compared to surgical pathology (reference standard). Spearman (non-parametric) correlation was then performed.

RESULTS

40 patients (all female, mean age 52.9 years (range 35-73)) met inclusion criteria. Type of neoadjuvant therapy was 85% (34/40) chemotherapy and 15% (6/40) endocrine therapy. Tumor histology comprised invasive ductal carcinoma 37/40 (92.5%), invasive lobular carcinoma 1/40 (2.5%), mixed invasive carcinoma 1/40 (2.5%) and other subtypes 1/40 (2.5%). Post-neoadjuvant T category consisted of T1 28% (11/40), T2 50% (20/40), and T3/ T4 22% (9/40). Mean tumor size after neoadjuvant therapy was 10.3 mm (range 0-75 mm) for CEDM and 9.7 mm (range 0-60 mm) for MRI compared to 15.7 mm (range 0-100 mm) on final surgical pathology. Spearman correlation showed no significant difference for tumor size on CEDM and MRI compared to final surgical pathology, with values of 0.753 for CEDM (mean difference -5.4 mm, standard deviation 12.6 mm) and 0.655 for MRI (mean difference -6 mm, standard deviation 11.7 mm). The number of patients with a complete response on CEDM and MRI was 25 and 22 respectively and these cases were confirmed on pathology in 56% vs 55% of cases. CEDM and MRI demonstrated residual disease in 15 vs 18 patients respectively and this was confirmed on pathology in 100% vs 94% of cases.

CONCLUSION

Accuracy of size of residual malignancy on CEDM is comparable to breast MRI for women with breast cancer following neoadjuvant therapy. Findings suggest CEDM could be considered as a potential alternative to MRI in this setting.

CLINICAL RELEVANCE/APPLICATION

CEDM may be comparable to breast MRI for evaluating size of residual malignancy in women with breast cancer following neoadjuvant therapy, thereby offering a faster and less expensive alternative to MRI.

RC215-16 Additive Benefit of Quantitative Radiomics in Distinguishing Between Benign Lesions and Luminal a Cancer Subtypes on a Large Clinical Breast MRI Dataset

Monday, Nov. 27 11:40AM - 11:50AM Room: Arie Crown Theater

Participants
Nathan S. Taylor, Wheaton, IL (*Abstract Co-Author*) Nothing to Disclose
Karen Drukker, PhD, Chicago, IL (*Abstract Co-Author*) Royalties, Hologic, Inc
Alexandra V. Edwards, Chicago, IL (*Abstract Co-Author*) Research Consultant, QView Medical, Inc; Research Consultant, Quantitative Insights, Inc
John Papaioannou, MSc, Chicago, IL (*Abstract Co-Author*) Research Consultant, QView Medical, Inc
Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Shareholder, QView Medical, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Medical Systems Corporation
Heather Whitney, PhD, Wheaton, IL (*Presenter*) Nothing to Disclose

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PURPOSE

To evaluate the benefit of including additional breast DCE-MRI characteristics beyond maximum lesion diameter in distinguishing between benign lesions and luminal A cancer subtypes.

METHOD AND MATERIALS

Magnetic resonance cases of breast lesions (212 benign, 296 luminal A) were collected under HIPAA and IRB compliance. The lesions were segmented using fuzzy-C means and radiomics features (including lesion size, shape, and margin morphology, as well as kinetics and texture) were extracted using previously reported methods. Linear discriminant analysis was performed with 10-fold cross validation using feature selection for each fold to yield a multi-feature lesion signature. Performance in the clinical task of distinguishing between benign and luminal A lesions was measured by ROC analysis with area under the curve (AUC) as the performance metric.

RESULTS

The AUC for maximum diameter alone was 0.87 +/- 0.02, compared to 0.91 +/- 0.01 for our radiomics signature. The 2-tailed p-value was 0.0003 with a 95% confidence interval for the difference in the area under the curve of [0.0195; 0.0652].

CONCLUSION

Our radiomics lesion signature demonstrated statistically significant improved performance over maximum diameter alone in the clinical task of distinguishing between benign and luminal A cancer subtype.

CLINICAL RELEVANCE/APPLICATION

A radiomics signature that includes automated lesion segmentation and extraction of multiple lesion characteristics, as compared to maximum diameter alone, has demonstrated significant improvement in distinguishing between benign lesions and luminal A breast tumors, and thus may enable translation to the clinical arena for assessing prognosis in precision medicine.

RC215-17 Breast Tumor Neoadjuvant Chemotherapy Response Prediction Based on Deep Learning Through Convolution Neural Networks Using a Breast MRI Dataset

Monday, Nov. 27 11:50AM - 12:00PM Room: Arie Crown Theater

Participants
Jenika Karcich, MD, New York, NY (*Presenter*) Nothing to Disclose
Sachin Jambawalikar, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Peter Chang, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Christine Chin, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Priya Jadeja, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Michael Z. Liu, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ralph T. Wynn, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Simukayi Mutasa, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Eduardo Pascual Van Sant, BS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Eileen Connolly, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Richard S. Ha, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We hypothesize that convolutional neural networks (CNN) can be used to predict neo-adjuvant chemotherapy (NAC) response using a breast MRI tumor dataset prior to initiation of chemotherapy.

METHOD AND MATERIALS

An IRB approved retrospective review of our database from 1/2009 to 6/2016 identified 142 locally advanced breast cancer patients who: 1) underwent breast MRI prior to the initiation of NAC; 2) successfully completed Adriamycin/Taxane-based NAC; and 3) underwent surgical resection with available final surgical pathology data. Patients were classified into 3 groups based on their NAC response confirmed on final surgical pathology: Pathologic complete response (group 1), partial response (group 2) and no response/progression (group 3). For deep learning, 142 cases were randomly separated into a training set [80% (113/142)] and test set [20% (29/142)]. For each breast MRI, tumor was identified on first T1 post contrast dynamic images and underwent 3D segmentation using an open source software platform 3D Slicer. A 32x32 patch was then extracted from the center slice of the segmented tumor data. A CNN was designed for neoadjuvant class prediction based on each of these cropped images. In brief, CNN consisted of 4 convolution layers, max-pooling layers and dropout of 0.25 after each convolution layer. Three class neoadjuvant prediction model was evaluated (group 1, group 2 or group 3). Code was implemented in open source software Keras with TensorFlow on a Linux workstation with NVIDIA GTX 1070 Pascal GPU.

RESULTS

Three class neoadjuvant prediction model was evaluated for the 3 patient groups. Group 1 consisted of 46 patients with pathologic complete response. Group 2 consisted of 57 patients with partial response. Group 3 consisted of 39 patients with no response to progression on chemotherapy. The CNN achieved an overall accuracy of 86% in 3 class prediction of neoadjuvant treatment response.

CONCLUSION

Current deep CNN architectures can be successfully trained to predict NAC treatment response using a breast MRI data set obtained prior to initiation of chemotherapy. Larger data set will further improve our prediction model.

CLINICAL RELEVANCE/APPLICATION

Deep learning through CNN can provide early prediction of a patient's treatment response to conventional therapies which can direct novel targeted cancer therapy in potential poor responders.

RSNA 2017 Explore. Invent. Transform.
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RC216

Interacting Effectively with Referring Physicians in the Digital Age

Monday, Nov. 27 8:30AM - 10:00AM Room: S404AB

PR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Max Wintermark, MD, Lausanne, Switzerland (*Moderator*) Advisory Board, General Electric Company;
Annette J. Johnson, MD, MS, Winston Salem, NC (*Presenter*) Nothing to Disclose
Andrew B. Rosenkrantz, MD, New York, NY (*Presenter*) Nothing to Disclose
Tarik K. Alkasab, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discern what referring physicians want and need from radiologists in the digital age. 2) Better implement virtual radiology rounds and other digital tools. 3) Leverage enterprise IT to improve radiology communication and collaboration.

ABSTRACT

In transitioning to a value-based practice in the digital age, it is imperative that the radiologist learn to interact efficiently and effectively with other members of the patient's healthcare team. In this course, attendees will learn how to harness the growing number of digital tools and reporting capabilities to improve their interactions with referring clinicians.

RC217

Emerging Technology: Imaging of Dementias

Monday, Nov. 27 8:30AM - 10:00AM Room: S505AB

CT MR NR NM

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

FDA Discussions may include off-label uses.

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the value of FDG brain PET/CT in differentiating various dementias in cognitive decline. 2) To discuss the value of Amyloid brain PET/CT in patients with cognitive decline and Alzheimer's disease. 3) Understand which FDA approved MR techniques are currently available for improving differential diagnosis in patients with dementia. 4) Improve basic knowledge of how MR results correspond to clinical dementia phenotypes. 5) Discuss recent technological advances including applications of dynamic susceptability contrast (DSC) MR, arterial spin labelling (ASL) and resting state functional connectivity MRI (rs-fcMRI) in the setting of patients with dementia. 6) Describe the basic science principles behind tau PET/CT imaging. 7) Understand the utility of tau PET/CT imaging in neurodegenerative disease. 8) Identify the findings of a positive tau PET/CT scan.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC217A Imaging Dementias: FDG and Amyloid PET/CT

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the value of FDG brain PET/CT in differentiating various dementias in cognitive decline. 2) To discuss the value of Amyloid brain PET/CT in patients with cognitive decline and Alzheimer's disease.

RC217B Imaging Dementias: MRI

Participants
Tammie S. Benzinger, MD, PhD, Saint Louis, MO (*Presenter*) Research Grant, Eli Lilly and Company; Investigator, Eli Lilly and Company; Investigator, F. Hoffmann-La Roche Ltd;

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LEARNING OBJECTIVES

1) Understand which FDA approved MR techniques are currently available for improving differential diagnosis in patients with dementia. 2) Improve basic knowledge of how MR results correspond to clinical dementia phenotypes. 3) Discuss recent technological advances including applications of dynamic susceptability contrast (DSC) MR, arterial spin labelling (ASL) and resting state functional connectivity MRI (rs-fcMRI) in the setting of patients with dementia.

RC217C Imaging Dementias: Tau PET/CT

Participants
Val J. Lowe, MD, Rochester, MN (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Eli Lilly and Company; Advisory Board, Merck & Co, Inc

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LEARNING OBJECTIVES

1) Describe the basic science principles behind tau PET/CT imaging. 2) Understand the utility of tau PET/CT imaging in neurodegenerative disease. 3) Identify the findings of a positive tau PET/CT scan.

RC218

Interactive Game: When Do Imaging Findings Make a Difference? (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: E352

GU MK NR OI

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

Participants
David M. Panicek, MD, New York, NY (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To recognize and review a range of potential interpretive pitfalls in oncologic imaging of the nervous, gynecologic, and musculoskeletal systems, using an interactive audience response system.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC218A Neuro

Participants
Birgit B. Ertl-Wagner, MD, Munich, Germany (*Presenter*) Author, Springer Nature; Author, Thieme Medical Publishers, Inc; Author, Bracco Group; Spouse, Stockholder, Siemens AG; ;

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LEARNING OBJECTIVES

1) To comprehend the importance of signs in neuroimaging for diagnostic decision making. 2) To understand in which instances imaging findings have a direct consequence for therapeutic decision making. 3) To appreciate the therapeutic consequences of selected neuroimaging findings.

RC218B Musculoskeletal

Participants
David M. Panicek, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Assess imaging features that facilitate specific diagnoses of musculoskeletal lesions. 2) Describe scenarios in which various imaging features of musculoskeletal lesions lead to more accurate tumor staging and treatment response assessment. 3) Detect musculoskeletal complications of tumors and their treatment.

RC218C Pelvis

Participants
Caroline Reinhold, MD, MSc, Montreal, QC (*Presenter*) Consultant, GlaxoSmithKline plc

LEARNING OBJECTIVES

1) Understand the role of imaging in the management of gynaecological malignancies.2) Assess imaging features that allow accurate staging of gynaecological malignancies.3) Be familiar with pitfalls that can result in staging errors using imaging.4) Understand the changes in imaging appearance post treatment.

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/ Caroline Reinhold, MD, MSc - 2013 Honored EducatorCaroline Reinhold, MD, MSc - 2014 Honored EducatorCaroline Reinhold, MD, MSc - 2017 Honored Educator

RC220

Fundamentals of Imaging for the Radiation Oncologist

Monday, Nov. 27 8:30AM - 10:00AM Room: E261

OI RO

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

Participants
Matthew M. Harkenrider, MD, Maywood, IL (*Moderator*) Nothing to Disclose

Sub-Events

RC220A Fundamentals in Radiation Oncology Imaging of Gynecologic Cancer

Participants
Eric Leung, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

eric.leung@sunnybrook.ca

LEARNING OBJECTIVES

1) To review imaging modalities for the assessment and management of gynecological cancers. 2) To gain an understanding of new imaging techniques for radiation treatment planning in gynecological cancers. 3) To review three-dimensional image-guided brachytherapy techniques and modalities. 4) To gain an understanding in functional imaging and its role in gynecological radiation oncology.

RC220B Fundamentals in Radiation Oncology Imaging of Gastrointestinal Cancer

Participants
Salma Jabbour, MD, New Brunswick, NJ (*Presenter*) Research funded, Merck & Co, Inc

For information about this presentation, contact:

jabbousk@cinj.rutgers.edu

LEARNING OBJECTIVES

1) Comprehend imaging modalities used in the upper GI tract pertaining to patterns of spread and target delineation. 2) Evaluate imaging modalities useful in the post-radiotherapy setting.

RC220C Fundamentals in Radiation Oncology Imaging of Skull Base Cancer

Participants
Lia M. Halasz, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify helpful imaging modalities and techniques for contouring skull base tumors. 2) Obtain helpful tips for accurate target delineation for radiation treatment planning. 3) Recognize the challenge of response assessment in imaging skull base tumors after radiation therapy.

RC220D Fundamentals in Radiation Oncology Imaging of Head and Neck Cancer

Participants
Min Yao, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

min.yao@uhhospitals.org

LEARNING OBJECTIVES

1) Review imaging modalities in treatment planning in head and neck cancer. 2) Review FDG-PET in assessment of treatment response in head and neck cancer. 3) Review images as prognostic indicators.

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RC221

Advances in CT: Technologies, Applications, Operations-Spectral CT

Monday, Nov. 27 8:30AM - 10:00AM Room: S102CD

CT PH

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

Participants
Ehsan Samei, PhD, Durham, NC (*Coordinator*) Research Grant, General Electric Company; ; Research Grant, Siemens AG; ; Advisory Board, medInt Holdings, LLC
Norbert J. Pelc, DSc, Stanford, CA (*Coordinator*) Research support, Koninklijke Philips NV; Research support, General Electric Company; Research support, Siemens AG; Consultant, Varian Medical Systems, Inc; Consultant, NanoX; Scientific Advisory Board, RefleXion Medical Inc; Scientific Advisory Board, Prismatic Sensors AB; Scientific Advisory Board, Theranos, Inc; Medical Advisory Board, OurCrowd, LP

For information about this presentation, contact:

samei@duke.edu

Sub-Events

RC221A Data Acquisition and Image Formation Methods for Multi-Energy CT

Participants
Cynthia H. McCollough, PhD, Rochester, MN (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

mccollough.cynthia@mayo.edu

LEARNING OBJECTIVES

1) Understand the various methods used to acquire multi-energy CT data. 2) Comprehend the different methods used to present the information obtained with multi-energy CT.

Active Handout:Cynthia H. McCollough

http://abstract.rsna.org/uploads/2017/16001048/Active RC221A.pdf

RC221B Applications

Participants
Sebastian T. Schindera, MD, Riehen, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the various clinical applications of multi-energy CT. 2) Discuss the most important challenges of multi-energy CT in clinical routine. 3) Identify future opportunities of multi-energy CT.

RC221C Future Prospects—Photon Counting

Participants
Taly G. Schmidt, PhD, Milwaukee, WI (*Presenter*) Research Grant, General Electric Company

For information about this presentation, contact:

tal.gilat-schmidt@marquette.edu

LEARNING OBJECTIVES

1) Understand the potential benefits and current status of photon-counting detection for Spectral CT. 2) Understand the challenges of photon-counting Spectral CT.

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RC222

Imaging for Personalized Medicine: Thorax

Monday, Nov. 27 8:30AM - 10:00AM Room: S103AB

CH PH

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

Participants
Martha M. Matuszak, PhD, Ann Arbor, MI (*Moderator*) Research Grant, Varian Medical Systems, Inc

Sub-Events

RC222A Anatomical Imaging for Personalized Medicine in the Thorax

Participants
Geoffrey Hugo, PhD, Richmond, VA (*Presenter*) Research Grant, Koninklijke Philips NV; Research Grant, Varian Medical Systems, Inc

For information about this presentation, contact:

gdhugo@vcu.edu

LEARNING OBJECTIVES

1) Understand how respiration impacts radiotherapy imaging and delivery and how to implement strategies to mitigate these issues on a patient-specific basis. 2) Understand types and magnitude of geometric changes in thoracic anatomy during radiotherapy, and determine approaches to correct for discrepancies between the planned and delivered dose to the patient.

ABSTRACT

Radiotherapy is in widespread use for both early and advanced stage lung cancer, as a sole modality and also in combination with other modalities such as chemotherapy. Due to the potential for both acute and late toxicities in organs adjacent to treated regions, modern techniques seek to limit the extent of the high dose volume. The purpose of this session is to develop an understanding for how geometric and anatomic changes during radiotherapy can be managed. The focus will be on solutions readily available in the clinic today, particularly with respect to imaging modalities and planning solutions.

RC222B Functional Imaging for Targeting and Adaptation in the Thorax

Participants
Martha M. Matuszak, PhD, Ann Arbor, MI (*Presenter*) Research Grant, Varian Medical Systems, Inc

For information about this presentation, contact:

marthamm@med.umich.edu

LEARNING OBJECTIVES

1) Understand the opportunities for targeting and avoidance based on functional imaging in lung. 2) Discuss the technical details of functional targeting for tumor and functional avoidance in normal tissue for lung cancer in the pre-treatment and adaptive settings.

ABSTRACT

Radiation therapy continues to play an important role in the treatment of lung cancer although many opportunities remain to improve local control and survival as well as reduce toxicity, especially in advanced stage lung cancer. The use of functional imaging and biomarkers to predict tumor burden and response as well as measure and predict normal tissue toxicity has begun to increase in the community. This session aims to summarize the different modalities and types of information available to perform functional targeting or avoidance of tumor and normal tissue in lung cancer, including imaging (such as PET and SPECT) and other data (such as blood-based biomarkers). The session will also highlight the technical details associated with the use of functional data for treatment planning, treatment response, and adaptation.

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RC223

Update on the Maintenance of Certification Program (MOC) for ABR Medical Physics Diplomates

Monday, Nov. 27 8:30AM - 10:00AM Room: E263

ED PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
G. Donald Frey, PhD, Charleston, SC (*Director*) Nothing to Disclose
G. Donald Frey, PhD, Charleston, SC (*Presenter*) Nothing to Disclose
James A. Seibert, PhD, Sacramento, CA (*Presenter*) Advisory Board, Bayer AG
Matthew B. Podgorsak, PhD, Buffalo, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) The participant will understand the importance of the MOC program for medical physicists. 2) The participant will understand the Part 1, Part 2 & Part 4 requirements and how the simplified attestation process works. 3) The participant will understand how the replacement of the decennial exam with the on-line longitudinal assessment program will work. 4) The participant understand what is necessary for the annual evaluation.

ABSTRACT

The ABR MOC program has undergone many changes in the last few years. This talk will review the importance of the MOC program for maintaining clinical skills and the changes concerning the MOC program. These include simplified attestation for Part 1 - Professional Standing, Part 2 - Lifelong Learning and Part 4 - Process Quality Improvement. The new On-line Longitudinal Assessment (OLA) program that will replace the decennial exam will also be discussed. The speakers will also explain how the annual evaluation program works and how a diplomate can restore their status if the fall behind.

RC224

A Primer of Primaries

Monday, Nov. 27 8:30AM - 10:00AM Room: S104A

OI

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

Participants
Mark D. Murphey, MD, Berkeley, CA (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the typical clinical and pathological features that allow distinction of common malignancies in multiple organ systems. 2) Define the characteristic imaging patterns that are important to differentiate common primary malignancies in multiple organ systems. 3) Understand the pathological basis for imaging patterns of common malignancies in multiple organ systems.

ABSTRACT

Common primary malignancies in numerous organ systems will be reviewed. These include molecular subtypes of breast cancer, hepatocellular carcinoma, cholangiocarcinoma, renal cell carcinoma, lung cancer, glioma, neuroblastoma and chondrosarcoma. These diseases often reveal a characteristic appearence on imaging, reflecting their pathology which is emphasized in a multiorgan multimodality approach.

Sub-Events

RC224A Imaging of Molecular Subtypes of Breast Cancer

Participants
Jennifer A. Harvey, MD, Charlottesville, VA (*Presenter*) Research Grant, Hologic, Inc Stockholder, Hologic, Inc Research Grant, Volpara Health Technologies Limited Stockholder, Volpara Health Technologies Limited

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC224B Primary Liver Tumors

Participants
Maria A. Manning, MD, Silver Spring, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC224C Renal Cell Carcinoma

Participants
Darcy J. Wolfman, MD, Washington, DC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dwolfma1@jhmi.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC224D Adenocarcinoma of the Lung: A Changing Entity

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC224E Glioma

Participants
Kelly K. Koeller, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Highlight characteristic imaging appearances of glial neoplasms and their correlation with gross pathology and histopathology. 2) Introduce important revisions to the 2016 WHO classification of glial neoplasms, emphasizing molecular markers.

RC224F Neuroblastoma

Participants
Ellen M. Chung, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ellen.chung@usuhs.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC224G Imaging of Chondrosarcoma and Distinction from Enchondroma

Participants
Mark D. Murphey, MD, Berkeley, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

Honored Educators

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RC225

Radiomics: Mini-Course: Oncologic Applications

Monday, Nov. 27 8:30AM - 10:00AM Room: S404CD

BQ OI PH

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

FDA Discussions may include off-label uses.

Participants
Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Coordinator*) Institutional research agreement, Siemens AG; ; ; ; ;
Sandy Napel, PhD, Stanford, CA (*Coordinator*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc; Scientific Advisor, RADLogics, Inc

For information about this presentation, contact:

snapel@stanford.edu

Sub-Events

RC225A Breast Cancer with PET-CT

Participants
Richard L. Wahl, MD, Saint Louis, MO (*Presenter*) Consultant, Nihon Medi-Physics Co, Ltd; Contract, WhiteRabbit.AI Inc; ;

LEARNING OBJECTIVES

1) Which type of breast cancer is the most glycolytically active as measured by FDG PET/CT. 2) At least one method of assessing quantitative changes in FDG PET SUV during therapy. 3) Three radiomic features of breast cancer on FDG PET which may have prognostic significance.

ABSTRACT

Breast cancer can be imaged using PET/CT in a qualitative and a quantitative fashion. A single quantitative 'radiomic feature' SUVmax is but one of the many quantitative metrics which can be extracted from FDG PET images.This feature is associated with biological differences reflecting thebreast cancer genotype and phenotype. More complex features can be extracted and, at least when when assessed on correlated anatomic images, may be related to outcomes-- especially a feature of tumor heterogenity at baseline being associated with less favorable outcomes. More complex features are uncertain in their prognostic value. Changes in simple parameters like SUL peak are associated with outcomes of therapy and have been integrated into the PERCIST 1.0 formulation for treatment response. With other tracers such as NaF, features can also be identified, but the signal with this tracer is complicated by its indirect linkage to tumor and its more strong linkage to tumor induced remodeling. Other non FDA approved tracers such as FES and FLT can reflect biological features of tumors and simple quantiative analysis are associated with tumor phenotypes and genotypes. Radiomics in breast cancer as related to PET/CT (and PET/MRI) is in its infancy, but it is anticipated that a more thorough exploration of stable radiomic features obtained with a variety of tracers may ultimately inform the managerment of individual patients with breast cancer.

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RC225B Radiogenomics of Lung Cancer

Participants
Neema Jamshidi, MD, PhD, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

njamshidi@mednet.ucla.edu

LEARNING OBJECTIVES

1) Have a general knowledge of oncologic radiogenomics. 2) Have an understanding of progress made to date and the current status of lung cancer radiogenomics. 3) Appreciate the next steps and advancements that will be required for clinical deployment of lung cancer imaging genomics applications.

RC225C Brain Cancer: Radiomics, Radiogenomics, and Big Data

Participants
Rivka R. Colen, MD, Houston, TX (*Presenter*) Research Grant, General Electric Company;

LEARNING OBJECTIVES

1) Define and understand the keys concepts of radiomics. 2) Understand the basic concepts of radiogenomics. 3) Understand the basic analytical algorithms that are used for big data analysis and integration. 4) Know and review of of the selected important publications and literature on radiomics and radiogenomics in brain cancer.

ABSTRACT

Radiogenomics is the linkage of imaging features with genomics of tumor or tissue. In the case of cancer, radiogenomics seeks to link imaging features with the genomic composition of the tumor and/or key genomic events. Radiomics, on the other hand, are defined as imaging features that are extracted using an automated approach using multiple computational analytical methods; these are typically seen with texture analysis and go beyond the resolution of the human eye. Given that thousand of imaging features, and if combined with genomics, are extracted, we are confronted with a 'big data' problem. Numerous statitstical and machine learning approaches that deal with large data analysis can be applied to radiomics and radiogenomics.

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RC227

24 Hour Attending Coverage: Has the Time Come?

Monday, Nov. 27 8:30AM - 10:00AM Room: E353B

HP LM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Howard P. Forman, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Hani H. Abujudeh, MD, MBA, Camden, NJ (*Presenter*) Royalties from books
Jonathan Mezrich, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Michael A. Bruno, MD, Hershey, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mbruno@pennstatehealth.psu.edu

LEARNING OBJECTIVES

1) To understand the clinical, economic, medicolegal, strategic and policy factors to consider when initiating or expanding 24 hour attending coverage vs. overnight resident coverage with faculty oversight. 2) To understand how 24 hour coverage becomes more important as we move toward alternative/advanced payment models. 3) To understand operational and fiscal challenges and solutions to implementing 24 hour coverage. 4) To understand the potential negative impacts to resident education and patient safety that a switch to 24 hour attending coverage may inadvertently create. 5) At the completion of the course the learner will be better able to assess if a change to 24 hour radiology attending coverage is right for them and their institution, and be better prepared to meet the challenges inherent in implementing such a change. *New in 2017: PLEASE NOTE* - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

ABSTRACT

Active Handout:Michael Andrew Bruno

http://abstract.rsna.org/uploads/2017/17000099/Active RC227.pdf

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RC229

MRI Safety Issue for Implants, Devices, and Contrast: Update 2017 (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: E451A

MR SQ

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

FDA Discussions may include off-label uses.

Participants
Jeffrey C. Weinreb, MD, New Haven, CT (*Moderator*) Consultant, Bracco Group;

For information about this presentation, contact:

jeffrey.weinreb@yale.edu

LEARNING OBJECTIVES

1) Understand the various MRI issues that impact passive and active, implants and devices. 2) Define the terms applied to MRI labeling of implants and devices. 3) Appreciate the controversies that exist for certain implants and understand the latest labeling information for implanted medical products. 4) Describe current data about safety of gadolinium-based contact agents. 5) Compare the association of various GBCAs with NSF and gadolinium retention. 6) Review updated recommendations about use of gadolinium-based contrast agents. 7) Through case presentation format multiple common clinical scenarios will be presented that reflect potential MRI safety events.8) Best practices and literature will be reviewed to inform participants on how to best address these scenarios with an emphasis on MR and patient safety principles.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC229A MRI Safety for Implants and Devices

Participants
Frank G. Shellock, PhD, Playa Del Rey, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the various MRI issues that impact passive and active, implants and devices. 2) Define the terms applied to MRI labeling of implants and devices. 3) Appreciate the controversies that exist for certain implants and understand the latest labeling information for implanted medical products.

RC229B Update on the Risks of Gadolinium-Based Contrast Agents

Participants
Jeffrey C. Weinreb, MD, New Haven, CT (*Presenter*) Consultant, Bracco Group;

For information about this presentation, contact:

jeffrey.weinreb@yale.edu

LEARNING OBJECTIVES

1) Describe current data about safety of gadolinium-based contact agents. 2) Compare the association of various GBCAs with NSF and gadolinium retention. 3) Review updated recommendations about use of gadolinium-based contrast agents.

RC229C Common Clinical MRI Safety Scenarios

Participants
Jay K. Pahade, MD, New Haven, CT (*Presenter*) Consultant, Precision Imaging Metrics, LLC

LEARNING OBJECTIVES

1) Through case presentation format multiple common clinical scenarios will be presented that reflect potential MRI safety events. 2) Best practices and literature will be reviewed to inform participants on how to best address these scenarios with an emphasis on MR and patient safety principles.

RC229D Questions and Answers

Participants
Frank G. Shellock, PhD, Playa Del Rey, CA (*Presenter*) Nothing to Disclose
Jay K. Pahade, MD, New Haven, CT (*Presenter*) Consultant, Precision Imaging Metrics, LLC
Jeffrey C. Weinreb, MD, New Haven, CT (*Presenter*) Consultant, Bracco Group;

For information about this presentation, contact:

jeffrey.weinreb@yale.edu

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RC231

Hands-on Musculoskeletal Ultrasound: A Forum for Question and Answer (Hands-on)

Monday, Nov. 27 8:30AM - 10:00AM Room: E258

MK US

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

Participants
Marnix T. van Holsbeeck, MD, Detroit, MI (*Presenter*) Consultant, General Electric Company; Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder MedEd3D; Grant, Siemens AG; Grant, General Electric Company;
Joseph H. Introcaso, MD, Neenah, WI (*Presenter*) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

marnix@rad.hfh.edu

LEARNING OBJECTIVES

1) Recognize and identify pitfalls of scanning that lead to false positive or false negative musculoskeletal ultrasound results. 2) Perform skills for scanning difficult patients. 3) Follow rigorous protocols for the examination of different anatomic regions. 4) Position patients for more complicated musculoskeletal ultrasound examinations. 5) Recognize and integrate the importance of tissue movement in judging the functionality of the extremities.

ABSTRACT

In this Musculoskeletal Ultrasound Master class, an opportunity will be given to participants to start a written dialogue in advance to RSNA 2017. The electronically submitted questions will be sorted by instructors and organized per topic. A select number of recurrent themes in these questions will be prepared for dialogue on stage. When the questions focus on a particular scanning skill, the authors of the questions will be invited on the examination platform to show problems they encounter in their practice. By using a step-by step approach in solving the scanning issues, all who are present should benefit from the technical interactions on stage. Cameras will project scanning details on large screens. The seating in the class will guarantee close proximity for an enriching interaction between audience and stage. If you plan to attend this session and you want your questions answered please contact us soon as possible at marnix@rad.hfh.edu

RC232

Diversity and Inclusion: Leadership Imperatives and Opportunities in the Radiological Professions

Monday, Nov. 27 8:30AM - 10:00AM Room: S503AB

LM

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

Participants
Johnson B. Lightfoote, MD, MBA, Pomona, CA (*Coordinator*) Nothing to Disclose

For information about this presentation, contact:

Lightfoote@msn.com

LEARNING OBJECTIVES

1) Understand the current state of diversity in the radiological profession with respect to race, gender, and ethnicity, and describe trends. 2) Compare representation of diverse groups among our service populations, and various stages of education and seniority in the radiological professions. 3) Cite examples of successful diversity initiatives from outside the radiological professions. 4) Identify critical success factors for diversity and inclusion initiatives in industry, government and academia. 5) Describe appropriate goals, objectives, and resource requirements for a diversity and inclusion program. 6) Design, implement and measure a diversity and inclusion program in the learner's institution.

ABSTRACT

Diversity and inclusion have become top-of-mind imperatives for leaders of organizations that serve an increasingly diverse American population. The current representation of groups in our population in the radiologic professions will be reviewed, with special reference to women and people underrepresented in medicine. Comparisons with the general population, other industries, other medical specialties, and at various stages of radiology training and seniority are illuminating. Enterprises beyond the radiological professions provide signal examples of successful diversity and inclusion initiatives. Identifying imperatives and opportunities for improving the diversity and responsiveness of our professional workforce is a central task of effective top leadership in radiology. Illustration and discussion will focus on initiating, designing, implementing and measuring a diversity, inclusion and representation program for a radiological professions organization.

Sub-Events

RC232A The State of Diversity, Inclusion and Representation in Radiology and Radiation Oncology: History, Trends, and Where We Are Today

Participants
Curtiland Deville, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the trends in historical and current representation. 2) To identify the potential barriers to diversity and inclusion in training and advancement. 3) To address potential interventions and solutions.

RC232B Leveraging Diversity and Inclusion: Leadership Lessons from Outside the House of Radiology

Participants
Johnson B. Lightfoote, MD, MBA, Pomona, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Lightfoote@msn.com

LEARNING OBJECTIVES

1) Describe socioeconomic imperatives prompting organizations to expand their diversity and inclusiveness. 2) Identify the benefits of a diverse workforce and inclusive culture for private and public enterprises outside the House of Radiology. 3) Specify industries, companies, and academic institutions which have implemented diversity, representation and inclusion programs. 4) Specify health care services, medical specialty, and medical education organizations which have developed diversity, representation and inclusion programs. 5) Define the critical success factors for a successful diversity and inclusion initiative. 6) Compare the impetus, methods and outcomes in diversity and inclusion initiatives in non-radiology organizations with practices and programs within the radiological professions. 7) Appraise the diversity and inclusiveness of organizations, particularly the learner's own organization. 8) Formulate diversity and inclusiveness initiatives for an organization, particularly the learner's own organization.

ABSTRACT

Maturing, successful and advancing organizations universally recognize the importance of a diverse workforce, and the value of including and representing constituents in their operations. The radiological professions can inform their own diversity initiatives by reviewing the success and cautionary tales from private enterprise, government, academic institutions, health care organizations, medical education organizations, and other medical specialty societies. Critical success factors include (a) primary commitment of top leadership, (b) committed resources, and (c) measurable process goals. Clinical radiologists and practice leaders have an

opportunity to imitate the success of enterprises outside the House of Radiology, and to leverage those lessons to improve the effectiveness of their own imaging, intervention and radiation oncology practices.

RC232C Creating and Leading Successful Diversity Initiatives in the Radiological Professions: A Call to Action

Participants
Karen M. Winkfield, MD, PhD, Winston-Salem, NC (*Presenter*) Consultant, Novartis AG

LEARNING OBJECTIVES

1) Explain why diversity and inclusion are critical for top management in leading medical organizations. 2) Discuss the 3-step ("Triple A") approach to creating a more inclusive work environment.3) Identify available resources to assist with the development of a diverse and inclusive organization.

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RC250

Fallopian Tube Catheterization (Hands-on)

Monday, Nov. 27 8:30AM - 10:00AM Room: E260

GU OB IR

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

FDA Discussions may include off-label uses.

Participants
Amy S. Thurmond, MD, Portland, OR (*Presenter*) Nothing to Disclose
Ronald J. Zagoria, MD, San Francisco, CA (*Presenter*) Consultant, ReCor Medical, Inc
A. Van Moore JR, MD, Charlotte, NC (*Presenter*) Nothing to Disclose
Anne C. Roberts, MD, La Jolla, CA (*Presenter*) Nothing to Disclose
David M. Hovsepian, MD, Stanford, CA (*Presenter*) Nothing to Disclose
James E. Silberzweig, MD, New York, NY (*Presenter*) Nothing to Disclose
Lindsay S. Machan, MD, Vancouver, BC (*Presenter*) Stockholder, Analytics for Life, Inc Stockholder, Calgary Scientific, Inc Stockholder, Endologix, Inc Stockholder, Harmonic Medical Stockholder, IKOMED Technologies Inc Stockholder, Innovere Medical Inc Stockholder, NDC, Inc
Maureen P. Kohi, MD, Tiburon, CA (*Presenter*) Research Grant, Boston Scientific Corporation; Consultant, Sirtex Medical Ltd; Consultant, LaForce;

For information about this presentation, contact:

Maureen.kohi@ucsf.edu

LEARNING OBJECTIVES

1) Obtain hands-on experience with fallopian tube catheterization using uterine models and commercially available catheters and guidewires. 2) Review the evolution of interventions in the fallopian tubes. 3) Learn safe techniques for fallopian tube recanalization for promoting fertility, and fallopian tube occlusion for preventing pregnancy. 4) Discuss the outcomes regarding pregnancy rate and complications. 5) Appreciate ways to improve referrals from the fertility specialists and expand your practice.

ABSTRACT

Fallopian tube catheterization using fluoroscopic guidance is a relatively easy, inexpensive technique within the capabilities of residency trained radiologists. Fallopian tube cathterization can be used to dislodge debris from the tube in women with infertility,or to place FDA-approved tubal occlusion devices in women who do not desire fertility. The fallopian tube is the 1 mm gateway between the egg and the sperm. Noninvasive access to this structure for promoting, and preventing, pregnancy has been sought for over 160 years. This hands-on course allows participants use commercially available catheters and devices in plastic models for fallopian tube catheterization, and to speak directly to world experts about this exciting procedure.

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RC252

Techniques for Interventional Sonography and Thermal Ablation (Hands-on)

Monday, Nov. 27 8:30AM - 10:00AM Room: E264

US IR

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

Participants
Stephen C. O'Connor, MD, Boston, MA (*Presenter*) Nothing to Disclose
Veronica J. Rooks, MD, Tripler AMC, HI (*Presenter*) Nothing to Disclose
Kristin M. Dittmar, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Carmen Gallego, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Mabel Garcia-Hidalgo Alonso, MD, Majadahonda, Spain (*Presenter*) Nothing to Disclose
Hollins P. Clark, MD, Winston Salem, NC (*Presenter*) Research Consultant, Galil Medical Ltd
James W. Murakami, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Sara E. Zhao, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose
William W. Mayo-Smith, MD, Boston, MA (*Presenter*) Author with royalties, Reed Elsevier;
Jeremiah J. Sabado, MD, Kennett Square, OH (*Presenter*) Nothing to Disclose
John D. Lane, MD, Bayside, WI (*Presenter*) Nothing to Disclose
Neil T. Specht, MD, Trumbull, CT (*Presenter*) Nothing to Disclose
Manish N. Patel, DO, Cincinnati, OH (*Presenter*) Nothing to Disclose
Yassine Kanaan, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Njogu Njuguna, MD, Springfield, MA (*Presenter*) Nothing to Disclose
Robert M. Marks, MD, San Diego, CA (*Presenter*) Nothing to Disclose

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manish.patel@cchmc.org

LEARNING OBJECTIVES

1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography. 2) Discuss and perform basic skills involved in thermal tumor ablation in a live learning model. 3) Perform specific US-guided procedures to include core biopsy, abscess drainage, vascular access, cyst aspiration, soft tissue foreign body removal, and radiofrequency tumor ablation. 4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

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RC253

Value-based Imaging in the ACO Model

Monday, Nov. 27 8:30AM - 10:00AM Room: S403B

HP IN

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

Participants
James Whitfill, MD, Scottsdale, AZ (*Moderator*) President, Lumetis, LLC; Speaker, FUJIFILM Holdings Corporation;
James Whitfill, MD, Scottsdale, AZ (*Presenter*) President, Lumetis, LLC; Speaker, FUJIFILM Holdings Corporation;
Rodney S. Owen, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose
Gary H. Dent, MD, Macon, GA (*Presenter*) Officer, Radius, LLC; Stockholder, Radius, LLC;

For information about this presentation, contact:

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ROwen@eSMIL.com

LEARNING OBJECTIVES

1) Review the forces at work which are pushing the US Healthcare system to adopt value based care models. 2) Learn the mechanisms currently used to contract for value based care contracts. 3) Learn how imaging and radiology currently relate to new value based care models. 4) Hear from radiologists who are active leaders in value based models in their community.

ABSTRACT

The march towards value based care is a confusing one with fits and starts. Hear from several physicians who have come from a radiology background and have successfully engaged in larger efforts to advance their community's efforts at value based care. A key concept is that while radiology has an unclear role in current value based payment models, radiologists and radiology leaders have essential skillsets which make them sought after members of any valued based organization.

RC254

Structured Reporting and the RSNA/ESR Reporting Initiative

Monday, Nov. 27 8:30AM - 10:00AM Room: N229

IN

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

Participants
Marta E. Heilbrun, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how to implement structured reporting across your department to make radiology reports more consistent and improve quality. 2) Describe national and international efforts to share best-pracitce radiology report templates. 3) Explore how RSNA's reporting initiative adds value to the healthcare enterprise.

Sub-Events

RC254A Successfully Implementing a Department-Wide Standardized Reporting Program

Participants
David B. Larson, MD, MBA, Stanford, CA (*Presenter*) Grant, Siemens AG; Grant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Understand critical interpersonal elements to consider in implementing and managing a department-wide standardized structured report program. 2) Understand the technical challenges associated with implementing and managing a department-wide standardized structured report program.

ABSTRACT

Modern voice recognition technology has made department-wide standardized structured reporting feasible. However, the most significant challenges often lie in the interpersonal and organizational aspects.The author will discuss his experience in implementing and maintaining department-wide standardized structured reporting programs at two academic institutions, highlighting critical steps, major pitfalls, and strategies for success. The session will focus on those who might wish to develop department-wide structured reporting programs at their own institutions.

Honored Educators

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RC254B Radiology Reporting in the Age of Precision Medicine

Participants
Charles E. Kahn JR, MD, MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ckahn@upenn.edu

LEARNING OBJECTIVES

1) Understand the background and rationale for RSNA's reporting initiative. 2) Describe recent advances in the technologies for radiology reporting. 3) Explore how reporting can add augment radiology's value to the healthcare enterprise. 4) Envision the latest directions and opportunities for radiology reporting.

ABSTRACT

Since 2007, the RSNA has taken a leading role in developing tools and clinical content to help radiologists improve their reporting practices. RSNA's library of best-practice reporting templates (www.radreport.org) has seen more than 2 million views and downloads. The "Management of Radiology Report Templates" (MRRT) profile and a DICOM standard for transmitting template-based reports into the electronic health record (EHR) have been recently developed. These standards, and a set of tools that use them, provide new opportunities for information from radiology reports to be integrated into the clnical enterprise. The "Open Template Library" (open.radreport.org) allows any RSNA member to contribute report templates, and the open-source "T-Rex" template editor simplifies the editing process. Through partnerships with other organizations, RSNA is seeking to improve and extend these approaches. This presentation will highlight recent advances and new directions in radiology reporting.

Honored Educators

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https://www.rsna.org/Honored-Educator-Award/ Charles E. Kahn JR, MD, MS - 2012 Honored Educator

RC254C radreport.org: Publishing Your Templates

Participants
Marta E. Heilbrun, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how to share templates on open.radreport.org Know how templates from open.radreport.org are promoted to radreport.org. 2) Describe the active collaborations with the European Society of Radiology (ESR) and other societies with the RSNA structured reporting effort.

ABSTRACT

As a component of the RSNA structured reporting initiative a select template library was created and is available at www.radreport.org. In order to facilitate the exchange of templates and to identify best practices, a resource for hosting templates created by RSNA members and affiliated societies has been created at the www.open.radreport.org site. This presentation will walk the audience through the process for sharing templates on open.radeport.org and using the T-Rex editor to create MRRT templates. Additionally, the activities of the Template Library Advisory Panel (TLAP), a joint collaboration between the RSNA and the ESR will be described. The TLAP is responsible for promoting the crowd-sourced templates to the the select template library will be described.

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RCA21

3D Printing Hands-on with Open Source Software: Introduction (Hands-on)

Monday, Nov. 27 8:30AM - 10:00AM Room: S401AB

IN

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

Participants
Michael W. Itagaki, MD, MBA, Lynnwood, WA (*Presenter*) Owner, Embodi3D, LLC
Beth A. Ripley, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose
Tatiana Kelil, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Carissa M. White, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Dmitry Levin, Seattle, WA (*Presenter*) Nothing to Disclose
Steve D. Pieper, PhD, Cambridge, MA (*Presenter*) CEO, Isomics, Inc; Employee, Isomics, Inc; Owner, Isomics, Inc; Research collaboration, Siemens AG; Research collaboration, Novartis AG; Consultant, Harmonus; Research collaboration, gigmade
Anish Ghodadra, MD, New Haven, CT (*Presenter*) Consultant, PECA Labs; Advisory Board, axial3D Limited

For information about this presentation, contact:

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aghodadramd@gmail.com

LEARNING OBJECTIVES

1) To learn about basic 3D printing technologies and file formats used in 3D printing. 2) To learn how to segment a medical imaging scan with free and open-source software and export that anatomy of interest into a digital 3D printable model. 3) To perform basic customizations to the digital 3D printable model with smoothing, text, cuts, and sculpting prior to physical creation with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a physical object from a digital file with layer-by-layer deposition instead of conventional machining, and allows for creation of complex geometries, including anatomical objects derived from medical scans. 3D printing is increasingly used in medicine for surgical planning, education, and device testing. The purpose of this hands-on course is to teach the learner to convert a standard Digital Imaging and Communications in Medicine (DICOM) data set from a medical scan into a physical 3D printed model through a series of simple steps using free and open-source software. Basic methods of 3D printing will be reviewed. Initial steps include viewing and segmenting the imaging scan with 3D Slicer, an open-source software package. The anatomy will then be exported into stereolithography (STL) file format, the standard engineering format that 3D printers use. Then, further editing and manipulation such as smoothing, cutting, and applying text will be demonstrated using MeshMixer and Blender, both free software programs. Methods described will work with Windows, Macintosh, and Linux computers. The learner will be given access to comprehensive resources for self-study before and after the meeting, including an extensive training manual and online video tutorials.

Active Handout:Michael Ward Itagaki

http://abstract.rsna.org/uploads/2017/14003455/Active RCA12.pdf

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RCC21

Interoperability - Imaging and Beyond: IHE, Standards and The RSNA Image Share

Monday, Nov. 27 8:30AM - 10:00AM Room: S501ABC

IN

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

Participants

David S. Mendelson, MD, Larchmont, NY (*Moderator*) Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Medical Systems Corporation Advisory Board, Bayer AG
David S. Mendelson, MD, Larchmont, NY (*Presenter*) Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Medical Systems Corporation Advisory Board, Bayer AG
Didi Davis, Knoxville, TN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the importance of interoperability throughout healthcare. 2) Understand the importance of standards to ensure interoperability. 3) Understand the role of IHE profiles in defining workflows and the applicable standards including XDS and XDS-I. 4) Learn about real world implementations including Health Information Exchanges (The Sequoia Project) including Personal Health Records (The RSNA Image Share). 5) Learn the status of the RSNA Image Share and the RSNA Image Share Validation Program.

ABSTRACT

This course will focuson HIT inteoperability and its importance in providing for the optimal care of patients. The session will start with a review of standards and the role of IHE. The goals and operation of the RSNA Image Share Validation Program will be discusses as well as the validation process itself. The discussion will then move to a discussion of HIEs focused on The Sequoia Project (Heatlheway and Carequality) as well as other HIEs.

Active Handout:Didi Davis

http://abstract.rsna.org/uploads/2017/13013137/Active RCC21.pdf

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MSAS22

MACRA, MIPS and Money (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Monday, Nov. 27 10:30AM - 12:00PM Room: S105AB

HP

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

Participants
Patricia Kroken, Albuquerque, NM (*Moderator*) Nothing to Disclose
Kendra Huber, RT, BS, Castle Rock, CO (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

pkroken@comcast.net

Sub-Events

MSAS22A How Winners and Losers Will Be Decided and What You Can Do

Participants
Claudia A. Murray, Harrisburg, PA (*Presenter*) Nothing to Disclose
Don Good, New Market, MD (*Presenter*) President, InContext

For information about this presentation, contact:

cmurray@msnllc.com

LEARNING OBJECTIVES

1) The Quality Payment Program with an emphasis on the four elements that comprise the MIPS program. 2) The basic scoring structure of the quality measures and the inherent challenges with that structure, especially as it pertains to topped out measures. 3) Two radiology group practice case studies, examining the options available to them, the path they chose, and the outcomes to see who will win and who will lose.

ABSTRACT

The Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) replaced the Medicare Part B Sustainable Growth Rate (SGR) reimbursement formula with a new, value-based reimbursement system. The intent is to tie 90% of Medicare payments to quality or value by 2018. How? MACRA introduced the Quality Payment Program (QPP), which provides two paths for Eligible Clinicians (ECs) to earn Medicare Part B reimbursement: • Alternative Payment Models (APMs) • Merit-based Incentive Payment System (MIPS) Most Medicare providers will participate in MIPS. Though much of MIPS is based on the Physician Quality Reporting System (PQRS) and the Value Based Modifier (VBM) programs, there are significant differences, especially in the scoring. A well-defined strategy and a strong implement plan are necessary to be successful in MIPS.

MSCM22

Case-based Review of Magnetic Resonance (An Interactive Session)

Monday, Nov. 27 10:30AM - 12:00PM Room: S100AB

MR

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

Participants
Jorge A. Soto, MD, Boston, MA (*Director*) Royalties, Reed Elsevier

Sub-Events

MSCM22A MRI of the Genitourinary System

Participants
Christine O. Menias, MD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

menias.christine@mayo.edu

LEARNING OBJECTIVES

1) Discuss MR imaging features of several GU cases in a case-based format. 2) Review imaging pitfalls and differential diagnoses of GU cases at MR imaging. 3) Pathology of the kidneys, bladder, seminal vesicles, testes, retroperitoneum , and adrenals will be discussed in a case based format.

ABSTRACT

MR imaging features of several GU entities will be discussed in a case based format. Differential diagnoses, and pitfalls will be addressed of the different GU entities. Renal, bladder, seminal vessicles , testes , retroperitoneum and adrenal gland pathologies will be reviewed

Honored Educators

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MSCM22B MRI of the Shoulder

Participants
Jim S. Wu, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the common conditions that lead to shoulder pain. 2) Recognize the MR features of conditions that cause shoulder pain.

ABSTRACT

The shoulder is a dynamic joint capable of a wide range of motion. Injuries to the shoulder are extremely commmon and it is important for the radiologist to understand the conditons that can affect the shoulder and their characteristic appearances on MRI.

MSCM22C MRI of the Knee

Participants
Donald L. Resnick, MD, Del Mar, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Illustrate the role of MRI in the assessment of internal derangements of the knee. 2) Stress the importance of knowledge of anatomy in correct diagnosis of these derangements. 3) Emphasize important points of differential diagnosis.

ABSTRACT

MRI of the knee is being used increasingly as the method of choice in the assessment of internal derangements of the knee. In this presentation, this role will be illustrated, with particular regard ot the menisci and ligaments, and points of differrential diagnosis will be stressed.

MSCM22D MRI of the Pediatric Disorders

Participants
Robert Orth, MD,PhD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review common and not so common abnormalities. 2) Discuss differential diagnoses and characteristic imaging features. 3) Describe important historical and imaging features that allow differentiation.

MSMC22

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

Monday, Nov. 27 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
Geoffrey D. Rubin, MD, Durham, NC (*Moderator*) Consultant, Fovia, Inc; Consultant, Informatics in Context, Inc; Research Consultant, General Electric Company;
Arthur E. Stillman, MD, PhD, Atlanta, GA (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

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

Sub-Events

MSMC22A Coronary Atherosclerosis I

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

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMC22B Coronary Atherosclerosis II

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

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

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

MSMC22C Valves and Cardiac Function

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

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

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

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MSMI22

Molecular Imaging Symposium: Oncologic MI Applications

Monday, Nov. 27 10:30AM - 12:00PM Room: S405AB

MI OI

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

FDA Discussions may include off-label uses.

Participants
Peter L. Choyke, MD, Rockville, MD (*Moderator*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc
Umar Mahmood, MD,PhD, Charlestown, MA (*Moderator*) Co-Founder, CytoSite Biopharma; Stockholder, CytoSite Biopharma; Consultant, CytoSite Biopharma

For information about this presentation, contact:

pchoyke@nih.gov

LEARNING OBJECTIVES

1) To understand the role of molecular imaging in cancer therapy. 2) To understand the impact that new molecular imaging agents could have on drug development. 3) To understand the barriers facing the development of new molecular imaging agents.

ABSTRACT

Molecular Imaging is expanding in many new directions. Most research is being performed for PET and SPECT agents. However, optical and MRI agents are also being developed. Molecular Imaging can play a role in accelerating the development and approval of new cancer therapeutics by quantifying the impact drugs have in early Phase studies and by selecting the most appropriate patients for trials. Molecular Imaging agents can be useful in determining the utility and mechanism of actions of drugs that are already approved and may provide insights to oncologists regarding the best treatment combinations for individual patients. Molecular Imaging methods have already expanded our knowledge of cancer behavior and this will ultimately lead to new forms of the therapy that will one day cure this dreaded disease.

Sub-Events

MSMI22A Hyperpolarized MRI of Prostate Cancer

Participants
Daniel B. Vigneron, PhD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company;

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMI22B Somatostatin Receptor Imaging

Participants
Corina Millo, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

millocm@mail.nih.gov

LEARNING OBJECTIVES

1) Describe the advantages of 68Ga-somatostatin PET/CT over 111In-DTPA-octreotide imaging. 2) Describe the physiologic biodistribution and the main pitfalls and abnormalities detected on 68Ga-somatostatin PET/CT. 3) Detect patients likely to benefit from peptide receptor radiotherapy (PRRT).

ABSTRACT

68Ga-labeled somatostatin analogs (DOTATATE, DOTATOC and DOTANOC) PET/CT imaging provides both higher resolution and enhanced receptor affinity compared with 111In-DTPA-octreotide, with less radiation, comparable cost, and imaging completion within 2 hours vs. 2-3 days. 68Ga-somatostatin analogs have a higher impact on care than 111In-DTPA-octreotide, including the ability to identify patients likely to benefit from PRRT. This activity will provide results from the literature and the author's experience to illustrate the advantages of 68Ga-somatostatin analogues PET/CT in imaging of neuroendocrine tumors.

MSMI22C Multimodal MI in Oncology

Participants
Umar Mahmood, MD,PhD, Charlestown, MA (*Presenter*) Co-Founder, CytoSite Biopharma; Stockholder, CytoSite Biopharma; Consultant, CytoSite Biopharma

LEARNING OBJECTIVES

1) To understand strengths of various imaging modalities for specific target/disease assessment.

ABSTRACT

Each imaging modality has a set of characteristics that helps define optimal use. These constraints include sensitivity, depth of imaging, integration time for signal, and radiation dose, among other factors. Understanding when each modality can be used and when combining the relative strengths of differerent modalities can be synergistic allows greater molecular information to be acquired.

MSMI22D Imaging of Delivered Gene Expression

Participants
Vikas Kundra, MD, PhD, Houston, TX (*Presenter*) Institutional license agreement, Introgen Therapeutics, Inc; Research Grant, General Electric Company

For information about this presentation, contact:

vkundra@mdanderson.org

LEARNING OBJECTIVES

1) Understand the basic molecular biology principles of reporter imaging. 2) Describe applications of reporter imaging.

ABSTRACT

Reporter constructs are used to image gene expression. Most commonly, the delivered gene results in a protein that can be imaged upon binding to an imaging agent. This concept has several applications, for example, in gene therapy and cellular therapy.

MSMI22E PSMA Imaging in Prostate Cancer

Participants
Peter L. Choyke, MD, Rockville, MD (*Presenter*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc

For information about this presentation, contact:

pchoyke@nih.gov

LEARNING OBJECTIVES

1) Demonstrate the appearance of PSMA PET/CT in localized, recurrent and metastatic prostate cancer. 2) Understand the limitations of this technique in the pelvis. 3) Describe how PSMA targeted agents are being used in radionuclide therapies.

ABSTRACT

Prostate Specific Membrane Antigen (PSMA) is expressed in prostate cancer. Several small molecules with high binding affinity for PSMA have been developed and they have been labeled with PET radiotracers. Experience has now been gained in the role of PSMA PET/CT in diagnosis, restaging and followup of prostate cancer. Currently these agents are also being considered as platforms for the delivery of targeted radionuclide therapy.

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MSRO22

BOOST: CNS—Case-based Review (An Interactive Session)

Monday, Nov. 27 10:30AM - 12:00PM Room: S103AB

NR OI RO

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

Participants

Christina I. Tsien, MD, Saint Louis, MO (*Presenter*) Speaker, Merck & Co, Inc
Soonmee Cha, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Roger Stupp, MD, Chicago, IL (*Presenter*) Spouse, Employee, Celgene Corporation; Research Consultant, Celgene Corporation; Research Consultant, Merck & Co, Inc; Research Consultant, Novartis AG; Research Consultant, NovoCure Ltd; Research Consultant, F. Hoffmann-La Roche Ltd
Daniel P. Cahill, Boston, MA (*Presenter*) Speaker, Merck & Co, Inc

LEARNING OBJECTIVES

1) Present latest advances in imaging for assessment of brain tumors before, during and after therapy. 2) Discuss challenges and strategies for accurate imaging characterization of brain tumors following therapy in a case based format.

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MSRO26

BOOST: Gynecologic—Oncology Anatomy (An Interactive Session)

Monday, Nov. 27 10:30AM - 12:00PM Room: S103CD

GU OI RO

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

Participants
Aoife Kilcoyne, MBBCh, Boston, MA (*Presenter*) Nothing to Disclose
Akila N. Viswanathan, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the gynecologic anatomy on MRI and PET-CT that is relevant to treatment planning in gynecologic oncology. 2) Report the salient MR and PET-CT findings that direct therapy in gynecologic oncology patients. 3) Avoid technical and anatomical imaging pitfalls related to normal anatomy and anatomical variants on MRI and PET-CT.

ABSTRACT

The purpose of this course is to provide attendees with a practical working knowledge of gynecologic anatomy to optimisea multidisciplinary approach to treatment planning.

Active Handout:Aoife Kilcoyne

http://abstract.rsna.org/uploads/2017/17001726/Active MSRO26.pdf

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RCA22

3D Printing (Mimics) (Hands-on)

Monday, Nov. 27 10:30AM - 12:00PM Room: S401AB

IN

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

Participants

Adnan M. Sheikh, MD, Ottawa, ON (*Moderator*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Dimitris Mitsouras, PhD, Boston, MA (*Presenter*) Research Grant, Toshiba Medical Systems Corporation;
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Carolina A. Souza, MD, Ottawa, ON (*Presenter*) Consultant, Pfizer Inc; Consultant, Boehringer Ingelheim GmbH ; Consultant, F. Hoffmann-La Roche Ltd; Speaker, Pfizer Inc; Speaker, Boehringer Ingelheim GmbH; Speaker, F. Hoffmann-La Roche Ltd
Waleed M. Althobaity, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Nicole Wake, MS, New York, NY (*Presenter*) In-kind support, Stratasys, Ltd
Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Elizabeth George, MD, Boston, MA (*Presenter*) Nothing to Disclose
Satheesh Krishna, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Carlos H. Torres, MD,FRCPC, Ottawa, ON (*Presenter*) Nothing to Disclose
Olivier Miguel, BEng, Ottawa, ON (*Presenter*) Nothing to Disclose
Shannon T. Lee, BEng, Ottawa, ON (*Presenter*) Nothing to Disclose
Ekin P. Akyuz, BSc, Ottawa, ON (*Presenter*) Nothing to Disclose
Andy Christensen, BS, Littleton, CO (*Presenter*) Consultant, 3D Systems, Inc; Consultant, Integrum AB; Board Member, Integrum AB
Amy E. Alexander, BEng, Rochester, MN (*Presenter*) Nothing to Disclose
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LEARNING OBJECTIVES

1) To become familiar with the computational processing of cross-sectional images required to enable 3D printing using practical examples from diverse organ systems and pathologies. 2) To learn to use software to identify and extract anatomical parts from cross-sectional images using manual and semi-automated segmentation tools, including thresholding, region growing, and manual sculpting. 3) To gain exposure to techniques involving model manipulation, refinement, and addition of new elements to facilitate creation of customized models. 4) To learn the application of tools and techniques to enable the accurate printing of the desired anatomy, pathology, and model customizations using Computer Aided Design (CAD) software. 5) To become exposed to file formats used in 3D printing and interfacing with a 3D printer.

ABSTRACT

Constant advances in 3D printing, including manufacturing and software technologies, ensure its ever-expanding role in the clinical setting. The RSNA 3D Printing Special Interest Group has adopted a position statement reflecting the FDA recommendation for FDA-approved software to be used where 3D printed models are created for clinical applications. This course covers the use of industry-standard FDA-cleared software for the design and fabrication of 3D printed models for a diverse range of pathologies. This couse will explore segmentation and 3D printing for musculoskeletal, respiratory, and cardiovascular systems, to create practically usable models for personalized medicine. Preoperative planning models and prosthetic implants will be created for a complex superior sulcus tumor, highlighting the expanding applications of 3D printing. The specific purpose of this hands-on course is to convert a set of DICOM files obtained from cross-sectional imaging into a 3D printed model through a series of simplified steps. Some of the initial post-processing steps may be familiar to the radiologist, as they share common features with 3D visualization tools that are used for image post-processing tasks such as 3D volume rendering. However, some are relatively or completely new to radiologists, including the manipulation of 3D printable files and Computer-Aided Design. This 90 minute session will begin with a DICOM file and review the commonest tools and techniques required to create customized 3D-printable models. An extensive training manual will be provided before the meeting. It is highly recommended that participants review the training manual to optimize the experience at the workstation.

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 EducatorCarlos H. Torres, MD,FRCPC - 2017 Honored Educator

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RCB22

Hands-on Introduction to Social Media: Basic (Hands-on)

Monday, Nov. 27 10:30AM - 12:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose
Amy L. Kotsenas, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Saad Ranginwala, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Tirath Y. Patel, MD, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learn about Twitter and its impact in radiology and medicine. 2) Learn why it is important to get engaged in social media, particularly Twitter, as a radiologitst. 3) Join Twitter and learn how to send your first tweet.

URL

http://bit.ly/RSNASocialMediaIntro

RCC22

Deep Learning in Radiology: How Do I Do It?

Monday, Nov. 27 10:30AM - 12:00PM Room: S501ABC

IN

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

Participants
Luciano M. Prevedello, MD, MPH, Columbus, OH (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn what Deep Learning is and how it may be applied to Radiology. 2) Understand the challenges and benefits of creating a laboratory dedicated to machine learning in Radiology. 3) Be exposed to several applied examples of Deep Learning in Radiology at different institutions.

Sub-Events

RCC22A Ohio State University Experience

Participants
Luciano M. Prevedello, MD, MPH, Columbus, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the existing infrastructure to handle pixel and non pixel data at our institution for translational research in machine learning. 2) Learn some applications of Deep Learning in Radiology through examples.

RCC22B Stanford University Experience

Participants
Curtis P. Langlotz, MD, PhD, Menlo Park, CA (*Presenter*) Advisory Board, Nuance Communications, Inc; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG;

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LEARNING OBJECTIVES

1) Consider the types of clinical problems that are best suited to machine learning solutions. 2) Understand how 'deep' neural networks work, and the technology and people needed for a successful program. 3) Learn about the type of work performed by an artificial intelligence laboratory focused on medical imaging and computer vision. 4) Analyze the key technologies needed to create large annotated training data sets.

RCC22C Mayo Clinic Rochester Experience

Participants
Bradley J. Erickson, MD, PhD, Rochester, MN (*Presenter*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma; Researcher, nVIDIA Corporation

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LEARNING OBJECTIVES

1) Describe Mayo experience with deep learning radiomics technology.

SPCP21

Colombia Presents: Diagnostic Imaging in Tropical and Infectious Diseases

Monday, Nov. 27 10:30AM - 12:00PM Room: E353C

OT

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

Sub-Events

SPCP21A Institutional Introduction by the President of ACR

Participants
Juan M. Lozano, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

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juamauloz@gmail.com

LEARNING OBJECTIVES

1. What is the ACR'2. What are our objetives3. What is the Tropical zone?4. What are the main health problems in the tropical zone?5. Why the radiologist of all the world need to know to diagnose the tropical and infectious diseases?

ABSTRACT

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Active Handout:Juan Mauricio Lozano

http://abstract.rsna.org/uploads/2017/17005766/Active SPCP21A.pdf

SPCP21B Imaging of the Tropical and Infectious Diseases of the Head, Neck and Spine

Participants
Juan E. Gutierrez, MD, Medellin, Colombia (*Presenter*) Speakers Bureau, Bayer AG

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LEARNING OBJECTIVES

1) To learn about the common and uncommon manifestations of tropical diseases in the central nervous system. 2) To become familiar with the imaging findings of common tropical diseases of the brain. 3) To understand the risk factors, prevalence and incidence of the most common tropical infectious diseases. 4) To review through cases common imaging findings in bacterial, fungal and viral infections of the brain, spine and head. 5) To address in a systematic and location based fashion the most prevalent tropical infectious diseases of the CNS.

SPCP21C Imaging Overview of Chagas Disease

Participants
Monica D. Ocampo, MD, Floridablanca , Colombia (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review the epidemiology and clinical course of Chagas disease. 2) To become familiar with the cardiovascular complications of Chagas disease. 3) To discuss the role of different imaging modalities in the evaluation of patients with chagasic cardiomyopathy.

SPCP21D Imaging Manifestations of Tropical and Infectious Diseases of the Abdomen

Participants
Diego A. Aguirre, MD, Bogota, Colombia (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify most common tropical infectious processes involving the abdomen and pelvis and their imaging manifestations. 2) Assess imaging presentation of amebic infections of the abdomen, their complications and image guided management. 3) Describe most common parasitic infections of the hepatobiliary, gastrointestinal and genitourinary systems and their related complications. 4) Identify most common abdominal manifestations of systemic tropical diseases and their imaging manifestations. 5) Describe most

common tropical infectious processes in immunocompromised patients, and their imaging manifestations.

SPCP21E Question Session and Video Presentation "Colombia, Magical Realism"

SPCP21F Closing Remarks from RSNA

Participants
Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

Honored Educators

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SSC01

Cardiac (Non-ischemic Cardiomyopathy and Myocarditis)

Monday, Nov. 27 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
Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV
Tina D. Tailor, MD, Durham, NC (*Moderator*) Research support, General Electric Company

Sub-Events

SSC01-01 Noninvasive Hematocrit Assessment for Cardiac MRI Extracellular Volume Fraction Quantification Using a Point of Care Device and Synthetic Derivation

Monday, Nov. 27 10:30AM - 10:40AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Sean Robison, MBBS, Toronto, ON (*Presenter*) Nothing to Disclose
Gauri R. Karur, MBBS, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Rachel Wald, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Dinesh Thavendiranathan, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Andrew M. Crean, MD, Toronto, ON (*Abstract Co-Author*) Research support, sanofi-aventis Group
Kate Hanneman, MD, FRCPC, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate noninvasive measures of hematocrit (Hct) for cardiac MRI extracellular volume (ECV) quantification using a noninvasive point of care (POC) device and synthetic derivation, with laboratory Hct as the reference standard.

METHOD AND MATERIALS

In this prospective IRB approved study, 129 subjects (46% male, 47.4±13.4 years) underwent cardiac MRI T1 mapping at 1.5T (n=83) and 3T (n=46) using MOLLI (n=118) or ShMOLLI (n=11). Laboratory Hct values were obtained by venipuncture within 24 hours. Same day noninvasive hemoglobin values were acquired utilizing a POC device (Pronto-7, Masimo, Irvine, California, USA) with a 0.3 conversion to Hct. Three test-retest POC values were obtained in a subgroup of patients (n=44). Synthetic hematocrit was derived from pre-contrast blood pool R1 using previously published conversions in the subgroup at 1.5T. Left ventricular ECV was calculated based on pre- and post-contrast T1 values and input of laboratory Hct (ECV-lab), POC Hct (ECV-POC), and synthetic Hct (ECV-synthetic), respectively.

RESULTS

There was no significant difference between laboratory and POC Hct (0.397±0.050 vs. 0.395±0.047, p=0.532) or ECV (27.3±4.7 vs. 27.4±4.8, p=0.451) with excellent correlation between measures (Hct r=0.81, p=<0.001 and ECV r=0.92, p=<0.001). There was no significant difference between laboratory and synthetic Hct (0.395±0.031, p=0.073) or ECV (26.7±4.1, p=0.084) with good correlation between measures (Hct r=0.66, p=<0.001 and ECV r=0.90, p=<0.001). Bland-Altman analysis demonstrated minimal bias for ECV-POC (bias= -0.15%, 95%CI[-2.2, 2.3]) and ECV-synthetic (bias=0.22%, 95%CI[-1.82, 2.7]) compared to ECV-lab. Excellent diagnostic performance was achieved for ECV-POC (area under the curve (AUC) 0.909, 95%CI[0.840, 0.977]) and ECV-synthetic (AUC 0.852, 95%CI[0.734, 0.970]) for discriminating ECV-lab≥30%, with no significant difference in AUC between the two noninvasive measures (p=0.485). There was excellent test-retest agreement for ECV-POC (ICC 0.977, 95%CI[0.963, 0.987]).

CONCLUSION

Myocardial ECV calculated using noninvasive measures of Hct correlates strongly with conventionally calculated ECV using laboratory Hct values with minimal bias.

CLINICAL RELEVANCE/APPLICATION

Myocardial ECV derived from noninvasive measures of Hct is accurate and reproducible, eliminating the need for blood collection by venipuncture and potentially improving patient comfort and safety.

Honored Educators

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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/ Kate Hanneman, MD, FRCPC - 2017 Honored Educator

SSC01-02 Regional Ventricular Dysfunction Differs In Cardiac Sarcoidosis and Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy: Assessment by MRI Strain Analysis

Monday, Nov. 27 10:40AM - 10:50AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Farnaz Najmi Varzaneh, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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Crystal Tichnell, MSc, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Brittney Murray, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Bharath Ambale Venkatesh, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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David A. Bluemke, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Research agreement, Siemens AG; Research support, Siemens AG; Research agreement, Carestream Health, Inc; Research support, Carestream Health, Inc
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PURPOSE

Myocardial sarcoidosis is the most common 'missed' diagnosis in patients evaluated for arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C). The purpose of this study was to investigate the utility of left and right ventricular strain analysis by cardiac MRI (CMR) in distinguishing these two entities.

METHOD AND MATERIALS

68 patients who were consecutively screened for ARVD/C between 2009-2011 and fulfilled diagnostic criteria for ARVD/C were obtained by retrospective chart review. An additional 21 sarcoidosis who fulfilled 2014 Heart Rhythm Society consensus recommendations were identified from a review of consecutive patients who underwent CMR to screen for cardiac sarcoidosis during the same time interval. Regional and global systolic strain analysis was performed on cine SSFP CMR images (Myocardial Tissue Tracking, Toshiba). Global and segmental right ventricular (RV) and left ventricular (LV) longitudinal strains were measured on 4-chamber long axis views and circumferential strains on short-axis views. RV regional strain was divided into basal, mid, and apical segments. LV strain was analyzed according the standard 17 segment model.

RESULTS

Overall 47 men and 42 women were studied (mean age: 53±19 years). There were no significant differences in age and sex between the two groups. Sarcoidosis patients had significantly worse LV systolic longitudinal strain both globally (-16±6 vs -22±7, $p<0.001$) and in the basal septum (-11±8 vs -18±7, $p<0.001$). In contrast, ARVD patients had significantly worse RV systolic longitudinal strain both globally (-16±9 vs -20±8, $p=0.03$) and in the basal free wall (-23±7 vs -29±13, $p=0.03$). Similar differences between groups were seen for circumferential RV and LV systolic strain measures. There were no significant strain differences for the other segments of the RV and LV.

CONCLUSION

Regional and global longitudinal strain patterns are markedly different in patients with sarcoidosis versus ARVD/C as assessed by feature tracking CMR strain analysis.

CLINICAL RELEVANCE/APPLICATION

Sarcoidosis and ARVD/C have considerable overlap in clinical and imaging features. RV and LV strain analyses with CMR may provide additional information to help facilitate distinguishing these diseases when the diagnosis is unclear.

SSC01-03 Trastuzumab and Anthracycline-Induced Cardiotoxicity: Evaluation with Contrast-Enhanced T1 Mapping Cardiovascular Magnetic Resonance Imaging, and Histological Findings

Monday, Nov. 27 10:50AM - 11:00AM Room: S502AB

Participants
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Sang A. Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cardiotoxicity is a notorious adverse effect of anthracycline agents and trastuzumab. This study was designed to investigate serial

myocardial change owing to cardiotoxicity by using T1 mapping cardiovascular magnetic resonance imaging and cardiotoxicity rat models.

METHOD AND MATERIALS

Twenty-three rats were assigned to one of three groups (control group: n = 5, trastuzumab group: n = 8, trastuzumab + doxorubicin group: n = 10). These received one of the following treatment drug regimens administered intravenously through the tail vein: (1) saline control, 0.9% (n = 5), (2) trastuzumab, 8 mg/kg once a week, and (3) trastuzumab, 8 mg/kg followed by doxorubicin (2 mg/kg) once a week (n = 8). Cine, pre-contrast, and post-contrast T1 mapping sequences were performed by using a 9.4-T magnetic resonance scanner every 4 weeks after drug administration until 12 weeks. After 8 or 12 weeks, the hearts were processed for pathological analysis.

RESULTS

In normal control subjects, the measured ejection fraction (EF), native T1, and extracellular volume fraction (ECV) of the left ventricle were 72.05%, 1190 ms, and 15.03%, respectively. In the trastuzumab group, the EF, native T1, and ECV did not significantly change in accordance with the modeling time (4 vs. 8 vs. 12 weeks) as follows: EF, 68.02% vs. 66.19% vs. 68.53% (p = 0.131); native T1, 1235.8 vs. 1238.83 vs. 1198.63 ms (p = 0.323); and ECV, 16.12% vs. 17.96% vs. 18.55% (p = 0.609). In the trastuzumab + doxorubicin group, EF decreased significantly according to the modeling time (64.55% vs. 56.00% vs. 37.25%, p = 0.008), whereas native T1 and ECV increased in accordance with the modeling time (native T1: 1245.75 vs. 1238.02 vs. 1273.9 ms, p = 0.145; ECV: 15.85% vs. 22.12% vs. 25.15%, p = 0.034). Histological examination revealed, a mild interstitial edema in the left ventricular myocardium in the trastuzumab group (n = 4) and a significant myocardial fibrosis in the trastuzumab + doxorubicin group (n = 6).

CONCLUSION

T1 mapping CMR imaging may be the useful noninvasive monitoring method tool for anthracycline-associated and trastuzumab-associated cardiotoxicity owing to its comprehensive nature of myocardial tissue characterization.

CLINICAL RELEVANCE/APPLICATION

T1 mapping CMR imaging can demonstrate subclinical anthracycline-associated and trastuzumab-associated cardiotoxicity and is recommended as a useful noninvasive monitoring method.

SSC01-04 T2-Weighted Short Tau Inversion Recovery Image of Cardiac Magnetic Resonance Reflects Disease Activity of Cardiac Involvement of Sarcoidosis: Comparison with Conventional Methods

Monday, Nov. 27 11:00AM - 11:10AM Room: S502AB

Participants
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Makoto Mutoh, Kumagaya-City, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Accurate evaluation of disease activity of cardiac involvement of sarcoidosis (CIS) is critical for treatment planning. We investigated whether high signal intensity on T2-weighted short tau inversion recovery image (T2W-STIR-BB) of cardiac magnetic resonance (CMR) is useful in evaluating CIS activity.

METHOD AND MATERIALS

18F-fluorodeoxyglucose positron emission tomography(FDG-PET), CMR, 67Gallim-schintigraphy, echocardiogram, electrocardiogram (ECG) and biomarkers (angiotensin-converting enzyme, soluble interleukin-2 receptor, lysozyme) were obtained within 3 months for patients who met at least one major and one minor criterion of the 2016 guidelines of diagnosis of cardiac sarcoidosis by the Japanese circulation society that upgrade late gadolinium enhancement of CMR and positive uptake of FDG by the myocardium to major criteria. We measured the spleen to myocardium ratio (SMR) of signal intensity for quantitative analysis of T2W-STIR-BB, with SMR above 0.58 considered positive based on our previous investigation. We determined CIS activity based on positive uptake of FDG by the myocardium. Maximum standard uptake value (SUV-max) of 2.5 and above was defined as significant uptake of FDG.

RESULTS

Of 28 patients with CIS (14 men, 65.4±15.0 years), 17 demonstrated positive findings on FDG-PET (SUV-max, 5.11±3.51);19,on T2-STIR-BB (SMR, 0.64±0.13); three, on 67Gallium-schintigraphy; six, on biomarkers; and 20, on ECG. Sensitivity, specificity, accuracy, positive, and negative predictive values for diagnosing CIS activity using positive uptake of FDG by the myocardium as a gold standard were 87.5%, 60.0%, 76.9%, 77.8%, 75.0% for T2W-STIR-BB; 21.4%, 100.0%, 50.0%, 100.0% and 42.1% for 67Gallium-schintigraphy; 20.0%, 66.7%, 37.5%, 50.0%, and 33.3% for biomarkers and 78.6%, 30.8%, 55.6%, 55.0% and 57.1% for

ECG.

CONCLUSION

Although specificity was higher in 67Gallium schintigraphy, the sensitivity and accuracy of T2W-STIR-BB were better than those of 67Gallium schintigraphy, biomarkers and ECG findings. T2W-STIR-BB is more useful than conventional methods for evaluating disease activity in CIS.

CLINICAL RELEVANCE/APPLICATION

T2W-STIR-BB reflects disease activity of cardiac involvement of sarcoidosis with better accuracy compared with those of conventional methods and is recommended in the initial evaluation.

SSC01-05 Association of Imaging Markers of Diffuse Myocardial Fibrosis by CMR T1ρ Mapping and T1 Mapping with Myocardial Diastolic Function in Rhesus Monkeys with Spontaneous Type 2 Diabetes Mellitus

Monday, Nov. 27 11:10AM - 11:20AM Room: S502AB

Participants
Yu Zhang, Chengdu, China (*Presenter*) Nothing to Disclose
Fabao Gao, MD, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Jie Zheng, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the relationship of myocardial fibrosis and diastolic dysfunction in a rhesus monkey model with early type II diabetes mellitus. Imaging biomarkers of ECV and a new non-contrast myocardial fibrosis index were used to determine myocardial fibrosis content.

METHOD AND MATERIALS

A total of 19 male rhesus (14.27years±2.22years, 10.1kg±1.98kg) monkeys were studied. Fourteen of them were spontaneous type 2 diabetes mellitus (T2DM, FPG>104mg/dl, HbA1c: 4.5-7.3%). The other five controls (HC, FPG<90mg/dl) are matched in age, weight and gender. Blood biochemical examination was tested during the four-week acclimation. CMR protocol included: cine, T1ρ mapping (TR = 640 ms, TE = 1.45 ms, FA = 7, bandwidth = 1002 Hz/Px, FOV = 160mm x 160 mm, voxel size = 2.2 mm x 1.7 mm x 5.0 mm, slice thickness = 5 mm , spin-locking frequency (SLF) = 510 Hz or 0 Hz, time of spin-locking (TSL) = 10, 30, 50 ms),T1 mapping, and LGE. All images were acquired during a breath-hold time by turning off ventilation for 15-20 sec. Pre-T1, post-T1 and extracellular volume (ECV) values were acquired using software available in the MRI system. Myocardial fibrosis index (mFI), which is a new non-contrast myocardial fibrosis index calculated based on the dispersion characteristics of T1ρ, and absooute T1ρ values were calculated. Cardiac function was calculated using cine images. One heart was harvested from a diabetic monkey with diastolic dysfunction after imaging. HE and Masson staining were performed to confirm diffuse myocardial fibrosis.

RESULTS

Echocardiographic results show all 14 monkeys in T2DM have diastolic dysfunction (8 monkeys in T2DM is E/A<1,E'/A' >1; the other 6 in T2DM is E/A>1,E'/A' <1), whereas E/A>1,E'/A' >1 in all 5 controls. MRI results and the association between MRI marker for myocardial fibrosis and diastolic dysfunction shows in Table 1. For focal fibrosis, there was no evidence of regional late contrast enhancement in all animals. Histopathology showed that the myocardial extracellular space was widened with diffuse fibrosis with ECV = 37.46% and mFI =5.85 in this diabetic monkey.

CONCLUSION

CMR drevied myocardial fibrosis markers (ECV and mFI) are associated with diastolic dysfunction in T2DM monkeys but not an independent determiner for it.

CLINICAL RELEVANCE/APPLICATION

For diabetic cardiomyopathy therapy maybe we can target both myocardial fibrosis and diastolic at the same time.

SSC01-06 Quantitative Parameters Using Cardiovascular Magnetic Resonance for Differential Diagnosis of Cardiac Amyloidosis and Hypertrophic Cardiomyopathy: Comparison of Inversion Time to Native T1 and Extracellular Volume

Monday, Nov. 27 11:20AM - 11:30AM Room: S502AB

Participants
Min Jae Cha, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sung Mok Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Boda Nam, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Na Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yiseul Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yeon Hyeon Choe, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to explore the quantitative CMR parameters such as inversion time (TI), native T1, and extracellular volume (ECV) for differential diagnosis between cardiac amyloidosis (CA) and hypertrophic cardiomyopathy (HCM).

METHOD AND MATERIALS

We included 46 patients with biopsy-confirmed CA and 22 consecutive patients with clinically diagnosed HCM from our CMR registry. Ten healthy subjects were also included for reference value. All patients underwent CMR examination using 1.5T system. T1 values were measured by drawing region of interest (ROI) in left ventricle (LV) septum and cavity on pre- and post-contrast T1 mapping to obtain native T1 and ECV values. TI values were also measured using same method on TI scouts images, which were acquired at 10 minutes after contrast injection. TI values were selected at nulling point of each LV septum and cavity. The interval of TI was calculated to show time difference of nulling points of LV septum and cavity. Comparison of continuous variables of three groups

was performed using Kruskal Wallis test. The diagnostic performance of TI interval for CA diagnosis was compared to native T1 and ECV using area under the receiving operating characteristics curve (AUC).

RESULTS

Native T1 values of CA, HCM, and control groups were significantly different (1176.35 ± 261.15 vs. 1060.62 ± 46.71 vs. 971.17 ± 68.67 ms, p <0.001). ECV values of three groups were significantly different (52.47 ± 14.73 ms vs. 26.94 ± 3.89 vs. 26.04 ± 4.83, p <0.001). The TI interval values of three groups were significantly different (-5.3 ± -0.9 vs. 62.9 ± 27.6 ± 83.9 ± 1.7 ms, p <0.001). On AUC analysis, the AUC values of TI interval and ECV were significantly different to that of native T1 for different diagnosis between CA and HCM (AUC: 0.924 vs. 0.821, p =0.035 in TI interval vs. native T1 and 0.941 vs. 0.821, p =0.008 in ECV vs. native T1). The diagnostic performance of TI interval was not inferior to that of ECV (AUC: 0.924 vs. 0.941, p =0.514).

CONCLUSION

The diagnostic performance of TI interval of LV septum and cavity shows superior that of native T1 and non-inferior to that of ECV for differential diagnosis between CA and HCM.

CLINICAL RELEVANCE/APPLICATION

The interval s of inversion time of LV septum and cavity can be quantitative CMR parameters for CA diagnosis without the need to obtain further mappings.

SSC01-07 Left and Right Ventricular Cardiac MRI T1 mapping at 3T Differentiates Anderson-Fabry Disease from Hypertrophic Cardiomyopathy

Monday, Nov. 27 11:30AM - 11:40AM Room: S502AB

Awards
Student Travel Stipend Award

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PURPOSE

To compare 3T cardiac MRI left ventricular (LV) and right ventricular (RV) T1 values in patients with Anderson-Fabry disease (AFD) and hypertrophic cardiomyopathy (HCM).

METHOD AND MATERIALS

In this prospective study, non-contrast cardiac MRI T1 mapping was performed at 3T using a modified Look-Locker inversion recovery (MOLLI) technique in patients with gene-positive AFD (n=14, 36% male, 43.36±15.06 years, 29% on enzyme replacement therapy) and HCM (n=25, 84% male, 49.48±12.11 years). Cine SSFP and late gadolinium enhancement (LGE) imaging were also performed. Same day hematocrit values were used for calculation of LV extracellular volume (ECV).

RESULTS

LV ejection fraction (p=0.950), LV mass (p=0.169), RV ejection fraction (p=0.472) and RV mass (p=0.626) were not significantly different between AFD and HCM. There was no statistically significant difference in the presence of non-hinge point LGE between AFD and HCM (57% vs. 79%, p=0.799). However, the presence of basal inferolateral LGE was more common in AFD compared to HCM (29% vs. 4%, p=0.028). Non-contrast myocardial T1 values (excluding areas of LGE) were significantly lower in AFD compared to HCM for both LV (1140.0±48.0ms vs. 1251.6±39.8ms, p<0.001) and RV (1234±82.6ms vs. 1331.5±131.6ms, p=0.020). LVECV did not differ significantly between AFD and HCM (24.5±1.9% vs. 24.1±3.0%, p=0.705). A non-contrast LV T1 cut-off value of ≤1190ms distinguished AFD from HCM with sensitivity 92% and specificity 96% (AUC 0.944, 95%CI [0.864, 1.00]). In a multivariable logistic regression model, LV non-contrast T1 values have independent value over other conventional imaging parameters (LV mass, basal inferolateral LGE, apical-basal muscle bundle and myocardial crypt) and age to differentiate AFD from HCM (OR 0.92, 95%CI [0.86, 0.99], p=0.019). In a nested logistic regression model with age and conventional imaging parameters, model fit is significantly improved by the addition of LV non-contrast T1 values (p<0.001).

CONCLUSION

Non-contrast cardiac MRI T1 values at 3T are significantly lower in patients with AFD compared to HCM and provide independent and incremental diagnostic value beyond traditional imaging features.

CLINICAL RELEVANCE/APPLICATION

Distinguishing myocardial hypertrophy related to AFD and HCM is a clinical and imaging challenge. Non-contrast T1 mapping provides incremental diagnostic value beyond traditional imaging features.

SSC01-08 Persistence of Late Gadolinium Enhancement in Imaging Post-Acute Myocarditis

Monday, Nov. 27 11:40AM - 11:50AM Room: S502AB

Participants
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PURPOSE

To demonstrate the persistence of late gadolinium enhancement (LGE) during follow-up cardiac magnetic resonance (CMR) in asymptomatic patients with previous acute myocarditis (AM), confirmed by CMR.

METHOD AND MATERIALS

Between 2008 to 2016 thirty-three consecutive patients with clinical and laboratory suspicion of AM were included in the study. They were referred for CMR after seven days from the beginning of the clinical examination. CMR was performed at 1.5T, using a standard protocol: SSFP sequences in cine mode; black blood STIR T2 sequences in the short ventricular axis; T1 sequences with and without gadolinium (DOTA) to study early enhancement and LGE (at least 10 minutes after contrast injection).

RESULTS

Patients were 31±11 y.o. (91% males). Thirty one (94%) had CMR-confirmed AM. All thirty-three (100%) patients initially had either patchy or diffuse subepicardial and/or transmural edema in the T2 sequences and LGE corresponding with the areas of edema. LGE was typically localized to the sub-epicardial region of the left ventricle (LV) and extended to a variable extent through the ventricular wall, inferolaterally and less frequently to the anteroseptal segments. Sometimes it was distributed in a multi-focal or diffuse way. Twenty were referred for follow-up CRM three or six months later. None of the patients had edema during follow-up CRM, but in sixteen (52%) LGE persisted. Four (13%) referred for repeat follow-up, three years after being diagnosed of AM still had LGE without symptoms.

CONCLUSION

There is not a perfect correlation between clinical conditions (including a complete recovery of the global cardiac functionality) of the patients and imaging post-myocarditis. This study confirms that the presence and the extent of LGE in CMR follow-up are not predictive of outcome in patients without severe hemodynamic compromise and a CMR-based diagnosis of AM.

CLINICAL RELEVANCE/APPLICATION

Sub-epicardial LGE is frequently (52%) observed in patients with previous AM and it is not associated with hemodynamic compromise or/and poor clinical conditions.

SSC01-09 Right Ventricular Hemodynamics in the Course of Acute Myocarditis: A Cardiovascular Magnetic Resonance Study

Monday, Nov. 27 11:50AM - 12:00PM Room: S502AB

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PURPOSE

Cardiac magnetic resonance (CMR) can detect inflammatory and functional myocardial alterations in patients suspected of having acute myocarditis. There is limited information regarding the degree of right ventricular involvement and the impact on right ventricular function over the course of the disease.

METHOD AND MATERIALS

69 patients with myocarditis underwent CMR during the acute stage of the disease (baseline) and after a mean 92.5 ± 50.4 days follow-up. The CMR protocol allowed for the assessment of standard Lake Louise criteria (T2 SI ratio, early gadolinium enhancement ratio, late gadolinium enhancement) and parameters of right and left ventricular function. Logistic regression analysis was used to find predictors of functional recovery upon follow-up.

RESULTS

All inflammatory parameters showed a considerable decrease over the course of the disease ($P>0.001$ for all parameters). Left (LV) and right ventricular (RV) function were significantly improved on follow-up CMR (LV function: 53.6 ± 12.8% vs. 61.3 ± 9.5%; $P<0.001$, RV function: 54.1 ± 10.0% vs. 59.4 ± 6.3%; $P<0.001$). On initial CMR, RV function was significantly correlated with the percentage of LV late gadolinium enhancement ($r= 0.255$; $P= 0.040$). 82.6% (57/69) of all patients had a recovery of myocardial function upon follow-up. Using logistic regression analysis, the presence of myocardial edema and baseline RV function were associated with functional recovery ($P<0.05$ respectively).

CONCLUSION

In this study, we found an association between a reduced RV function and the degree of myocardial inflammation. RV function improved during follow-up. These results indicate an inflammatory involvement of the right ventricle in acute myocarditis. It further appears that baseline RV function -like the presence of myocardial edema- seems to have a predictive value for functional recovery during the course of the disease.

CLINICAL RELEVANCE/APPLICATION

Right ventricular dysfunction can frequently be observed during the acute stage of myocarditis. RV functional impairment function might be useful as a new parameter for the prediction of functional recovery.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
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SSC02

Science Session with Keynote: Cardiac (Myocardial Ischemia, Viability, and Fractional Flow Reserve: CT)

Monday, Nov. 27 10:30AM - 12:00PM Room: S504AB

CA CT

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

FDA Discussions may include off-label uses.

Participants
Hajime Sakuma, MD, Tsu, Japan (*Moderator*) Research Grant, Fuji Pharma Co, Ltd; Research Grant, DAIICHI SANKYO Group; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Siemens AG; Research Grant, NIHON MEDIPHISICS; Speakers Bureau, Bayer AG
Yeon Hyeon Choe, MD, PhD, Seoul, Korea, Republic Of (*Moderator*) Nothing to Disclose

Sub-Events

SSC02-01 Cardiac Keynote Speaker: Myocardial Perfusion and Delayed Enhancement with Dual-Source CT

Monday, Nov. 27 10:30AM - 10:50AM Room: S504AB

Participants
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SSC02-03 A Fast Functional CT Method for Assessing Myocardial Edema in Acute Myocardial Infarction

Monday, Nov. 27 10:50AM - 11:00AM Room: S504AB

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PURPOSE

We developed a fast functional CT technique for measuring extravascular contrast distribution volume (ECDV), which can be used to assess edema in acutely injured myocardium. This method relies on kinetic modeling of contrast retention in the myocardium after a bolus injection (BI). We validated this technique against a model-independent constant infusion (CI) method and cardiac magnetic resonance (CMR) T2-weighted (T2W) imaging in a pig model of reperfused acute myocardial infarction (AMI).

METHOD AND MATERIALS

CT and CMR studies were performed 12±3 days post ischemic insult in five pigs. In each CT study, 0.7 mL/kg of contrast was injected at 3-4 mL/s before dynamic contrast-enhanced (DCE) heart images were acquired with a 3-phase dynamic protocol on a GE CT750 HD scanner (<5 min). Next, the same dose of contrast was constantly infused for 1 hour, where 5 scans of the heart were taken both before and after CI of contrast. CMR T2W images were then acquired with a Siemens Biograph PET/MR scanner. From the BI study, DCE images were analyzed with a modified Johnson-Wilson-Lee model from which ECDV maps were generated. From the CI study, the pre- and post- images were subtracted to produce the difference images, which were then normalized to the arterial blood enhancement (in Hounsfield Unit) to estimate the partition coefficient (PC) in the myocardium. ECDV, PC and T2W signal intensities in the apical wall (injured) and mid-lateral wall (remote) of the left ventricle were compared.

RESULTS

Mean ECDV in the injured and remote segments were 0.46±0.18 ml/g and 0.22±0.10 ml/g respectively ($p<0.05$). The corresponding PC in the same segments were 0.59±0.15 and 0.29±0.05 respectively ($p<0.05$). CMR T2W images confirmed the injured apical segment was edematous as the signal intensity there was almost twice higher than that in remote (65.6±55.7 and 34.0±39.0 a.u., $p<0.05$).

CONCLUSION

After acute ischemic insult, interstitial and intracellular edema from enhanced cellular leakiness provide additional spaces for CT contrast to distribute. ECDV, which can be reliably assessed with a much faster BI protocol, is therefore a useful marker of myocardial edema in the acute phase post infarction.

CLINICAL RELEVANCE/APPLICATION

This method measures ECDV in conjunction to perfusion, which could be used to delineate the extent of myocardium at risk after a heart attack to inform revascularization.

SSC02-04 Whole-Heart Quantitative CT Myocardial Perfusion Imaging for Assessing Functionally Significant Coronary Artery Disease

Monday, Nov. 27 11:00AM - 11:10AM Room: S504AB

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PURPOSE

To determine the diagnostic accuracy of CT Perfusion for detecting functionally significant (FS) coronary artery disease (CAD) from whole-heart quantitative myocardial perfusion (MP) measurement

METHOD AND MATERIALS

Twenty-one symptomatic patients (age 59±9 yrs) with suspected or known CAD had the following tests within 6 weeks: CT and SPECT MP imaging at rest and after dipyridamole stress, coronary CT angiography (CCTA) and/or catheter-based coronary angiography (CAG). CCTA, CAG and SPECT MP imaging (with Tc99m-MIBI or 201-Thallium tracers) were performed using routine clinical protocols as required by the standard of care. In each CT MP study, 0.7 mgI/mL of iodinated contrast (Omnipaque350) was injected followed by saline flush before 12 cm of the heart was scanned over 20 mid-diastoles using a prospective ECG gating protocol on a GE Healthcare (GE) Revolution CT scanner. Dynamic contrast-enhanced heart images at 5 mm slice thickness were corrected for beam hardening and photon noise and residual motion using proprietary image reconstruction and non-rigid registration algorithms (GE) before they were reformatted into short-axis images from which rest and stress MP maps were generated using CT Perfusion (GE). Myocardial perfusion reserve (MPR) in each of the 17 short-axis segments were calculated as the ratio of stress to rest MP. A binomial logistic regression analysis was used to determine the diagnostic accuracy of CT-measured MPR for assessing FS CAD, which was defined as one of the following criteria: (1) >=70% narrowing in a coronary artery and/or >=50% narrowing in the left main artery; (2) 60-69% narrowing in a coronary artery with downstream ischemia assessed by the SPECT summed stress and difference scores; (3) previous episode of STEMI or NSTEMI. In all cases, CCTA was used for the anatomical evaluation of CAD only if CAG was not acquired.

RESULTS

Mean MPR in the FS CAD (n=25) and normal (n=38) coronary territories were 1.81±0.60 and 2.57±0.67 ($p<0.05$) respectively. The overall diagnostic accuracy of CT Perfusion for detecting FS CAD was 85.7% with 84.0% sensitivity and 86.8% specificity.

CONCLUSION

CT Perfusion showed an excellent diagnostic accuracy for detecting FS CAD as identified by combined CAG/CCTA and SPECT assessment.

CLINICAL RELEVANCE/APPLICATION

The high diagnostic accuracy of CT Perfusion for detecting high-grade coronary stenosis suggested that it is useful for risk stratification and management of CAD patients.

SSC02-05 Prognostic Value of Dynamic Stress CT Myocardial Perfusion in Patients with Suspected Coronary Artery Disease

Monday, Nov. 27 11:10AM - 11:20AM Room: S504AB

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PURPOSE

To evaluate the ability of dynamic stress computed tomography myocardial perfusion (CTP) to predict major adverse cardiac events (MACEs) in patients with suspected coronary artery disease (CAD).

METHOD AND MATERIALS

We included 193 consecutive patients without a history of myocardial infarction, revascularization, or cardiomyopathy who underwent coronary CT angiography (CTA) and CTP between March 2012 and February 2015. Significant coronary stenosis (>=50% luminal narrowing) was visually identified on CTA. Dynamic CTP images were obtained using adenosine triphosphate as a coronary vasodilator. The ratio of myocardial blood flow (MBF ratio) was calculated as the lowest MBF in the myocardial segments divided by the highest MBF showed by a remote myocardium. MACEs were defined as severe cardiac events (cardiac death, myocardial infarction, and unstable angina) and revascularization (>182 days after CTP).

RESULTS

Significant coronary stenosis was detected in 62 patients on CTA. Area under the receiver operating characteristic curve for the MBF ratio was 0.82 ($p < 0.001$) in the identification of all MACEs. The best cut-off of the MBF ratio was 0.68. The patients were divided into the four groups based on the results of CTA and CTP: CTA+/CTP+ (n = 39), CTA+/CTP- (n = 23), CTA-/CTP+ (n = 16), and CTA-/CTP- (n = 115). In Cox regression analysis, CTP maintained a >10-fold association with all MACEs when adjusted for CTA (adjusted hazard ratio, 13.4; $p = 0.014$). During a median follow-up of 29 months, 10 MACEs, including 3 severe cardiac events (1 myocardial infarction and 2 unstable angina) and 7 revascularizations, were observed. Kaplan-Meier curves demonstrated a significant difference in event-free survival between the CTA+/CTP+ group and the CTA+/CTP- group for severe cardiac events (annual event rate, 7.4% vs 0% respectively; log rank test, $p = 0.028$) and all MACEs (12% vs 1.2%; $p = 0.002$). No MACEs occurred in the CTA-/CTP+ group and the CTA-/CTP- group.

CONCLUSION

Among the patients with significant stenosis on CTA, patients with positive CTP had significantly worse prognosis than those with negative CTP for severe cardiac events as well as all MACEs.

CLINICAL RELEVANCE/APPLICATION

Dynamic stress CTP is useful for predicting cardiac events in patients with suspected CAD and provides additional prognostic information for patients with significant stenosis on CTA.

SSC02-06 Delayed Enhancement Dual Energy Computed Tomography for Detection of Myocardial Infarction in Stable Patients

Monday, Nov. 27 11:20AM - 11:30AM Room: S504AB

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PURPOSE

Aside from the acute myocardial infarction (MI) setting, delayed enhancement CT (CTDE) imaging suffers from a limited contrast tissue resolution compared to cardiac magnetic resonance (CMR). Accordingly, suboptimal results have been obtained for the assessment of chronic MI.We exploredthe ability of dual energy delayed enhancement CT (CTDE) to detect myocardial infarcts among stable patients.

METHOD AND MATERIALS

Our population comprised patients with documented previous myocardial infarction (n= 9) who underwent CTDE and DE-CMR), and patients with known or suspected coronary artery disease clinically referred for myocardial perfusion imaging by single-photon emission computed tomography (SPECT) (n= 25). Using a dual energy CT scanner, all patients (n=34) also underwent stress, rest, and CTDE.All CT scans were performed using a single-source dual energy CT scanner by rapid switching between low (80 kV) and high (140 kV) tube potentials, and prospective ECG gating. Images were obtained 7-10 minutes after contrast administration.

RESULTS

The mean age was 60.2±12.0 years, 26 (76 %) were male. A total of 12 (35%) patients showed evidence of MI at the reference study. CTDE had a sensitivity, specificity, positive predictive value, and negative predictive value for the detection of MI of 63% (95% CI 54-72%), 95% (95% CI 92-97%), 77% (95% CI 67-85%), and 90% (95% CI 87-93%), on a per segment basis; and of 85% (95% CI 66-96%), 97% (95% CI 91-100%), 92% (95% CI 74-99%), and 95% (95% CI 87-99%) on a per territory basis. The number of myocardial segments with DE was systematically lower with CTDE compared to the reference modality [median 2.5 (95% CI 1.65-4.0) segments vs. 4.0 (95% CI 0.0-6.0), Bland-Altman plot]. The mean signal density of MI at 40 keV was significantly higher than (at the same slice) normal myocardium (234±49.8 HU vs. 139±32.9 HU, $p<0.0001$).

CONCLUSION

In this study, CTDE using dual energy CT allowed an accurate detection of MI on per patient and per territory basis among stable patients, although it systematically underestimated the number of segments with DE.

CLINICAL RELEVANCE/APPLICATION

Dual energy delayed enhancement CT allowed an accurate detection of myocardial infarction

SSC02-07 Diagnostic Performance of a Fast, 3D Lattice Boltzmann-Based (LBM) Computational Fluid Dynamics (CFD) Method for Coronary Computed Tomography (CT)-Based Fractional Flow Reserve (FFR)

Monday, Nov. 27 11:30AM - 11:40AM Room: S504AB

Awards
Student Travel Stipend Award

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PURPOSE

FFR from CTA (CT-FFR) using CFD has excellent accuracy to detect lesion-specific ischemia (FFR<=0.8). The initial CT-FFR method (Heartflow FFRct) cannot be performed on-site due to lengthy CFD computations. Newer "on-site" methods compatible with clinical workflow (Siemens cFFR, Toshiba 4D CT-FFR) reduce computation time by simplifying the CFD from the 3-dimensional (3D) lumen to a 1- or 2-dimensional anatomic model. We developed a CT-FFR using the highly accurate and automatically parallelizable Lattice-Boltzmann CFD technique for the full 3D computation, and assessed its diagnostic accuracy to detect invasive FFR<=0.8

METHOD AND MATERIALS

64 consecutive patients at 3 hospitals with clinically-indicated CTA (64- to 320-row CT) and invasive FFR in an average of 40.6 days (interquartile range: 6-57) were retrospectively analyzed. Our LMB CT-FFR technique used an on-site tool to segment images and estimate patient-specific hyperemic conditions, and a commercial LBM platform (PowerFLOW, EXA Corporation) to seamlessly solve the CFD on 388 cores of a cloud computing service (ExaCLOUD). We report Pearson correlation and Bland-Altman limits of agreement with invasive FFR, and comparison of LBM CT-FFR and CTA % diameter stenosis (%DS) diagnostic accuracy to detect FFR<=0.8 using receiver operating characteristic curve areas (AUC)

RESULTS

LBM CT-FFR was successfully performed for 73 lesions in 60 patients; 4 patients were excluded (failure to segment). Mean invasive FFR was 0.81±0.1; 29 lesions (40%) had FFR<=0.8, and 19 (26%) had FFR 0.75 to 0.85. LBM CT-FFR analysis was 40±10 min/patient. Correlation (r=0.60), bias (0.009) and limits of agreement (-0.223 to 0.206) to invasive FFR were similar or better than reported for other CT-FFR technologies. ROC AUC to detect FFR<=0.8 was higher (p=0.002) for LBM CT-FFR (AUC=0.89, 95%CI: 0.79-0.99) than for CTA %DS (AUC=0.69, 95% CI: 0.58-0.79). Per-lesion specificity/sensitivity/diagnostic accuracy of LBM CT-FFR were 97.7%/79.3%/90.4%, respectively

CONCLUSION

Lattice-Boltzmann-based CT-FFR can be performed in <1hr while maintaining 3D CFD accuracy. The technique achieved 90% diagnostic accuracy to detect lesion-specific ischemia defined by invasive FFR<=0.8.

CLINICAL RELEVANCE/APPLICATION

Lattice-Boltzmann-based CT-FFR can be performed on site in <1hr, with 90% overall diagnostic accuracy to detect lesion-specific ischemia (invasive FFR<=0.8).

SSC02-08 3D Printed Patient-Specific Coronary Models for Testing CT-Derived FFR

Monday, Nov. 27 11:40AM - 11:50AM Room: S504AB

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PURPOSE

Non-invasive fractional flow reserve derived from coronary CT angiography (CT-derived FFR) is a tool based on computational fluid dynamics to non-invasively detect hemodynamically significant coronary lesions. We sought to develop patient-specific 3D printed coronary flow phantoms which can supplant or support expensive clinical trials for validation of CT-derived FFR technologies. These patient-specific benchtop hemodynamic simulations were validated against clinical catheter-based FFR and used to test one CT-derived FFR algorithm.

METHOD AND MATERIALS

Five patients underwent 320-detector row coronary CT angiography (CCTA) (Aquilion ONE, Toshiba) plus invasive coronary

Five patients underwent 320-detector row coronary CT angiography (CCTA) (Aquilion ONE, Toshiba) plus invasive coronary angiography and FFR within 90 days. The coronary lumen was segmented from CCTA using a 3D workstation (Vitrea, Vital Images) and used to 3D print (Connex3, Stratasys) multi-material models with hollow lumens for flow experiments. Printed models were connected to a benchtop system with physiologically accurate flow and pressure. Pressure sensors embedded in the printed models were used to measure benchtop FFR. Additionally, CCTA data of each patient was analyzed using a CT-derived FFR technique. Benchtop FFR was compared with catheter-based invasive FFR, and used to compare CT-derived FFR measurements. Correlation was estimated using Pearson method.

RESULTS

The mean invasive FFR was 0.84 (range: 0.76-0.90); one patient had hemodynamically significant disease (FFR<=0.8). Benchtop FFR measurements were within 13% (mean difference: 7%) of catheter-based FFR. Mean variance of CT-derived FFR from benchtop FFR was 8%. Benchtop FFR correlated with both invasive FFR (r=0.90) and CT-derived FFR (r=0.86).

CONCLUSION

Patient-specific coronary 3D printed benchtop models can replicate in vivo hyperemic blood flow conditions that match invasive FFR measurements. This novel benchtop system can supplant the cost and risk of initial validation and optimization of CT-derived FFR technologies.

CLINICAL RELEVANCE/APPLICATION

Patient-specific 3D printing of the coronary circulation can optimize application of CT-derived FFR toward alleviating the cost and risk of invasive coronary angiography to detect significant lesions.

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

SSC02-09 Four-Dimensional Image Tracking Method for Computed Tomography-Derived Fractional Flow Reserve: Influence of Different Cardiac Phase Durations on the Computed Tomography-Derived Fractional Flow Reserve Analysis

Monday, Nov. 27 11:50AM - 12:00PM Room: S504AB

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PURPOSE

In the new computed tomography-derived fractional flow reserve (CT-FFR) algorithm, four-dimensional CT (4D CT) image tracking is used to obtain an accurate estimation of fractional flow reserve (FFR) by analyzing four diastolic cardiac phase images between 70% and 99% of R-R interval. However, the CT image quality may be impaired by cardiac motion artifacts in the late diastolic phase. The purpose of this study was to investigate the diagnostic accuracy of the new CT-FFR methods by comparing CT-FFR by "entire diastolic phase" and "mid-diastolic phase" analysis with invasive FFR as a reference standard.

METHOD AND MATERIALS

We enrolled 10 patients including 33 vessels. Patients underwent coronary CT angiography (CTA) using a 320-row CT scanner (Aquilion One Genesis; Toshiba Medical Systems). The scan parameters for coronary CTA were as follows: detector collimation, 320 mm × 0.5 mm; tube current, 190-480 mA; tube voltage, 120 kV; and gantry rotation time, 275 ms. CT-FFR analysis was performed by an experienced radiological technologist using a dedicated workstation (Vitrea; Toshiba). Four CT images were reconstructed from the mid-diastolic phase (R-R, 70%-80%) and the entire diastolic phase (R-R, 70%-99%). CT-FFR values were compared with two methods at the position of 5.0 mm distal to the stenosis and at the position of the distal vessel with a diameter of 2.0 mm. The value of CT-FFR was compared with the minimum value of invasive FFR recorded for each segment of a coronary artery.

RESULTS

The mid-diastole CT-FFR value (0.87 ± 0.11) was significantly lower than the entire-diastole CT-FFR value (0.90 ± 0.08). However, when applying a CT-FFR threshold value of <0.8, there was no difference between mid-diastole and entire-diastole CT-FFR for the detection of ischemia-related lesions in all vessels except for one, which showed a value of 0.75 and 0.82 for mid-diastole and entire-diastole CT-FFR, respectively. Compared with invasive FFR, mid-diastole and entire-diastole CT-FFR detected all hemodynamically significant stenosis.

CONCLUSION

The CT-FFR provides a high diagnostic capability for the detection of hemodynamically significant stenosis, and compared with the "entire-diastole CT-FFR," the "mid-diastole CT-FFR" showed an equivalent diagnostic value.

CLINICAL RELEVANCE/APPLICATION

The "mid-diastole CT-FFR" has a comparable diagnostic capability with "entire-diastole CT-FFR," leading to a reduction of radiation dose in the CT-FFR analysis.

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SSC03

Chest (Lung Nodule)

Monday, Nov. 27 10:30AM - 12:00PM Room: S504CD

CH CT OI

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

SSC03-01 Automatic Detection of Malignant Pulmonary Nodules on Chest Radiographs Using a Deep Convolutional Neural Network: Detection Performance and Comparison with Human Experts

Monday, Nov. 27 10:30AM - 10:40AM Room: S504CD

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate the performance of a deep learning-based automatic detection (DLAD) algorithm in detecting malignant pulmonary nodules on chest radiographs (CPAs) and its comparison with human experts.

METHOD AND MATERIALS

A DLAD algorithm was developed using a 25-layer deep convolutional network in a novel semi-supervised manner with 41,792 cases. For this observer performance test, 181 CPAs not used in the development of DLAD were included: 119 CPAs with 147 pathologically- or clinically-confirmed malignant lung nodules (mean size, 2.50 cm±1.60) and 62 normal CPAs. Reference for the nodules was established via CT taken within a week. Nineteen readers including 3 non-radiology physicians, 6 radiology residents, 5 board-certified radiologists, and 5 thoracic radiologists independently reviewed each CPA to detect lung nodules on a five-point confidence scale without DLAD (test 1). After test 1, each reader was allowed to change their decision by reviewing the results of test 1 and that of DLAD (test 2). The detection performances of DLAD, human experts (test 1), and human experts using DLAD (test 2) were evaluated and compared using jackknife free-response receiver operating characteristic (JAFROC) figure of merits (FOMs) on a per-nodule basis.

RESULTS

DLAD alone exhibited a FOM of 0.857, which was significantly higher than that of 16 of 19 readers (all *P*s <0.05). The mean FOM of the 19 readers using DLAD were significantly higher than that without DLAD (0.825 vs. 0.713, *P*=0.002). All readers showed improved detection performances for malignant pulmonary nodules using DLAD (mean FOM increase of 0.044 [range, 0.007-0.193]) with significant differences in 15 readers (*P*<0.05). On subgroup analysis, FOMs of the four reader groups (non-radiology physicians, radiology residents, board-certified radiologists, and thoracic radiologists) were 0.678, 0.784, 0.808, and 0.820, respectively, and their detection performances significantly improved with DLAD (0.814, 0.817, 0.827, 0.841; all *P*s <0.005).

CONCLUSION

DLAD showed better performance than most experts in detecting malignant pulmonary nodules on CPAs and enhanced the performance of human experts when used in conjunction.

CLINICAL RELEVANCE/APPLICATION

The excellent performance of DLAD demonstrates its great potential in changing our daily clinical practice; DLAD may provide

preliminary interpretation in pulmonary nodule detection on chest radiographs.

SSC03-02 Assessment of CT Texture Analysis as a Tool for Lung Nodule Follow-Up

Monday, Nov. 27 10:40AM - 10:50AM Room: S504CD

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PURPOSE

Lung nodule volumetry is currently the preferred method of following up small indeterminate lung nodules. This study assesses how CT texture analysis (CTTA) performs compared to volumetry in differentiating benign and malignant nodules.

METHOD AND MATERIALS

Data was collected for 143 patients with lung nodules (4-15mm) on an initial CT scan, with a follow-up CT 29 to 2747 days later. All scans had a slice thickness below 1.5mm. Nodules were delineated in 3D using a thresholded region with manual edits and the contour was propagated to a latter scan using deformable image registration. Definitive nodule diagnoses were established through histology, 2-year stability or malignant growth. Initially, the set was biased with respect to size (large nodules more likely to be cancer), so a subset of 113 patients (58 benign, 55 malignant) was selected such that size at presentation was uninformative (AUC 0.50-0.51). From each CT, a suite of classical texture features (Harlick, Gabor etc.) at various sizes/scales was extracted from isotropically-resampled volumes containing the contoured nodule. A derived feature vector was then created based on texture-feature changes between the first and second timepoints for each nodule, and volume doubling time (VDT) was calculated.

RESULTS

Area under the ROC curve (AUC) analysis showed that the VDT alone as an indicator of malignancy only performed at AUC=0.70 (95% CI=0.69-0.71). In contrast, the best difference-of-texture feature achieved AUC=0.81 (95% CI=0.80-0.82), with changes in size-linked texture features appearing more reliable than either absolute size at the second timepoint (AUC=0.75, 95% CI=0.74-0.76), or VTD. The mean of the top ten texture AUCs was above 0.76. This shows that quantitative texture measures extracted more information from the CT than size or VDT, and that this information is beneficial in malignancy prediction.

CONCLUSION

Our results indicate that changes in quantified texture around lung nodules and their surrounding microenvironment may be a more accurate tool for stratifying malignant lung nodules than VDT alone.

CLINICAL RELEVANCE/APPLICATION

Quantitative texture measures may be a useful adjunct in the follow-up of indeterminate lung nodules.

SSC03-03 Deep Learning-based Automatic Detection Algorithm for the Detection of Malignant Pulmonary Nodules on Chest Radiographs

Monday, Nov. 27 10:50AM - 11:00AM Room: S504CD

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PURPOSE

We developed a deep learning-based automatic detection (DLAD) algorithm for the detection of malignant pulmonary nodules on chest radiographs, and evaluated its diagnostic performance and nodule detection performance using large-scale chest radiograph (CR) data.

METHOD AND MATERIALS

A total of 44,087 CRs comprised of 9,269 abnormal and 34,818 normal CRs were collected. Abnormal CRs were pathologically or

clinically diagnosed as having malignant pulmonary nodules in 3,892 individuals (M:F=2,244:1,648; mean age, 63.6 years). Normal CRs were from 30,784 individuals (M:F=16,886:13,798; mean age, 51.3 years). We randomly split the datasets into a training set (33,467 normal and 8,625 abnormal CRs), a validation set (675 normal and 322 abnormal CRs) and a test set (675 normal and 322 abnormal CRs). There were no overlaps among these three datasets. We designed a deep convolutional network with 25 layers and 8 residual connections, and trained this network using a novel semi-supervised learning approach that partially utilized the location of the lesions, i.e., 6 thoracic radiologists manually marked the location of the abnormal lesions (3,213 CRs) in the abnormal CRs of the training set. The same radiologists also tagged the locations of all abnormal CRs in the validation and test sets to evaluate the localization performance of the DLAD algorithm. We then quantitatively verified the performances of DLAD by analyzing receiver-operating characteristics (ROC) curves for classification performance and localization average precision (AP) for detection performance.

RESULTS

In the validation dataset, DLAD showed an area under the ROC curve (AUC) of 0.9793, with an accuracy, sensitivity, and specificity of 93.83%, 85.54% and 98%, respectively. DLAD achieved 0.9257 for localization AP. In the test dataset, the AUC of DLAD was 0.9777 (accuracy, 93.53%; sensitivity, 86.2%; specificity, 96.15%). Localization AP was 0.862.

CONCLUSION

The DLAD algorithm demonstrated high diagnostic performance in differentiating malignant nodules from normal CR findings. DLAD also showed promising results in automatically detecting the location of nodules.

CLINICAL RELEVANCE/APPLICATION

As a second reader, DLAD has great potential to improve radiologists' detection performance and efficacy of malignant pulmonary nodules on chest radiographs.

SSC03-04 Computer-Aided Detection of Pulmonary Nodules on Chest Radiographs Using Deep Learning

Monday, Nov. 27 11:00AM - 11:10AM Room: S504CD

Awards
Student Travel Stipend Award

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PURPOSE

The chest x-ray is the most commonly performed radiology study, yet interpretation can be challenging. Deep learning systems for computer-aided detection (CAD) hold great potential but have been limited by the need for large numbers of radiologist-annotated radiographs. Other authors have described some success with report classification or manual annotation based CAD systems.We aimed to develop a novel nodule-detection CAD system, combining manually annotated images with 750,000 reported radiographs.

METHOD AND MATERIALS

We investigated image- and nodule-based metrics to compare our CAD system to alternatives. An ethics committee waiver of consent was granted.With natural language processing we analyzed free-text reports to generate labels, indicating which of our 750,000 radiographs contain a nodule or other abnormality. For 1,237 images, we provided radiologist-annotated boxes around 1,861 nodules. We proposed a CAD system using convolutional neural networks trained using hybrid loss on class labels and nodule annotations. The system can predict if there is a nodule and its location.For image-based classification, a test set of 7,850 images, 1,864 containing nodules, was used to assess the CAD system in predicting presence of a nodule. For nodule-based classification a test set of 575 previously unseen radiographs containing 787 nodules was used to investigate co-localization whilst penalizing false positives. For both, we applied other leading methodologies to our test dataset for comparison.

RESULTS

Image-based classification yielded an Accuracy of 0.76 and F1 of 0.67 (cf. 0.64 & 0.55 for annotation-based, and 0.72 & 0.62 for report-based CAD systems, respectively).Nodule-based metrics showed Recall 0.65, Precision 0.15, with 43% overlap between manual and CAD bounding boxes (cf. 0.37, 0.28, 30% for annotation-based, and 0.34, 0.10, 17% for report-based CAD systems).

CONCLUSION

Our study demonstrates improved nodule detection and localization from combining manual annotations with 'big data' from 750,000 films.With further work, CAD may act as a 'second reader' for chest radiographs, increasing sensitivity in nodule detection without compromising specificity.

CLINICAL RELEVANCE/APPLICATION

Computer-aided detection systems learning from 'big data' can help detect nodules on chest radiographs with potential to act as a cost-effective 'second reader' across healthcare systems worldwide.

SSC03-05 QIBA Challenge: Establishing Conformance of Segmentation Algorithms for Quantitative CT Volumetry

Monday, Nov. 27 11:10AM - 11:20AM Room: S504CD

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PURPOSE

To conduct a public Challenge through Quantitative Imaging Biomarker Alliance (QIBA) to assess the conformance of segmentation algorithms for CT volumetry and to establish interchangeability between real and simulated lesions.

METHOD AND MATERIALS

Simulated lung lesion models (based on pathologically confirmed malignant tumors) were virtually inserted into (a) 3 phantom datasets using validated projection and image-domain insertion programs, and (b) 30 clinical chest CT cases containing real lesions "hybrid datasets". The study was designed as a public Challenge to academic researchers and commercial software developers to apply their volume estimation algorithms on simulated and corresponding real lung lesions. Equivalence between real and simulated lesions was analyzed in terms of bias and repeatability coefficient (RC) (phantom only), and algorithm reproducibility (variance between measurements by different algorithms on the same lesion). Comparisons were made relative to insertion method, participant, and lesions (shape, size, location).

RESULTS

8 and 16 groups (industry/academic) participated in the phantom and hybrid sections of the Challenge, respectively. Either fully or semi-automated segmentation algorithms were used. Percent bias and repeatability coefficient based on the defined QIBA compliance criteria showed that 3 of 8 groups were fully compliant with the profile, and one close non-compliance. For compliant groups, %bias (95% confidence intervals) was -0.43% (±5.6%) for real and -0.34 to -2.2% (±5.8%) for simulated lesions; while RC was 13% for real and 2 to 13% for simulated lesions.

CONCLUSION

Hybrid datasets can overcome phantom lack of realism and patient lack of ground truth limitations. Our results indicate that simulated and real lesions are generally comparable but exhibit differences for certain algorithms. This shows simulated lesions inserted into clinical cases can be used in the assessment of quantitative volumetry methods.

CLINICAL RELEVANCE/APPLICATION

Hybrid datasets help us better assess the performance of lesion segmentation algorithms for QIBA Profile conformance. This enables translation of precision medicine in the context of quantitative CT.

SSC03-06 Pulmonary Hamartomas: Safely Increasing the Rate of CT Diagnosis

Monday, Nov. 27 11:20AM - 11:30AM Room: S504CD

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PURPOSE

For decades, the CT diagnosis of pulmonary hamartoma (PH) has been based on the presence of popcorn calcifications or fat (-40 to -120 HU) limited to a smooth <2.5cm pulmonary nodule. These rigid criteria were selected to avoid classifying necrotic neoplasms as benign. A minority of the PH fulfill these criteria which results in unnecessary surgical resections. The aim of our study was to assess the spectrum of HU distribution in PH and whether the adoption of a wider threshold for fat content can safely be implemented for non invasively diagnosing PH without misinterpreting malignant lesions as benign.

METHOD AND MATERIALS

We retrospectively assessed the CT scans of consecutive histologically confirmed: PH (histPH), pulmonary metastases and primary lung cancers as well as PH diagnosed by CT (CTPH). Their size, volume, average, minimum and maximal HU were assessed using an ROI of at least 8 pixels, placed in the lowest attenuation region of the nodule.

RESULTS

There were 52 histPH, 41 metastases, 49 primary lung cancers, and 34 CTPH. PH average size and volume were 14.5mm and 2270.2mm 3 and that of malignancies 26.5mm and 22,031mm 3. Popcorn calcifications were seen in 2 (4%) histPH, 11 (32%) CTPH

and non of the malignant lesions. The average HU for histPH, CTPH, metastases, and primary lung cancers were: 3.99, -10.97, 25.53, 38.61 respectively. Of the malignant lesions, only 4 had an average of <0 HU and comprised of metastses of sarcoma (n=1), colon (n=1), mature cystic teratoma (n=1) and ovary (n=1). Minimum pixel HU value of <0 were seen in 28 (31.1%) of malignant nodules with the lowest minimal pixel value of -42 as compared to 44 (84.6%) of the histPH and 33 (97%) of the CTPH with a minimal pixel value of -168 HU. By raising the average HU threshold value for diagnosing PH from -40 to -20, the sensitivity for diagnosing PH rises from 9.3% to 18.6% while the positive predictive value and the specificity remain 100%.

CONCLUSION

By increasing the threshold for identification of fat in PH to -20 unnecessary surgical intervention may be prevented without misdiagnosing cancer as benign.

CLINICAL RELEVANCE/APPLICATION

By increasing the threshold for fat identification, a greater number of PH will be safely identified and unnecessary surgery avoided.

SSC03-07 Computer-Aided Detection (CAD) Of Pulmonary Nodules on Computed Tomography (CT) With AIDR3D in Vivo-Result: Comparison between Ultra-Low-Dose CT (ULDCT) Equivalent Dose to Chest X-Ray and Low-Dose CT (LDCT)

Monday, Nov. 27 11:30AM - 11:40AM Room: S504CD

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PURPOSE

To determine the beneficial effect of computer-aided detection (CAD) for pulmonary solid and sub-solid nodules in ultra-low-dose CT with AIDR 3D (ULDCT) and low dose CT with AIDR 3D (LDCT).

METHOD AND MATERIALS

This was part of the ACTIve Study, a multi-center research project in Japan. The Institutional Review Board of each institution approved this study, and written informed consent was obtained. In a single visit, 68 subjects underwent chest CT (64-row helical mode) using identical 320-row scanners with different tube currents: 240,120 and 20 mA (2.51, 1.26 and 0.21mSv, respectively). Standard of reference (SOR) was established based on consensus reading of CT images at 240mA by two radiologists. CAD was performed in ULDCT (20mA) and LDCT (120mA) with lung reconstruction kernels. Another 2 observers independently assessed lung nodule presence on both methods. In total and 4 subgroups classified according to the combination of nodular size (<5, >5mm) and characters (solid, sub-solid), nodule detection rate (NDR) for both CAD and 2 observers with CAD was compared between both methods with Fisher's exact probability test, and NDR without CAD and that with were compared with McNemar test for each observer. Scan-based false positive ratio by CAD (FPR) was compared with paired t-test between both methods.

RESULTS

For SOR, 123 solid and 100 sub-solid nodules were identified (mean diameter 6.0 ±4.1 mm, range 2-29 mm). NDR by CAD on ULDCT (28%) was similar to that on LDCT (30%) in total as well as the 4 subgroups ($p>0.05$). CAD led to a significant increase of NDR for 2 observers on both modalities for smaller solid nodules (<5mm) ($p<0.001$) and observer 1 on LDCT for larger solid nodules (>5mm) ($p=0.031$). For larger nodules, NDR for 2 observers with CAD on ULDCT (92% for solid, 77% for sub-solid) was comparable to that on LDCT (95% for solid, 86% for sub-solid) ($p>0.05$). FPR on LDCT (2.5±4.1) was similar to that on ULDCT (2.4±2.2).

CONCLUSION

ULDCT showed comparable NDR for larger nodules to LDCT regardless of CAD application. In contrast, adding CAD in ULDCT improved NDR by observers for smaller solid nodules, although similarity in NDR to LDCT was not achieved.

CLINICAL RELEVANCE/APPLICATION

ULDCT could be useful for larger lung nodule detection irrespective of nodular characters and provide improved detection sensitivity of radiologists by CAD for smaller lung solid nodules

SSC03-08 Lung Nodule Volumetry: Variability at Multiphase Cardiac CT

Monday, Nov. 27 11:40AM - 11:50AM Room: S504CD

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PURPOSE

The purpose of the study was to determine the intra-scan variability of volumetric measurements of solid pulmonary nodules.

METHOD AND MATERIALS

In this retrospective study, 827 consecutive patients that underwent cardiac multi-phase CT scan were evaluated. All the CT exams were performed on a 256-row CT scanner (SIEMENS Somaton Definition Flash) using 0.6mm slice thickness and soft kernel. The image reconstructions were done using 10 phases in 10% of each RR interval. The images were evaluated in the axial plane to identify the lung nodule and after the semi-automatic tool for lung lesions / volumetry was applied. The volume of the nodule was determined two times according with two different phases of the scan for each patient.

RESULTS

For statistical analysis 66 pulmonary nodules with medium volume of 8mm were included. The mean nodule volumetric difference was 513mm3 or 21.6%. Confidence interval of difference observed on measurements taken on different cardiac phases: Percentile 5. 15mm3 or 0.00%; Percentile 50. 62mm3 or 14%, and Percentile 95. 1696mm2 or 58%. The volume measurements showed significant variability for any one given nodule during a single multi-phase scan ($p<0.05$). There was no correlation between the volume measurement of the nodule and the difference between the volume measurements.

CONCLUSION

There is significant cardiac phase variability in lung nodule volume measurement.

CLINICAL RELEVANCE/APPLICATION

Lung nodule measurements are important in identifying potential early malignant transformation and relies on identifying a significant increase in size (25%) and change in character between serial scans.In recent years many limiting factors to the measurements' accuracy have been identified, such as nodule size, location, morphology, inspiratory effort and others such as the technical parameters of the scan.Our purpose is to determine the importance of the hemodynamic factors in the lung nodule volumetry, measuring the variation and reliability of semiautomated lung nodule volumetric measurements during the same CT acquisition and in different cardiac phases.

SSC03-09 Pulmonary Nodules in Melanoma Patients: How Long Do We Need to Follow Them to Determine if They Are Benign or Metastatic?

Monday, Nov. 27 11:50AM - 12:00PM Room: S504CD

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PURPOSE

This study aims to determine what timeline should be utilized to follow pulmonary nodules in melanoma patients to confirm metastatic or benign origin and to delineate features that favor metastatic versus benign etiology.

METHOD AND MATERIALS

588 patients had surgery for primary melanoma between 2012-15 in our tertiary care centre. Out of these, 148 patients had baseline chest CT and at least one followup (FU) CT and were included in the study. Patients with definitely benign nodules, metastases and other non-melanoma malignancies were excluded. Nodules were volumetrically measured on FU CTs and a cut-off of 15% difference in volume was considered as significant change. Distance from pleura, peripheral versus central and perifissural location, irregularity, solid versus groundglass density were evaluated. Nodules were considered metastases if they increased in size between two FU CTs or if increase was accompanied by multiple new lung nodules or extrapulmonary metastases.

RESULTS

On baseline CT, 70 patients (A) had at least one indeterminate pulmonary nodule (IPN) and 78 (B) had none. In group A all patients had 243 IPN (0.0236 cm3) and only 1 nodule increased 405% in volume in 5 months and was proven metastatic. Out of 243 IPN, 215 were peripheral, 40 perifissural, 218 solid, 25 groundglass, 4 had irregular margins. 18 nodules increased 50% in volume in the first 3-month CT and either resolved or decreased in another 3 months. During FU, overall, 28 patients developed 33 new nodules (0.0814 cm3) out of whom 24 (86%) were metastases. In 4 patients, nodules resolved or decreased in 5.5 months and were presumed benign. All metastases (33) were solid and 4 were perifissural. Median volume increase between 2 CTs (median 3 months) was 260% ($p <0.001$). All but one metastases had smooth margins.

CONCLUSION

IPN on baseline CT are most likely benign and monitoring up to 6 months can confirm it. Newly developed nodules have a high possibility of being metastatic and FU in 3 months can confirm it if needed. Volume increase is significantly lower in benign than metastatic nodules. Perifissural location of new nodules does not exclude metastatic origin, however groundglass and irregular

margin most likely does.

CLINICAL RELEVANCE/APPLICATION

IPN on baseline CT require monitoring up to 6 months to confirm benign origin. Newly developed nodules have a high risk of being metastatic and follow up in 3 months will confirm increase in size.

SSC04

Gastrointestinal (Rectal Cancer)

Monday, Nov. 27 10:30AM - 12:00PM Room: E353A

GI MR OI BQ

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

Participants
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Sub-Events

SSC04-01 Comparison in Prognosis of Patients with Rectal Cancer between Low- and High-Risk Group Defined by Magnetic Resonance Imaging (MRI)

Monday, Nov. 27 10:30AM - 10:40AM Room: E353A

Participants
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PURPOSE

To compare the prognosis of patients with rectal cancer between low- and high-risk group detected by MRI, who were treated by total mesorectal excision (TME) surgery and selective adjuvant chemoradiotherapy

METHOD AND MATERIALS

Patients with pathology-proven rectal adenocarcinoma and received TME surgery between January 2006 and December 2014 were included in this retrospective study. Patients who were treated with neoadjuvant chemoradiotherapy, and had other malignancies or distant metastasis were excluded. All included patients had been followed-up until December 2016. The risk factors detected by MRI were defined as: extramural depth of tumor invasion larger than 5mm for mid and upper tumor, intersphincteric space invasion for low tumor, extramural venous invasion (EMVI), circumferential resection margin (CRM) involvement. Patients were divided into low- and high-risk group based on the presence of risk factors. Kaplan-Meier method was used to compare the local overall survival (OS), disease-free survival (DFS), and local recurrence (LR) between two groups, and analyze the univariate influence of risk factors of OS, DFS and LR. A Cox proportional hazards regression model was constructed to figure out independent risk factors of OS, DFS and LR.

RESULTS

Sixty-five patients (35.1%) of whole cohort (185) were divided into low-risk group and 120 (64.9%) were divided into high-risk group. Significant difference was demonstrated between low- and high- risk group shown as 3-year actuarial OS (100% vs.87.8%), DFS (92.3% vs.55.7%) and LR (3.1% vs.10.4%). Compared with mrT and mrN, CRM was identified as the independent risk factor of OS (HR 4.70, 95% confidence interval (CI) 1.25-17.66), DFS (HR 2.44, 95%CI 1.24-4.81) and LR (HR 3.92, 95%CI 1.07-14.41) by using the Cox proportional hazards regression analysis. Moreover, EMVI was identified as the independent risk factor of DFS (HR 2.46, 95%CI 1.28-4.73).

CONCLUSION

For patients with rectal cancer, CRM and EMVI status preoperatively assessed by MRI are the most important factors in predicting local recurrence and long-term survival.

CLINICAL RELEVANCE/APPLICATION

Estimating the presence of risk factors by MRI preoperatively can help predict prognosis and make decision of whether patients need to receive neoadjuvant therapy before TME surgery.

SSC04-02 Comparison of Reduced Field-of-View Diffusion Weighted Imaging (DWI) and Conventional DWI Techniques in Assessment of Rectal Carcinoma at 3.0 T: Image Quality and Histological T Staging

Monday, Nov. 27 10:40AM - 10:50AM Room: E353A

Participants

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PURPOSE

To assess the image quality (IQ) and histological T staging of rectal cancer by comparison of reduced field-of-view (FOV) and full FOV DWI sequences at 3T.

METHOD AND MATERIALS

Eighty-one patients with rectal cancer received MR scan of both rFOV DWI and fFOV DWI sequences. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were quantitatively evaluated using paired T test. Two radiologists independently assessed the subjective IQ parameters including image sharpness, distortion, artifacts, lesion conspicuity and overall subjective IQ of both DWI sequences. Wilcoxon signed rank test was used to compare subjective IQ scores and tumor ADCs between DWI sequences. Mean tumor ADCs between DWI sequences were compared in relation to corresponding T staging of rectal cancer by utility of the spearman rank correlation analysis test.

RESULTS

CNR was significantly higher in rFOV DWI than in fFOV DWI (7.15±2.77 vs. 5.39±2.08, P<0.001). SNR was significantly higher in rFOV DWI than in fFOV DWI (44.17±11.01 vs. 34.76±13.30, P<0.001). The subjective IQ parameters of rFOV DWI sequence were rated superior to that of fFOV DWI sequence by both readers (P<0.001). There was no significant difference between mean tumor ADC values of rFOV and fFOV DWI sequences (0.991±0.121 vs. 0.100±0.126×10-3mm2/s, P=0.617). Apart from T1 stage, T staging of rectal cancer was correlated inversely with ADC values of rFOV DWI (r= -0.688, P<0.001) and fFOV DWI sequences (r= -0.641, P<0.001).

CONCLUSION

rFOV DWI sequence provided significantly higher image quality and lesion conspicuity than fFOV DWI sequence. Besides, both DWI sequences can be used for evaluation of histological T staging of rectal cancer.

CLINICAL RELEVANCE/APPLICATION

Image quality can be improved by utility of rFOV DWI sequence and is recommended as part of MR study for rectal cancer before total mesorectal excision(TME) surgery

SSC04-03 Colorectal Carcinoma: Ex Vivo Evaluation using q-Space Imaging and its Correlation with Histopathologic Findings

Monday, Nov. 27 10:50AM - 11:00AM Room: E353A

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PURPOSE

To determine the feasibility of ex vivo q-space imaging (QSI) as a method of evaluating the histologic grades of colorectal carcinomas and lymph node metastasis by colorectal carcinomas.

METHOD AND MATERIALS

Twenty colorectal specimens each containing a carcinoma and their resected lymph nodes were imaged with a 3-T MR imaging system equipped with a 4-channel phased-array surface coil. QSI data were obtained by using a spin echo-based single-shot echo-planar imaging sequence: repetition time, 10000 ms; echo time, 216 or 210 ms; field of view, 113 mm x 73.45 mm; matrix, 120 x 78; section thickness, 4 mm without intersection gaps; eleven b values ranging from 0 to 9000 s/mm2; and motion-probing gradients perpendicular to the colorectal wall. Mean displacement (MDP; in μm), zero-displacement probability (ZDP; in arbitrary unit [a.u.]), and kurtosis (K; in a.u.) were calculated from the displacement distribution profiles, and apparent diffusion coefficient (ADC) was also calculated from two b values (b = 0 and 500 s/mm2). The MR images were then compared with the histopathologic findings as the reference standard.

RESULTS

In all 20 colorectal carcinomas, the MDP was calculated as 8.85 ± 0.36 μm, ZDP 82.4 ± 6.2 a.u., K 74.4 ± 3.0 a.u., and ADC 0.219 ± 0.041 x 10-3 mm2/s. With the histologic grades (well, moderately, and poorly differentiated) of the colorectal carcinomas, the MDP (r = -0.829; P < 0.001) showed a significant inverse correlation and the ZDP (r = 0.810; P < 0.001) and K (r = 0.848; P < 0.001) showed a significant positive correlation, while the ADC (r = 0.104; P = 0.673) showed no significant correlation. Between metastatic lymph nodes and nonmetastatic lymph nodes, the MDP (10.3 ± 1.2 vs. 19.0 ± 2.0 μm; P < 0.01), ZDP (53.6 ± 16.1 vs. 26.2 ± 2.0 a.u.; P < 0.01), and K (61.0 ± 10.9 vs. 25.3 ± 2.7 a.u.; P < 0.01) showed significant differences, while the ADC (1.02 ± 0.38 vs. 1.39 ± 0.09 x 10-3 mm2/s; P = 0.095) showed no significant differences.

CONCLUSION

QSI provides useful diagnostic information for evaluating the histologic grades of colorectal carcinomas and lymph node metastasis by colorectal carcinomas.

CLINICAL RELEVANCE/APPLICATION

By using QSI for patients with colorectal carcinoma, we may have an effective tool to noninvasively diagnose the histologic grades of colorectal carcinomas and lymph node metastasis by colorectal carcinomas.

SSC04-04 Long-Term Follow-Up with MRI during a "Watch-And-Wait" Approach in Clinical Complete Responders after Chemoradiotherapy

Monday, Nov. 27 11:00AM - 11:10AM Room: E353A

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PURPOSE

A 'watch-and-wait' approach is emerging as an alternative to resection in rectal cancer patients with a clinical complete response (CR) after CRT. Follow-up consists of clinical examination, endoscopy and MRI. Limited data exists on what to expect on MRI during follow-up. Aim was to evaluate the morphology of the rectal wall in patients in the watch-and-wait programme and study its evolution during follow-up for watch-and-wait these patients.

METHOD AND MATERIALS

140 patients with a sustained complete response (i.e. no evidence of recurrence on sequential imaging and endoscopy±biopsy examinations) were analysed during follow up within the scope of a 'watch-and-wait' protocol. Patients underwent MRI (and clinical examination and endoscopy) 3-monthly in the first year and 6-monthly during the 2nd to 5th year. Two readers in consensus analysed the rectal wall morphology on the initial post-CRT scan and studied the evolution in morphology on the various sequential follow-up MRIs.

RESULTS

Median follow-up time was 18 months (range 6-82). A total of 801 MRIs were analysed (median 5, range 2-13 per patient). In 9% of patients the rectal wall completely normalised post-CRT. The other 91% showed a fibrotic remnant (64% minimal fibrosis limited to the bowel wall; 21% thick/mass-like fibrosis and 6% irregular/spicular fibrosis). In 92% the rectal wall morphology remained unchanged during long-term follow-up, in 4% initial fibrosis later developed into a normalised wall, in 4% the fibrosis slightly thickened (without evidence of recurrence).

CONCLUSION

In the vast majority of patients with a complete response residual fibrosis is present post-CRT, which remains unchanged during long-term follow-up in almost all patients. A completely normalised wall is observed in approximately 1 in 10 complete responders. These findings may serve as a reference and provide teaching for radiologists involved in the clinical follow-up of patients selected to undergo a watch-and-wait policy.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the evolution of the rectal wall is crucial to allow for safe use of a watch-and-wait approach in complete responders after CRT for rectal cancer.

SSC04-05 Use of Restaging Abdominopelvic CT after Neoadjuvant Chemoradiation Therapy in Patients with Nonmetastatic Locally Advanced Rectal Cancer

Monday, Nov. 27 11:10AM - 11:20AM Room: E353A

Participants
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PURPOSE

Neoadjuvant chemoradiation therapy (CRT) before surgery is current standard for locally advanced rectal cancer without distant metastasis, but it delays surgery for several months. We investigated if restaging abdominopelvic CT before surgery after CRT is beneficial given the time lag from the initial diagnosis.

METHOD AND MATERIALS

472 consecutive patients (M:F, 308:164; 62.2±11.8 years) who had newly diagnosed rectal cancer (T3 or N+ as assessed with MRI), no distant metastasis or any lesions that were not cleared of metastasis as evaluated with both CT and PET/CT, and no previous (during past 5 years) or concomitant cancers, underwent long-course CRT. Patients were reevaluated 4-6 weeks after CRT with rectal MRI and restaging abdominopelvic CT (n=231) or with rectal MRI alone (n=218). 23 patients dropped out. Diagnostic yield of the restaging CT for abdominopelvic metastasis was determined. The rate of overlooked abdominopelvic metastasis, defined as lesions that were unexpectedly found during rectal cancer surgery or developed early (within 6 months) after the surgery or CRT (for 8 patients followed without surgery), and the outcome of the overlooked lesions were compared between the two patient groups. Abdominopelvic progression-free survival (PFS) was compared between the two groups.

RESULTS

Diagnostic yield of restating CT was 2.2% (5/231), all of which were resected with curative intent. Restaging CT created false positives in three patients, causing unnecessary hepatic resection (n=1), RFA (n=1), and follow-up liver MRI (n=1). Restaging CT group had seven patients (3%) with overlooked abdominopelvic metastasis; four patients found during the surgery, three of whom could be operated with curative intent, and three patients as early postsurgical metastasis, one of whom was amenable to curative-intent treatment. The no CT group had seven patients (3.2%) with overlooked metastasis; all as early postsurgical metastasis, three of whom were amenable to curative-intent treatment. These rates did not significantly differ (P=1). Abdominopelvic PFS did not significantly differ between the two groups (P=.426).

CONCLUSION

Restaging abdominopelvic CT after CRT for locally advanced rectal cancer does not have a clear benefit due to its low yield, insufficient exclusion of metastasis, and unignorable risk of false-positives.

CLINICAL RELEVANCE/APPLICATION

This study recommends against restaging abdominopelvic CT after CRT for rectal cancer.

SSC04-06 PET/MRI in Patients with Pelvic Recurrence of Rectal Cancer: Technical Feasibility and First Clinical Experiences

Monday, Nov. 27 11:20AM - 11:30AM Room: E353A

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PURPOSE

Accurate diagnosis of pelvic recurrence of rectal cancer is crucial in determining further treatment, especially prior to surgical resection. So far, PET/MRI has not been widely used in this setting. The purpose of this study was to determine the value of PET/MRI in the pre-therapeutic staging and management of patients with pelvic recurrence of rectal cancer.

METHOD AND MATERIALS

Out of 57 patients with a history of rectal cancer who received PET/MRI between June 2011 and July 2016 at our institution, 34 patients were retrospectively enrolled in the study. 23 patients were excluded because they were lost to follow-up. One patient received two PET/MRIs, thus a total number of 35 examinations was included. Pelvic recurrence was confirmed either with histology (biopsy n=5, surgery n=21) or clinical and imaging follow-up (>6 months). Two blinded readers (1 radiologist, 1 nuclear medicine physician) interpreted the images in consensus. Pelvic lesions were assessed regarding FDG-uptake, morphology, contrast enhancement and diffusion restriction. Sensitivity, specificity, positive and negative predictive value as well as accuracy of PET/MRI were determined.

RESULTS

In 35 PET/MRIs 26 pelvic lesions were identified, out of which 25 were deemed suspicious for pelvic tumor recurrence. One lesion was thought to be a vesicovaginal fistula. 24 of the 25 lesions were confirmed as malignant. One patient was resected and had histologically proven pelvic recurrence without suspicious findings on PET/MRI. Changes in management due to PET/MRI findings were implemented in 2 patients (metastasis sacral nerve=1, penile metastasis=1), 83% of resected patients had histologically negative resection margins (R0). The sensitivity of PET/MRI in detecting recurrence was 96%, specificity 92%, positive/negative predictive value and accuracy were 96%, 92% and 95%, respectively.

CONCLUSION

PET/MRI demonstrates high sensitivity and specificity in the preoperative diagnosis and staging of pelvic recurrence in patients with rectal cancer.

CLINICAL RELEVANCE/APPLICATION

PET/MRI is a valuable tool in the preoperative diagnosis and staging of pelvic recurrence in patients with rectal cancer, aiding in achieving high rates of R0-resection.

SSC04-07 Interobserver Reproducibility in Assessing the Response after Neoadjuvant Chemoradiation Therapy for Locally Advanced Rectal Cancer Using Magnetic Resonance Tumor Regression Grade (mrTRG)

Monday, Nov. 27 11:30AM - 11:40AM Room: E353A

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PURPOSE

Methods to assess the response after neoadjuvant chemoradiation therapy (CRT) for locally advanced rectal cancer on post-CRT MRI have been proposed, of which magnetic resonance tumor regression grade (mrTRG) is seemingly most recognized. However, interobserver reproducibility of mrTRG has hardly been evaluated outside those who developed the mrTRG system. This study is to assess the interreader reproducibility of mrTRG externally.

METHOD AND MATERIALS

50 pairs of pre- and post-CRT (obtained 4-6 weeks after the finish of CRT) rectal MRI sets obtained in 50 patients (M:F, 36:14; 65.5±12.4 years), who were randomly chosen from a consecutive cohort of 439 patients who underwent long-course CRT for a newly diagnosed locally advanced rectal cancer (T3 or N+ stage as seen on pre-CRT MRI, no distant metastasis, and no other previous or concomitant cancers), were included. Before the study, three abdominal radiologists experienced with rectal MRI went through an educational session consisting of a review of 50 training cases collected outside the study cohort and reading of relevant articles. The three readers assessed the CRT response for this study using mrTRG (1 to 5) independently blinded to any other information than the history of CRT. We analyzed interreader reproducibility regarding the description of individual mrTRG (1 to 5) as well as regarding the binary interpretation of mrTRG1 and 2 (i.e., good response) vs. 3-5, using weighted kappa with linear weights and the conventional kappa, respectively. For mrTRG1 and 2 vs. 3-5, the proportional agreement was also obtained.

RESULTS

According to the consensus interpretation among the three readers, the mrTRG distribution in the study patients was 14% mrTRG1 (n=7), 26% mrTRG2 (n=13), 32% mrTRG3 (n=16), 28% mrTRG4 (n=14), and 0% mrTRG5. The weighted kappa for describing the individual mrTRG (1 to 5) was 0.62 overall and 0.60 to 0.62 for individual reader pairs. The kappa for mrTRG1 and 2 vs. 3-5 was 0.65 overall and 0.57 to 0.72 for individual reader pairs. The proportional agreement in interpreting mrTRG1 and 2 vs. 3-5 was 83% overall and 80-86% for individual reader pairs.

CONCLUSION

mrTRG showed a substantial interobserver reproducibility, which further supports its implementation for use in clinical practice and trials.

CLINICAL RELEVANCE/APPLICATION

mrTRG could be used fairly reliably in clinical practice and trials to guide further treatment after neoadjuvant CRT for rectal cancer.

SSC04-08 Assessing FDG-PET/3-T MRI after Preoperative Chemoradiotherapy for Rectal Cancer

Monday, Nov. 27 11:40AM - 11:50AM Room: E353A

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PURPOSE

To assess the accuracy of pelvic 3-T MRI and combined FDG-PET/3-T MRI (PET/MRI) in predicting pathological tumor and node (ypTN) stages, and to compare the accuracy of whole-body PET/MRI with thoraco-abdominal CT (CT) in predicting metastases (ypM) stage.

METHOD AND MATERIALS

This prospective study concerned 17 patients (16 male) with locally advanced rectal cancer who underwent preoperative chemoradiotherapy, PET/MRI and CT for staging purposes. PET/MRI included T2 and diffusion weighted images. Total mesorectal excision was the treatment of choice for 13 patients; the remainders were MRI node negative and underwent transanal local excision with at least 1-year endoscopic and pelvic MRI follow-up. Concurrent distant metastases were confirmed by surgery/biopsy or followed up with CT. One radiologist assessed pelvic MRI and CT images. Another radiologist and a nuclear medicine physician jointly assessed PET/MRI findings. All three were blinded to all other imaging and pathology results.

RESULTS

ypT was T0 in 4 patients, T1 in 3, T2 in 1, T3 in 7, and T4 in 2. ypN was positive in 5/17 cases, and metastases were detected in 3/17 patients. MRI and PET/MRI findings for ypT were concordant and correct in 11/17 patients (64.7%), concordant and incorrect

in 2/17 (11.8%), and discordant in 4/17 (23.5%), PET/MRI staging being correct in 2 cases. As for ypN staging, MRI and PET/MRI were concordant and correct in 14/17 patients (82.3%) and discordant in 3/17 (17.7%), with PET/MRI staging predicting ypN status in 2 cases. Two patients with metastases were diagnosed correctly, while PET/MRI misdiagnosed one case of a small lung metastasis.

CONCLUSION

Integrated whole-body PET/MRI improves the accuracy of ypTN staging, but is less accurate than CT in ypM staging. Further studies are needed, including efforts to refine PET/MRI by using specific sequences for the lung and intravenous gadolinium, to examine the role of this technique in monitoring distal cancer spread. If successful, it would be possible to combine local and distant rectal cancer staging in a single examination.

CLINICAL RELEVANCE/APPLICATION

FDG-PET/3-T MRI can be a useful tool for the whole-body staging (TNM) of patients with advanced rectal cancer after chemoradiotherapy.

SSC04-09 Tumor Heterogeneity MRI Features Improve Machine Learning-Based Prognostication in Patients with Metastatic Colon Cancer

Monday, Nov. 27 11:50AM - 12:00PM Room: E353A

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PURPOSE

Intra-tumor heterogeneity has been previously shown to be an independent predictor of patient survival. The goal of this study is to use machine learning to assess the role of quantitative MRI-based measures of intra-tumor heterogeneity as predictors of survival in patients with metastatic colorectal cancer.

METHOD AND MATERIALS

In this IRB-approved retrospective study, we identified 52 patients with stage 4 colon cancer who underwent MRI from 2007-2013 for liver metastasis evaluation. Patient survival data was available for up to 95 months. Standard clinical and pathologic prognostic variables were extracted from the medical record. The largest metastatic hepatic lesion was identified on portal venous phase T1-weighted fat-suppressed post-contrast images and manually segmented. A heterogeneity phenotype vector was extracted from each lesion by using quantitative texture analysis as a measure of spatial heterogeneity. Univariate regression analysis was used to assess for independent contribution of 32 extracted texture features to survival prediction. A linear support vector machine (SVM) machine learning technique was applied to the extracted heterogeneity phenotype vector and to the standard prognostic clinical and pathologic variables. The classifiers were trained and tested using 10-fold cross validation to avoid overfitting. ROC analysis and the area under the curve (AUC) were used to assess classification performance. Delong's test was used to assess for differences between ROC curves.

RESULTS

Mean survival time was 39±3.9 months for the study population. Tamura texture features, directionality, coarseness and contrast were independently associated with patient survival ($p<0.01$). The trained SVM model that included standard clinical and pathological prognostic variables resulted in an area under the ROC curve of 0.80. An SVM model that adds imaging-based heterogeneity features to the clinical and pathological variables resulted in improved model performance for survival prediction with an AUC of 0.98 ($p<0.001$).

CONCLUSION

MRI-based texture features improve the performance of standard clinical and pathological variables for predicting patient survival in metastatic colorectal cancer.

CLINICAL RELEVANCE/APPLICATION

Machine learning-based predictive models incorporating quantitative MRI heterogeneity features may improve prognostication and personalize treatment choices in patients with metastatic colon cancer.

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SSC05

Gastrointestinal (Small Bowel Imaging)

Monday, Nov. 27 10:30AM - 12:00PM Room: E451A

GI MR

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

Participants
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Sub-Events

SSC05-01 Development and Validation of simplified Magnetic Resonance Index of Activity (sMARIA)

Monday, Nov. 27 10:30AM - 10:40AM Room: E451A

Participants
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PURPOSE

MaRIA index is the most used Magnetic Resonance Enterography (MRE) index in clinical trials for luminal Crohn's disease (CD). However, a number of limitations had been recognized. The aim of this study is to develop and to validate a simplified and accurate Magnetic Resonance Index of activity (sMaRIA) for assessing activity and therapeutic response on patients with luminal CD.

METHOD AND MATERIALS

MRE data from 98 patients, including active and inactive disease on the colon and/or terminal ileum, from two prospective studies were re-analysed to develop the sMaRIA using endoscopy (CDEIS) as gold standard. Further analysis of responsiveness in a cohort of 48 patients who underwent MRE and endoscopy at screening and after 12 weeks of therapy with antiTNF or corticoids was performed. Comparison between MaRIA and sMARIA for detecting active/severe lesions and therapeutic response was performed.

RESULTS

Logistic regression analysis showed that wall thickness >3 mm, presence of edema, ulcers and fat stranding were independent predictors for assessing CD activity and were used as descriptors of sMaRIA. The sensitivities and specificities of sMaRIA at segment level for detecting active disease using a cutoff >=5 were 90% and 81% (AUC 0.91), and for detecting severe lesions at endoscopy (presence of ulcerations) using a cutoff >=10 were 85% and 92% (AUC 0.93). Correlation between sMaRIA and CDEIS was r=0.82 and with MaRIA r=0.91 (p<0.0001). Sensitivities and specificities of sMaRIA were no statistically significant different from MaRIA for detecting activity (p=0.07 and p=0.2 respectively) or for detecting severe lesions (p=0.5 and p=0.5 respectively). The sensitivity and specificity of sMaRIA for detecting endoscopic remission (CDEIS<3.5) using a cutoff<5 were 82% and 88% (AUC 0.88), and for detecting ulcer healing at endoscopy using a cutoff <10 were 64% and 96% (AUC 0.93).

CONCLUSION

The simplified MaRIA index is as accurate as the MaRIA for detecting active and severe inflammation, and also has high diagnostic accuracy for detecting therapeutic response. Main advantages over MaRIA includes simplicity, its calculation is less time consuming and accounts for missing segments.

CLINICAL RELEVANCE/APPLICATION

Simplified MaRIA index allows a fast and simple assessment of inflammation activity on CD by keeping high accuracy for both diagnosis and therapeutic response.

SSC05-02 Intravoxel Incoherent Motion Diffusion-weighted MRI Detection and Grading of Bowel Wall Fibrosis in Crohn's Disease

Monday, Nov. 27 10:40AM - 10:50AM Room: E451A

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PURPOSE

To determine the value of intravoxel incoherent motion (IVIM) diffusion-weighted MRI (DWI) for detecting and grading bowel wall fibrosis in adults with Crohn's disease (CD).

METHOD AND MATERIALS

17 adult patients (8 men, 9 women; mean age: 31.75 ± 8.58 years) with CD underwent pre-operative IVIM-DWI. The free-breathing IVIM-DWI was obtained using a single-shot spin-echo echo-planar imaging sequence with 13 b values (contains 0 - 2000 mm/s2) on a 3T MR system with eight-channel phased-array body coils. The perfusion-related fraction (*PF*), perfusion-related coefficient (*D**), and diffusion-related coefficient (*D*) of abnormal bowel segments were calculated using a bi-exponential model with constrained least squares algorithm. Mural fibrosis of the resected bowel segments was scored 0-3 histologically. The vessel density was assessed by immunohistochemistry using panendothelial cell antigen CD31.

RESULTS

In 77 surgical specimens sampled from 17 patients, the correlation between the *PF* values and histologic fibrosis scores was significantly inverse (r = -0.675, P<0.001). The *PF* values significantly decreased with increasing severity from mild, moderate, to marked fibrosis (P<0.001). ROC curve analysis showed high accuracy of *PF* values with an AUC of 0.885 (95% confidence interval: 0.79-0.97, P<0.001) for differentiating moderate-severe from mild bowel wall fibrosis. Using threshold *PF* value of 0.33, the sensitivity and specificity for differentiating between moderate-severe fibrosis and mild fibrosis were 95.50% and 81.80%, respectively. The *D* and *D** values were not significantly correlated with histological fibrosis. There was no significant association between IVIM parameters and vessel density.

CONCLUSION

Bowel wall fibrosis in CD correlates with perfusion rather than pure diffusion. The *PF* value decreases with severity and is useful to detect and grade fibrosis.

CLINICAL RELEVANCE/APPLICATION

Free-breathing IVIM-DWI without contrast administration is a potential biological marker of bowel perfusion and may be beneficial for treatment planning and monitoring bowel wall fibrosis of CD in adults.

SSC05-03 Towards Development of a CT Enterography Severity Score for Small Bowel Crohn's Disease

Monday, Nov. 27 10:50AM - 11:00AM Room: E451A

Awards
Student Travel Stipend Award

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PURPOSE

CT and MR enterography (CTE, MRE) are used to objectively measure small bowel Crohn's disease inflammation. Quantitative severity scores have been developed for MRE (i.e., MaRIA score), but no CT severity scoring system exists.

METHOD AND MATERIALS

Patients with biopsy-proven Crohn's disease with CTE and MRE within 30 days were identified. A GI radiologist examined CTE images for ulceration, mural edema, comb sign, perienteric stranding and fistulae involving the distal 10 cm of terminal ileum (TI), and measured wall thickness and attenuation. The CT EMBARK score (a visual score from 1 to 3, for enhancement, wall thickness, and ulceration) was assigned. MaRIA scores for the TI were separately calculated by an abdominal imaging fellow for each MRE. Total lengths of inflamed ileal segments were measured by both radiologists. Statistical modeling (i.e., linear models, regularized linear models, and Random Forests) was conducted to predict the MaRIA scores based on CT findings. Performance of fitted models was assessed by R-square (R2).

RESULTS

43 patients (18 M, 25 F) had CTE and MRE within a mean of 4 days (range 0-28). By MRE, 27 (63%) patients had evidence of active TI inflammation (mean MaRIA score 17±12; mean inflamed length 13±11 cm). By CTE, 30 (70%) had active TI inflammation (mean inflamed length 13±11 cm), with 8 (19%) showing ulceration, 19 (44%) mural edema, 9 (21%) comb sign, 6 (14%) perienteric stranding and 1 (2%) fistula. Association of the CTE severity scores with MaRIA score ranged from R2 = 0.60 for the

visual EMBARK score to R2=0.93 for the Random Forest model with all CT features considered. A parsimonious linear model, with variables informed through variable selection in a cross-validated regularized (elasticnet) regression model, was as follows: Predicted MaRIA = 2.90 + 2.78 * CT Wall Thickness + 5.72 (if Perienteric Stranding is present) + 6.72 (if Ulceration is present). This model performed well (R2 = 0.64). ICC for length measurements was 0.82 (95% CI: 0.70 to 0.90).

CONCLUSION

We determined CT features and weightings to calculate a CT severity score similar to MaRIA. Further work will be required to finalize and validate the scoring system.

CLINICAL RELEVANCE/APPLICATION

Because CT imaging is used to guide management in symptomatic Crohn's disease, a CT severity score similar to MaRIA has been developed to measure inflammatory severity and quantify therapeutic response.

SSC05-04 MR T2* Mapping Helps to Characterize Intestinal Fibrosis in Patients with Crohn's Disease

Monday, Nov. 27 11:00AM - 11:10AM Room: E451A

Awards
Student Travel Stipend Award

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PURPOSE

The assessment and quantification of fibrosis in Crohn's disease (CD) patients has important therapeutic implications. T2* mapping has the potential to reflect small changes in the biochemical components of the counterpart tissue without contrast medium injection. We first aimed to determine the utility of T2* mapping for grading diverse degrees of intestinal fibrosis using surgical pathology as reference standard.

METHOD AND MATERIALS

This was an observational study of 20 CD patients who underwent an MR T2*WI scan within 15 days before elective enterectomy. The T2* values of the bowel wall to be resected were measured for each region. Resected bowel tissues with pathological fibrosis and type I collagen were classified into four severity grades (from 0 to 3).

RESULTS

Eighty-six surgical specimens from twenty patients were analyzed, including non-fibrotic (n=1) and mild (n=14), moderate (n=48) and severe (n=23) fibrosis specimens. The T2* value differences of the fibrotic segments among non-fibrotic or mild, moderate and severe CD patients were significant (all P<.001). The T2* values were moderately associated with the histologic fibrosis (r=-0.687, P<.001) and type 1 collagen scores (r=-0.588, P<.001). T2*mapping could discriminate no or mild fibrosis (grade 0-1) from moderate-severe (grade 2-3) fibrosis deposition with an area under the receiver operating characteristic (ROC) curve of 0.939, which included a sensitivity of 84.6% and a specificity of 93.2%. A threshold T2* value of 21.84 was recommended for differentiating no or mild fibrosis from moderate-severe fibrosis.

CONCLUSION

T2*mapping is capable of detecting and distinguishing between certain degrees of bowel fibrosis in CD lesions. T2* mapping might be a potentially novel imaging tool for the evaluation of fibrotic stricture in CD patients.

CLINICAL RELEVANCE/APPLICATION

The T2* value is sensitive to small changes in biochemical composition, which suggests that lesion properties, particularly the transformation of water mobility within the macromolecular network, reflect the varying phase and status of CD. The T2* values were highly accurate for differentiating non- or mildly fibrotic and moderate-severe fibrotic bowel walls in CD patients. This may be important in further stratifying CD patients regarding the disease severity or suitability for modifying disease therapy.

SSC05-05 DECT in Bowel Inflammation Assessment on Low KeV Images

Monday, Nov. 27 11:10AM - 11:20AM Room: E451A

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PURPOSE

Low mono-energetic image derived by Dual Energy CT (DECT) can enable greater attenuation of contrast and improve conspicuity

Low mono-energetic image derived by Dual Energy CT (DECT) can enable greater attenuation of contrast and improve conspicuity. We hypothesized the low mono-energetic image will improve the reliability in the assessment of bowel inflammation. We aimed to compare conventional abdominal contrast-enhanced CT images with the low mono-energetic and virtual-non-contrast (VNC) DECT images to assess the contrast enhancement, contour and related findings in acute bowel inflammation.

METHOD AND MATERIALS

Forty patients who underwent abdominal contrast enhanced DECT (IQon, Philips Healthcare, Eindhoven, Nederland) between January and April 2017, with radiological findings correlating to bowel inflammation were retrospectively reviewed. Contrast enhanced series were performed using conventional single-energy mode at 120 kV. VNC and mono-energetic (ME) images at 50 keV were reconstructed from the conventional study. Qualitative assessments of the inflamed bowel wall, mural or intra luminal findings, adjacent fat stranding and fluid were performed on the conventional, VNC and ME images and rated on a scale of 1-5 (5 being the highest). Paired t-test was used to assess the significance of the differences between the conventional, VNC and ME images.

RESULTS

Bowel inflammation was cause by acute appendicitis (15%, 6/40), bowel obstruction (35%, 14/40), tumor (20%, 8/40) and colitis (30%, 6/40). The score of the qualitative assessment on the ME images at 50 keV (4.7) was significantly higher ($p<0.001$) compared to the score on the conventional image (3.9) The qualitative assessment had a lower score on the VNC image compared to the conventional image, with no significant difference.

CONCLUSION

Virtual low mono-energetic DECT images have the ability to significantly improve the conspicuity of bowel inflammation assessment. Non-conclusive radiological findings may thus be turned into definite and clinically relevant studies.

CLINICAL RELEVANCE/APPLICATION

The diagnostic yield of bowel inflammation can be increased with the use of mono-energetic images at low keV and therefore avoid non-conclusive radiological reports. This may assist in the clinical therapeutic decision making.

Honored Educators

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SSC05-06 Natural History of Endoscopic Skipping of the Terminal Ileum (ESTI): Incidence of Isolated Radiographic Intramural Inflammation

Monday, Nov. 27 11:20AM - 11:30AM Room: E451A

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PURPOSE

ESTI refers to a normal appearance of the terminal ileum (TI) at ileocolonoscopy (ICO) despite active small bowel (SB) Crohn's disease as evidenced by SB inflammation proximal to ICO, isolated radiographic findings of intramural inflammation (IMI) in the TI, or positive biopsy (microscopic inflammation). Our purpose is to evaluate the natural history of ESTI and the incidence of IMI in Crohn's patients.

METHOD AND MATERIALS

Patients were included who had normal ICO and CT/ MR enterography (CT/MRE) performed within 30 days showing active TI inflammation, as well as follow-up CTE/MRE. Severity of TI inflammation was assessed using a 4 point scale: 0: None; 1: hyperenhancement w/o thickening; 2: w/ >=5 mm thickness; 3: ulcers or > 10 mm in thickness. The length of TI involvement was recorded. Endoscopy and pathology reports were reviewed for length of TI intubation, endoscopic impression, and biopsy results. Patients were evaluated for new or worsening SB inflammation or stricture formation on subsequent CTE/MRE. Development of TI ulcers or inflammation detected on subsequent endoscopy or surgery was recorded. Patients with ESTI were then classified as: confirmed inflammation (subsequent worsening TI severity/length, new ulceration, or need of surgery); probable inflammation (decreased inflammation with medical therapy); inflammation unlikely.

RESULTS

113 patients had ESTI, 72 (64%) - IMI; 11 (10%) - proximal SB inflammation; 30 (27%) - microscopic and radiographic inflammation. 68 patients (60%) had confirmed inflammation, 14 (12%) - probable inflammation, and 31 (28%) - inflammation unlikely. Confirmed Inflammation was verified by subsequent surgery (n=40), positive ICO (n=41), worsened SB inflammation/stricture (n=39), and most had (IMI) (n=43/68; 63%). Median severity score and length were highest for confirmed inflammation (2, 10 cm) versus probable inflammation (1.5, 6 cm) and inflammation unlikely (1, 2 cm).

CONCLUSION

Patients with ESTI identified by CTE/MRE and who have more than 2 cm of inflammation with wall thickening >= 5mm will have

Patients with ESTI identified by CTE/MRE and who have more than 2 cm of inflammation with wall thickening >= 3mm will have inflammatory Crohn's, which worsens over time, or which will respond to medical therapy. About two-thirds of patients with ESTI have IMI, which behaves similarly.

CLINICAL RELEVANCE/APPLICATION

SB Crohn's disease should be monitored by endoscopy and enterography, as endoscopic skipping of the TI and isolated radiographic intramural inflammation will progress unless it is treated medically.

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/ Michael L. Wells, MD - 2017 Honored Educator

SSC05-07 Quantitative Inflammation Assessment for Crohn's Disease Using Ultrasound Microvessel Imaging: A Pilot Study

Monday, Nov. 27 11:30AM - 11:40AM Room: E451A

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PURPOSE

To evaluate Crohn's Disease (CD) bowel wall inflammation using the quantitative flow measurements derived from ultrasound microvessel imaging (UMI).

METHOD AND MATERIALS

Forty-four bowel wall segments (28 terminal ileum, 5 neoterminal ileum, 5 small bowel, 4 colon, 2 ileum) from 33 patients with CD symptoms undergoing CT or MR-enterography were imaged with UMI. UMI was performed with an ultrafast plane wave imaging system (Vantage, Verasonics Inc.) and a 5MHz linear array transducer (frame rate = 500 Hz, ensemble length = 250). A block-wise adaptive singular value decomposition (SVD)-based clutter filter was used extract the microvessel signal (Fig. (a)). UMI has significantly higher Doppler sensitivity than conventional Doppler (Fig. (a)). The dynamic range of the UMI images was carefully adjusted to reject background noise. Bowel wall microvessel density (MVD) was then calculated by measuring the number of microvessel pixels in the bowel wall and then normalizing to the bowel wall length. Bowel wall microvessel flow speed index (MVFS) was measured by calculating the local microvessel blood speckle decorrelation coefficient (faster flow speed leads to higher decorrelation), integrating the coefficient throughout the entire bowel wall, and normalizing to the bowel wall length. The CTE and MRE results were used as the reference standard for inflammation assessment.

RESULTS

Figures (c) and (d) show the MVD and MVFS measurements for normal, mild inflammation and active inflammation bowels. Active inflammation has significantly higher (p<0.05, one-tailed t-test) MVD and MVFS than normal and mildly inflamed bowels. MVD was significantly higher in mild than in normal bowel, while MVFS difference was not significant (p=0.07). A ROC analysis of using MVD to differentiate normal from inflamed (mild and active) bowel gave a sensitivity of 0.90, specificity of 0.85, and AUC of 0.96; differentiate active from normal and mild bowel gave a sensitivity of 0.96, specificity of 0.83, and AUC of 0.94.

CONCLUSION

The high Doppler sensitivity of UMI reveals bowel wall microvessels that are invisible to conventional Doppler. The quantitative microvessel measurements show promise of staging CD bowel wall inflammation.

CLINICAL RELEVANCE/APPLICATION

Reliable inflammation assessment for CD is essential to evaluate therapy efficacy and potential need for treatment modification. UMI offers a safe and cost effective tool for long term follow-up of CD.

SSC05-08 Consecutive Case Series of Pathologically Proven Small Bowel Neuroendocrine Neoplasms: Impact of Imaging Technologies

Monday, Nov. 27 11:40AM - 11:50AM Room: E451A

Awards
Student Travel Stipend Award

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PURPOSE

Neuroendocrine neoplasms are now the most common small bowel neoplasm. We conducted a retrospective review of small bowel neuroendocrine neoplasms (SBNEN) to determine: (1) frequency and diagnosis by various imaging modalities, (2) the impact of CT enterography (CTE) on diagnosis, and (3) rates of disease-free survival.

METHOD AND MATERIALS

Histopathologically confirmed SBNEN from 01/1996 - 02/2016 were identified, including those first diagnosed with SBNEN at our institution (FD-SBNEN). Clinical presentation, radiology, endoscopy, surgery, and pathology reports were reviewed and compared at 5-year periods.

RESULTS

294 SBNEN were included (178 FD-SBNEN). Diagnosis of SBNEN increased significantly (15 in 1996-2000, 168 in 2011-2016). GI bleeding increased as clinical presentation for FD-SBNEN (0% in 1996-2000, 25.4% in 2011-2016, p = 0.023). FD-SBNEN diagnosed by radiology increased 2-fold (n=3, 33.3% in 1996-2000; n=75, 65.8% in 2011-2016). The other primary diagnostic modality was EGD (n=3, 33.3% in 1996-2000; n=27, 23.7% in 2011-2016). For FD-SBNEN, CTE identified SBNEN 95% (52/55), with 91% (50/55) of original clinical reports diagnosing SBNEN. Routine abdominal CT detected 45% (37/85) and diagnosed 35% (29/85) of SBNEN. Of the 39 FD-SBNEN discovered by endoscopy, the recurrence rate correlated to initial lesion size; e.g., only 18% of SBNEN measuring 0.6± 0.3 cm recurred, but 75% measuring 3.7±1.0 cm recurred. Rates of disease-free survival during following resection for FD-SBNENs (n=96) was better when tumors were first identified by CTE rather than alternative radiologic methods (85% n=35 vs. 57% n=31, p=0.0034). Rates of local metastases (4.9% n=2 vs. 18.5% n=10, p=0.0475) and liver metastases (2.4% n=1, 24.1% n=13, p=0.0032) were also lower when CTE discovered SBNEN.

CONCLUSION

In the last two decades, there has been a dramatic increase (over 10-fold at our institution) in SBNEN's detected by CTE and endoscopy, and in patients with small bowel bleeding. SBNEN detection and characterization is better with CTE than routine abdominal CT. Small SBNEN's detected at endoscopy and CTE have longer disease-free survival.

CLINICAL RELEVANCE/APPLICATION

There has been a dramatic increase in SBNEN's detected by CTE and endoscopy, especially in patients with small bowel bleeding. Those with small tumors detected at endoscopy and CTE have longer disease-free survival after surgical resection.

SSC05-09 A New Semi-Automatic Technique for Crohn's Disease Diagnosis Using Supervised Machine Learning Algorithm: Kernel Support Vector Machine

Monday, Nov. 27 11:50AM - 12:00PM Room: E451A

Awards
Student Travel Stipend Award

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PURPOSE

We propose a new semi-automatic technique for Crohn's disease (CD) diagnosis, using Kernel Support Vector Machine (KSVM). KSVM is a supervised machine learning algorithm, which, instructed by a set of "labeled training example", outputs a function used to classify brand new data.

METHOD AND MATERIALS

Three radiologists extracted a dataset composed of 300 MR Enterography of 300 different patients used for KSVM training and validation. Each patient - classified in positive and negative according to histological specimen results - was "labeled" by 22 determined qualitative features, which are associated to CD or may help in CD diagnosis, according to worldwide literature: Terminal ileum thickening, length of the affected segment/s, single/skip lesions, fat wrapping, pseudo-polyps, ascites, stenosis/sub-stenosis, previous ileo-colonic surgery, sinus, fistulas, disease pattern and activity, complications, intestinal obstruction, lymph nodes, artifacts, enhancement pattern, parietal signal intensity on T2 SPAIR, signal intensity on DWI, bowel loops cleansing and distention. 300 MR enterography were divided as follows: 4/5 (240 patients) were used for KSVM training, and 1/5 (60 patients) were used for KSVM validation. This technique adopts a Stratified K(5)-Fold Cross-Validation strategy to enhance KSVM classifier reliability:

dataset is divided into k equal subsets, and the holdout method is repeated k times. Each time, one of the k subsets is used as validation set and the other K-1 subsets are put together to form the training set. So, the average error and/or any patient selection pitfall across all K experiments are computed and reduced.

RESULTS

The KSVM results were compared with the histological specimen results: Sensitivity: 94,80%; Specificity: 100,00%; Negative Predictive Value: 95,06%; Precision: 100,00%; Accuracy: 97,40%; Error: 2,60%.

CONCLUSION

The achieved results show that the proposed technique results are better than the manual reference methods reported in literature (Sensitivity: 93,00%; Specificity: 90,00%) with a greater usability and degree of acceptance.

CLINICAL RELEVANCE/APPLICATION

Crohn's Disease (CD) diagnosis using MRI requires great radiological expertise in gastrointestinal field. We propose a new semi-automatic technique for CD diagnosis, using machine learning algorithm.

SSC06

Genitourinary (Renal Mass Imaging)

Monday, Nov. 27 10:30AM - 12:00PM Room: N230B

CT GU OI

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

Participants
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Sub-Events

SSC06-01 Prospective Comparison of RECIST and Alternative Response Assessment Criteria Using Normalized Enhancement Values in the Evaluation of Metastatic Renal Cell Cancer Patients from Phase II of the Multi-Centre STAR Trial

Monday, Nov. 27 10:30AM - 10:40AM Room: N230B

Participants
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PURPOSE

Size and enhancement response criteria have been advocated for tumor assessment in metastatic renal cancer with the potential to predict earlier response or progression. We aimed to assess the difference in categorical response using RECIST 1.1, Choi and modified Choi (mChoi) criteria with normalised enhancement values between different readers on Computed Tomography (CT) as part of a prospective multicentre study.

METHOD AND MATERIALS

Following IRB approval and informed consent, 44 prospective patients enrolled in phase II of the STAR trial comparing treatment strategies of tyrosine kinase inhibitor therapies in metastatic renal cell carcinoma were assessed at baseline, 12 and 24 weeks post therapy commencement. Contrast enhanced CT scans were assessed by 2 radiologists: 104 target lesions were assessed using commercial semi-automated software. The sum of longest diameter of tumor target lesions and tumor normalised enhancement values (calculated relative to aortic attenuation) and subsequent percentage change at 12 week and 24 week CT were measured. Response categorisation by RECIST, Choi and mChoi criteria into stable disease (SD), partial response (PR) or progressive disease (PD) was undertaken, and discrepant cases identified. Cohen's kappa coefficients were calculated to assess reader agreement.

RESULTS

26 patient at 12 weeks had discrepant categories of response: PR by Choi/mChoi criteria but SD by RECIST. 13 became PR by RECIST at 24 weeks and 13 patients remained discrepant: PR by Choi/mChoi but SD by RECIST. At 12 week follow up, there was excellent reader concordance for RECIST (k 0.9 n=44) and modified Choi categorisation (k 0.9 n=43), decreasing for Choi criteria (k 0.76 n=42). At 24 weeks there was substantial agreement for RECIST (k 0.8 n=44) and modified Choi categorisation (k 0.79 n=40) with complete agreement of Choi categorisation (k 1 n=41). 5 patients had PD at 24 weeks, with complete agreement.

CONCLUSION

Early tumor response, confirmed on 24 weeks, was noted more frequently for Choi/mChoi than RECIST criteria. Substantial to excellent agreement was observed in response categorisation across all criteria.

CLINICAL RELEVANCE/APPLICATION

Choi/mChoi criteria using normalised enhancement values predict tumour response at 12 weeks, confirmed at 24 weeks with excellent observer agreement.

SSC06-02 Parapelvic Cysts: An Ultrasonographic Clue for Differential Diagnosis in Fabry Disease

Monday, Nov. 27 10:40AM - 10:50AM Room: N230B

Participants
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Amicus Therapeutics, Inc; Travel support, sanofi-aventis Group; Travel support, Shire plc; Travel support, Amicus Therapeutics, Inc
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PURPOSE

Fabry Disease (FD) is a rare inherited multi-systemic lysosomal storage disorder, related to a lack of activity of a-galactosidase. Kidney involvement in FD is common and linked to globotriaosylceramide deposition in all types of renal cells, with subsequent progression in untreated patients to end stage renal failure. Parapelvic cysts (PC) have been already described in literature as a possible feature of FD; nevertheless, their exact prevalence and their meaning in renal FD involvement remain uncertain. Aim of this study is to assess the actual prevalence of PC in a representative cohort of FD patients by renal ultrasound.

METHOD AND MATERIALS

We performed a restorspective multicentric study on 173 FD patients (Study 1), comparing the results with a second group of 67 FD patients analysed by the same ultrasonographer in a single center (Study 2). Age- and renal function-matched healthy controls (HC) were selected for comparison. Inclusion criteria were genetically proven FD and age>=18y, while exclusion criteria were renal replacement therapy and presence of renal malformations. Clinical and biochemical data concerning renal impairment were collected by trained physicians. Ultrasonographic examination included determination of renal diameters, presence of PC and cortical cysts or other renal abnormalities.

RESULTS

In Study 1, PC were detected in 28.9% of FD subjects and in 1.1% of control subjects ($p<0.001$); presence of other renal abnormalities and biochemical alterations did not differ between groups. In Study 2, prevalence of PC raised from 29.8% to 43.3% ($p<0.05$), due to a better accuracy in US examination. In both studies, no correlation was detected between PC. Finally, no difference was found between FD patients with and without PC.

CONCLUSION

Our results confirm the higher prevalence of PC in classical FD subjects compared to HC, highlighting the role of accurate US renal examination in their detection. Resort to CT or MRI should be considered only in case of ambiguous US findings.

CLINICAL RELEVANCE/APPLICATION

Although to date parapelvic cysts cannot be considered a pathognomonic sign of FD, their presence should induce to consider FD among differential diagnosis in subjects with unclear personal and family history of renal disease, in order to prevent disease progression.

SSC06-03 Clear Cell Renal Cell Carcinoma Treated by Antiangiogenic Therapy: Distribution of Metastatic Sites at Baseline and at Time of Progressive Disease Determination

Monday, Nov. 27 10:50AM - 11:00AM Room: N230B

Participants
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PURPOSE

Clear cell renal cell carcinoma (ccRCC) is the most prevalent and one of the most lethal RCC subtypes with a high potential for distant metastases. Angiogenesis influences hematogenous dissemination and metastatic distribution. Because anti-angiogenic therapy is first-line therapy for metastatic ccRCC, it is necessary to understand if sites of metastatic disease vary in patients treated with this treatment modality. The purpose of this study was to evaluate alterations in metastatic disease distribution between initial presentation and at time of progressive disease (PD) in a cohort of patients with metastatic ccRCC treated with VEGFR tyrosine kinase inhibitors.

METHOD AND MATERIALS

With IRB approval, we analyzed a cohort of patients enrolled in a Phase III multi-center open label trial who were randomized 1:1 to open label anti-VEGFR tyrosine kinase therapies. All patients had previously progressed after having received, at a minimum, first line VEGFR tyrosine kinase inhibitor therapy and had measurable metastatic disease at screening. A chest CT, and either a CT or MRI of the abdomen and pelvis were acquired at screening and every eight weeks, from over 150 global sites, and processed and interpreted at an imaging core laboratory for radiological progression using RECIST 1.1.

RESULTS

The study cohort included 397 patients (297 (75%) men and 100 (25%) women) with confirmed PD on imaging, with a mean age of 60.7 years (+/- 10.0). The four most common sites of metastatic spread at baseline and at the time of progression were lymph nodes (29.8%, 29.1%), lung (27.1%, 25.4%), liver (10.9%, 11.2%), and bone (8.6%, 11.5%), respectively. The most common sites of new lesions were bone (31.8%), lymph nodes (21.5%), liver (14.0%), and lung (13.3%).

CONCLUSION

The four most common sites for ccRCC metastatic disease are the lymph nodes, lungs, liver, and bones. Over the course of a clinical trial the overall sites at time of disease progression are the same as at screening, but the most common site for new lesions to develop is bone.

CLINICAL RELEVANCE/APPLICATION

Knowing common sites of metastatic disease in patients with ccRCC treated with targeted therapy can improve lesion detection in clinical practice and in therapeutic trials.

SSC06-04 Wavelets Analysis for Differentiating Solid, Non-Macroscopic Fat Containing, Enhancing Renal Masses: A Pilot Study

Monday, Nov. 27 11:00AM - 11:10AM Room: N230B

Participants
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PURPOSE

To evaluate potential use of wavelets analysis in discriminating benign and malignant renal masses (RM)

METHOD AND MATERIALS

In this IRB approved study, we evaluated 144 patients with predominantly solid, non-macroscopic fat containing, enhancing RM. 98 cases were malignant renal cell carcinoma (RCC) and 46 cases were benign RM: oncocytoma, lipid-poor angiomyolipoma. The Haar wavelet was used to analyze the grayscale images of the largest segmented tumor in the axial direction using Matlab® (Mathworks, Natick, MA) software. Six metrics (energy, entropy, homogeneity, contrast, standard deviation (SD) and variance) derived from 3-levels of image decomposition in 3 directions (horizontal, vertical and diagonal) respectively, were used to quantify tumor texture. Independent t-test or Wilcoxon rank sum test depending on data normality were used as exploratory univariate analysis. Stepwise logistic regression and ROC curve analysis were used to select predictors and assess prediction accuracy, respectively.

RESULTS

Consistently, 5 out of 6 wavelet-based texture measures (except homogeneity) were higher for malignant tumors compared to benign, when accounting for individual texture direction. Homogeneity was consistently lower in malignant than benign tumors irrespective of direction. SD and variance measured in the diagonal direction on the cortico-medullary phase showed significant ($p<0.05$) difference between benign versus malignant tumors. The multivariate model with average variance (across all 3 directions) and SD (along the vertical direction) extracted from the excretory and pre-contrast phase, respectively showed an AUC of 0.7 ($p < 0.05$) in discriminating malignant from benign. Additionally, AUC of 0.86 ($p < 0.05$) was obtained in discriminating oncocytoma (26) from clear cell RCC (68). The top predictors in the latter model discriminating RM subtypes included variance and homogeneity in the pre-contrast phase (diagonal) and, SD and entropy in the cortico-medullary phase (horizontal).

CONCLUSION

Wavelet analysis is a valuable texture evaluation tool to add to radiomics platforms geared at reliably characterizing and stratifying renal masses.

CLINICAL RELEVANCE/APPLICATION

Improved differential diagnosis based on better discrimination of the tumor types will provide patient-specific care-management options

SSC06-05 Variability of Texture Features Extracted from Contrast-Enhanced Computed Tomography Images of Renal Tumors: Role of Necrosis

Monday, Nov. 27 11:10AM - 11:20AM Room: N230B

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PURPOSE

CT texture analysis (CTTA) is popular tumor stratification tool. CTTA assumes CT attenuation patterns (image) depend on tumor-type, microvessel density, intratumoral necrosis and thus, indicative of tumor heterogeneity. Here we evaluate the effect of necrosis on CTTA features in differentiating benign from malignant renal masses (RM).

METHOD AND MATERIALS

In this retrospective study, we identified 144 patients with non-macroscopic lipid containing, predominantly solid, enhancing renal tumors based on post-surgical pathology examination (98 malignant renal cell carcinoma and 46 benign RM: oncocytoma, lipid-poor angiomyolipoma). CECT images of RM were used as inputs to a CTTA panel. The panel comprised of 29 different texture metrics derived using 6 methods: histogram analysis, gray-level co-occurrence matrix method and gray-level difference matrix method, spectral (fast fourier analysis), in both 2D and 3D. Tumor necrosis ranged from 1-30% of tumor volume (-10 to +15 HU; non-enhancing areas). Data normality was examined using D'Agostino's K2 test. Generalized linear model with an interaction term was used to test the difference of the difference (benign vs. malignant; with and without necrosis).

RESULTS

Histogram-based: variance and spectral-based: entropy of spectral magnitude, entropy of spectral phase, and complexity index (sum of spectral harmonics between 25-75% of the maximum frequency) showed significant ($p < 0.01$) difference between the benign and malignant group while taking into account the necrotic regions. Similar results were obtained while removing necrotic regions but the results were significantly ($p < 0.01$) different from those when necrosis was included. The results were consistent across all 4 CECT phases. In general, the malignant tumors showed higher variance, complexity index and entropy of spectral-magnitude, all of which are indicative of increased heterogeneity compared to benign tumors. Other metrics had mixed results with variable significance depending on necrosis status.

CONCLUSION

Standardized methods of identifying CT-based necrosis are warranted in lesions analysis particularly in whole lesions, where the analysis cannot be limited to non-necrotic region.

CLINICAL RELEVANCE/APPLICATION

The removal of necrotic tumor regions allows better representation of the radiomic signal from the remainder of the lesion leading to improved accuracy rate of differentiating benign and malignant enhancing RM.

SSC06-06 Subjective and Quantitative Computed Tomography (CT) Analysis to Differentiate Low Grade from High Grade Chromophobe Renal Cell Carcinoma

Monday, Nov. 27 11:20AM - 11:30AM Room: N230B

Participants
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PURPOSE

This study evaluates the ability of unenhanced CT to differentiate low versus high grade ch-RCC using subjective and quantitative analyses.

METHOD AND MATERIALS

With IRB approval, 37 ch-RCC (high grade N=13, low grade N=24) with pre-operative unenhanced CT were identified between 2012-2016. Two blinded radiologists (R1/R2) subjectively evaluated: tumor margin (smooth or irregular/spiculated), homogeneity (homogeneous, mildly or markedly heterogeneous) and calcification. A third blinded radiologist measured unenhanced CT attenuation (Hounsfield Units [HU]) and contoured tumors so that previously described texture analysis features studied in RCC could be extracted. Quantitative variables in this study were selected to potenitally correlate with the histological grading system for ch-RCC proposed by Paner et al. which includes nuclear-to-cytoplasmic ratio (attenuation) and anaplasia (heterogeneity). Comparisons were performed using chi-square, independent t-tests and logistic regression. Accuracy for diagnosis was assessed using ROC. Inter-observer agreement was calculated with Cohen's kappa statistic.

RESULTS

There were no differences in patient age or gender between groups (p=0.65 and 0.07). High grade tumors were larger (62.6 ± 34.9 mm [17.0-141.0]) than low grade tumors (39.0 ± 17.9 mm [16.0-72.3]) and showed higher attenuation (45.5 ± 8.2 HU [29.0-55.0] versus 35.3 ± 8.5 HU [14.0-51.0]), (p=0.01 and <0.01). Higher grade tumors were more frequently calcified (38.5% [5/13] R1 and 46.2% [6/13], p=0.03) and showed irregular/spiculated margins (46.2% [6/13] R1 and 69.2% [9/13], p=0.02). Agreement was moderate (K=0.47 and 0.36). Higher grade tumors were more frequently heterogenous (30.8% [4/13] R1 and 23.1% [3/13] R2 considered homogeneous, p=0.01). Agreement was also moderate (K=0.57). Quantitatively, run-length nonuniformity and gray-level nonuniformity (as described in the article by Schieda et al. who assessed texture analysis in CT to diagnose sarcomatoid RCC) were higher in high grade RCC (p<0.05) and could diagnose high grade tumors with moderate-to-good accuracy (area under curve 0.80).

CONCLUSION

Size, calcifications, irregular/spiculated margins, attenuation and heterogeneity at unenhanced CT are features associated with

high grade ch-RCC.

CLINICAL RELEVANCE/APPLICATION

High grade ch-RCC can be suspected at unenhanced CT when tumors are larger, calcified, have higher attenuation and are more heterogeneous.

SSC06-07 Differentiation of Clear Cell Papillary Renal Cell Carcinoma from Clear Cell and Papillary Subtypes on Multiphasic Computed Tomography

Monday, Nov. 27 11:30AM - 11:40AM Room: N230B

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PURPOSE

To determine if clear cell papillary renal cell carcinoma (ccpRCC) can be differentiated from clear cell (ccRCC) and papillary renal cell carcinoma (pRCC) on computed tomography (CT).

METHOD AND MATERIALS

An IRB-approved, retrospective review of our institutional surgical pathology database identified 23 ccpRCC, 46 ccRCC, and 51 pRCC from 2011-2016. Pre and post operative CT scans were reviewed and imaging features were compared. Statistical analysis was performed by ANOVA, sensitivity and specificity by ROC, and cutoff points established via a maximum Yoden index.

RESULTS

Compared to ccRCC, ccpRCC was more likely to have smooth rather than heterogeneous margins (p=0.012), less avid arterial attenuation (79.9±45.4 HU) (125.0±45.9 HU, p=0002), and progressive enhancement (rather than washout) on nephrographic phase. ccpRCC can be distinguished from ccRCC using an attenuation cutoff of 76 HU on arterial phase (sens 0.91, spec 0.64, p=0.005) and 45 HU enhancement between unenhanced and arterial phase (sens 0.85, spec 0.65, p=0.009). Compared to pRCC, ccpRCC was more likely to be heterogeneous (p=0.002), have higher nephrographic attenuation (88.8±35.8 HU) than pRCC (65.7±17.8 HU, p=0.031), and show similar progressive enhancement on nephrographic phase. There was no difference in unenhanced attenuation between the 3 subtypes. ccpRCCs were significantly smaller (2.8±1.5cm) than either ccRCC (5.6±3.4cm, p = 0.001) or pRCC (5.6±4.6 cm, p = 0.004). None of the ccpRCC demonstrated calcification, macroscopic fat, adenopathy, venous invasion, or metastatic disease. At pathologic analysis, ccpRCC was more likely to have low Fuhrman grade, stage T1, no renal vein involvement, no lymphovascular invasion, no sarcomatoid features and no necrosis. ccpRCC subtype is more often associated with African American race, history of chronic renal disease, and more likely to present as an incidental finding.

CONCLUSION

ccpRCC is a newly recognized subtype of RCC that is an indolent tumor with low malignant potential. It has imaging features of both ccRCC and pRCC and ccpRCC may potentially be characterized on preoperative imaging on the basis of tumor composition and enhancement patterns.

CLINICAL RELEVANCE/APPLICATION

ccpRCC is a newly recognized subtype of RCC with low malignant potential and may warrant nephron sparing surgery if accurately characterized on preoperative imaging.

SSC06-08 Correlation of Qualitative Enhancement Features on Multiphasic MDCT with CAIX Expression in Patients with Clear Cell Renal Cell Carcinoma to Predict Prognosis

Monday, Nov. 27 11:40AM - 11:50AM Room: N230B

Participants
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PURPOSE

Qualitative assessment of ccRCCs on multiphasic MDCT images may have potentially predictive information about tumor behavior and influence patient management. Low carbonic anhydrase IX (CAIX) expression has been identified as predictor of poorer oncological outcome in patients with ccRCC, but requires additional expense and subspecialty expertise. The primary objective of

our study was to determine which MDCT qualitative imaging features correlate with CAIX expression in patients with ccRCC.

METHOD AND MATERIALS

With IRB approval for this HIPAA-compliant retrospective study, our pathology and imaging databases were queried to obtain a cohort of ccRCC with preoperative multiphasic multidetector CT imaged with a four-phase renal mass protocol (unenhanced (U), corticomedullary (C), nephrographic (N), excretory (E)). CT examinations were reviewed independently by two abdominal fellowship-trained genitourinary radiologists. Each lesion was evaluated for enhancement pattern; presence of necrosis; pattern of; tumor margin; tumor-parenchymal interface, tumor-parenchymal interaction; intratumoral vascularity; collecting system infiltration; renal vein invasion; and calcification. Immunohistochemistry was performed on the resected specimens to assess the degree of CAIX expression. Comparisons between variables included chi-square, kappa and McNemar's test. P values less than 0.05 were considered to be significant. Inter-reader agreement was obtained with the Gwet agreement coefficient (AC1). Multivariate analysis was performed to find independent predictors of low CAIX expression.

RESULTS

We analyzed 108 patients (81 (64%) men and 46 (36%) women) with 108 ccRCC lesions (53 low CAIX and 55 high CAIX). Overall agreement between the two readers had a mean AC1 of 0.8172 (SE 0.0235). Low CAIX expression was significantly associated with the presence of necrosis (odds ratio=2.696, 95% CI=1.034-7.032, p=.038). ROC analysis showed an AUC of .621 (95% CI=.488-.754) in predicting low CAIX expression with qualitative assessment of necrosis.

CONCLUSION

Qualitative assessment had high inter reader agreement for determination of necrosis and was a significant independent predictor of low CAIX tumors.

CLINICAL RELEVANCE/APPLICATION

Qualitative assessment of necrosis on CT may help predict potentially prognostic tumor microenvironment information such as CAIX expression. This may provide a more robust assessment of ccRCC behavior and improve patient outcomes

SSC06-09 Clear Cell RCC Growth Rate Correlates with Degree of Restricted Diffusion in Patients with von Hippel-Lindau Disease

Monday, Nov. 27 11:50AM - 12:00PM Room: N230B

Participants
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PURPOSE

To investigate the correlation between growth rate on CT and apparent diffusion coefficient (ADC) in clear cell renal cell cancer (RCC) lesions in patients with von Hippel-Lindau (VHL) disease.

METHOD AND MATERIALS

In this retrospective analysis , 15 patients (6 men and 7 women; mean age, 48 years), with a total of 38 clear cell renal cell lesions, underwent contrast-enhanced CT at two-time points prior to surgery and one pre-operative contrast-enhanced MRI. Volumetric and longest axis diameter (LAD) measurements of the lesions were performed on CT images and growth rates were calculated. ADC values were obtained from pre-operative contrast-enhanced MRIs. Pearson's correlation test was performed to investigate the relationship between ADC values and growth rate based on LAD and volumetric measurements.

RESULTS

The average growth rate was 0.22 cm/year (range: -0.4 to 1.5) based on LAD measurements and 2.9 cc/year (range: -32.1 to 21.9) based on volumetric measurements, with 528 days mean time interval between the two CT scans (range: 67 to 1658). The average ADC value for all lesions was 1.9 χ 10-3 mm2/s (range: 1.1 to 2.6). The average growth rate of each lesion was inversely correlated to ADC value, with a correlation coefficient of -0.39 ($p<0.02$) for growth rate based on volumetric measurements (cc/day), and -0.37($p<0.03$) for growth rate based on LAD measurements (mm/day), suggesting that slower growing lesions demonstrate less restricted diffusion.

CONCLUSION

The degree of restricted diffusion may be a useful measurement in predicting progression of renal lesions in von Hippel-Lindau disease.

CLINICAL RELEVANCE/APPLICATION

The quantification of ADC values should be performed in patients with VHL syndrome undergoing surveillance abdominal MRI.

SSC07

Health Service, Policy and Research (Evidence and Outcomes)

Monday, Nov. 27 10:30AM - 12:00PM Room: S104B

HP RS

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

Participants
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Abbey Winant, MD, Boston, MA (*Moderator*) Spouse, Research Grant, Bristo-Myers Squib Company

Sub-Events

SSC07-01 Follow-up of Low-Risk Incidental Findings: Effects of Patient Age and Comorbidity Level on Projected Life Expectancy Benefits

Monday, Nov. 27 10:30AM - 10:40AM Room: S104B

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PURPOSE

To quantify effects of patient age and comorbidity level on life expectancy (LE) benefits associated with routine follow-up of common, low-risk incidental findings.

METHOD AND MATERIALS

We developed a decision-analytic Markov model to project LE benefits associated with imaging follow-up of Bosniak IIF renal cysts and pancreatic side-branch intraductal papillary mucinous neoplasms (SB-IPMNs). Hypothetical cohorts with varied age (60-80 years) and comorbidities (none, mild, moderate, severe) were evaluated. For each finding, we compared LE projections from two strategies: imaging follow-up; and no imaging follow-up. Under follow-up, we assumed that cancers associated with the incidental finding were successfully treated prior to spread. For patients without follow-up, we incorporated mortality risks from Bosniak IIF cysts (renal cell carcinoma) and SB-IPMNs (pancreatic ductal adenocarcinoma). Effects of parameter uncertainty were evaluated in sensitivity analysis.

RESULTS

In the youngest, healthiest cohorts (60-year-olds, no comorbidities), projected LE benefits from follow-up were modest (Bosniak IIF cyst: 7.2 months (women), 6.5 months (men); SB-IPMN: 6.4 months (women), 5.3 months (men)). For follow-up of Bosniak IIF cysts in other cohorts, the LE benefit was 4.3 months in 60-year-old women with severe comorbidities; 3.1 months in 80-year-old women with no comorbidities; and 1.6 months in 80-year-old women with severe comorbidities. Similar trends were observed in men and for SB-IPMN. Results were sensitive to: malignancy risks; and cancer stage at presentation for malignant, unfollowed Bosniak IIF cysts.

CONCLUSION

Follow-up of low-risk incidental findings yields limited benefit for patients with advanced age or severe comorbidities - for such patients, follow-up decisions merit careful consideration.

CLINICAL RELEVANCE/APPLICATION

Modest life expectancy benefits from follow-up of low-risk incidental findings and the variability of benefits by age and comorbidity highlight the importance of patient-centered follow-up decisions.

SSC07-02 Surveillance Imaging for Lung and Colorectal Cancer after Curative Intent Surgery: A Population-Based Study

Monday, Nov. 27 10:40AM - 10:50AM Room: S104B

Participants
Gelareh Sadigh, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
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PURPOSE

A variety of guidelines exist for surveillance imaging of patients with non small cell lung cancer (NSCLC) and colorectal cancer (CRC) after treatment (Table 1). The purpose of this study was to assess the utilization of high intensity surveillance imaging in Medicare beneficiaries with NSCLC or CRC after curative intent surgery.

METHOD AND MATERIALS

Surveillance imaging utilization was assessed between 2000 and 2013 in >=65 year old fee-for-service Medicare beneficiaries with stage I-IIIA NSCLC or stage I-III CRC registered in a Surveillance, Epidemiology, and End Results (SEER) registry who underwent curative intent surgery. Utilization was defined as the percentage of patients who underwent at least one surveillance examination between 6-18 months after surgery. Independent predictors for use of PET or PET/CT (for which surveillance imaging is not recommended by guidelines) was evaluated using logistic regression analysis.

RESULTS

89,875 curative intent surgical patients (77.6% CRC, 22.4% NSCLC; mean age at diagnosis 76 years; 86% white) were included. Surveillance imaging utilization rates in NSCLC patients were (Table 1): chest CT (69%); brain CT (7%); brain MRI (10%); bone scan (10%); PET or PET/CT (25%). Surveillance imaging utilization rates in CRC patients were (Table 1): chest CT (20%); abdomen and/or pelvis CT (36%); PET or PET/CT (11%). Higher PET or PET/CT utilization was associated with NSCLC vs. CRC (odds ratio [OR] 2.4), younger age (OR 2 for <70; OR 1.9 for 70-74; OR 1.6 for 75-80 when compared to age > 80), white race (OR 1.2 compared with African American), being married (OR 1.1), year of diagnosis after 2005 (OR 2) and geography (OR 1.2 for Southeast when compared to Northeast) (all p values <0.05). Lower utilization of PET or PET/CT was seen in Midwest compared to Northeast (OR 0.8; p<0.05).

CONCLUSION

More than one-third of patients with NSCLC and one-half with CRC undergoing curative intent surgery do not receive guideline recommended post-surgical surveillance imaging. On the other hand, as many as one-quarter undergo PET or PET/CT despite guidelines to the contrary.

CLINICAL RELEVANCE/APPLICATION

Utilization of post-surgical surveillance imaging in Medicare beneficiaries with cancer is frequently guideline discordant.

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/ Ruth C. Carlos, MD, MS - 2015 Honored Educator

SSC07-03 Subjective Differences in Solid Tumor Measurements by Radiologists Results in Inconsistent Reporting of Tumor Burden Which Could Adversely Affect Treatment Decisions

Monday, Nov. 27 10:50AM - 11:00AM Room: S104B

Participants
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PURPOSE

Investigate inter-reader variability in measurement of solid tumors. Compare linear measurement/volume to direct volumetric measurement using 3 dimensional(3D) post-processing software.

METHOD AND MATERIALS

For this IRB approved study initial diagnostic CT/MR exams in 100 patients(2mo-20yr) with solid tumors were reviewed by 11

Radiologists and 3 Technologists. Radiologists recorded measurements in 3 axes, described tumor shape (sphere, ellipse, cone) and surface texture (smooth, almost smooth, or mildly, moderately, markedly irregular). 3 Technologists individually, and 3 Radiologists by consensus, used 3D processing software (Intellispace Portal, Philips, Cleveland, OH) to directly measure tumor volume. Inter-reader variability in measurement in all tumors and for tumors divided by surface characteristics were assessed amongst radiologists, technologists, and Radiologist consensus using coefficient of variation(CoV).

RESULTS

Tumor shape was reported as 14 sphere, 84 ellipse, 2 cone, and surface texture as 8 smooth, 10 almost smooth, 32 mildly irregular, 31 moderately irregular,19 markedly irregular. Inter-reader variability of as much as 1,119cc above to 383cc below the mean was found among Radiologist linear measurements, SD 70.3cc, range 0.65-242. Inter-reader variability amongst technologist/radiologist derived volumes was considerably less; SD 14.1cc, range 0.03-98. CoV analysis shows a greater degree of variation in tumor volume calculated from linear measurements than direct volume determination. Variation was significant only for tumor with irregular surface texture [smooth (p=0.26), almost smooth(p=0.23), mildly(p=0.003), moderately(p=0.001), or markedly (p=0.002) irregular].

CONCLUSION

Radiologist generated measurements are subjective, with wide variation. Variation in linear measurement by radiologists affect RESIST, WHO and COG metrics relied on by clinicians but provide only a scalar or innaccurate measure of tumor size. 3D tumor volumetrics are more accurate and reproducible for determining tumor response, may best serve the patient and should become the standard on which to base treatment decisions.

CLINICAL RELEVANCE/APPLICATION

RECIST, WHO, and COG criteria provide only a scalar (RECIST, WHO) or sphere/cylindar volume (COG) measure of tumor burden and should be abandoned due to inherent innaccuracies and misrepresentations of 'accuracy' in reporting tumor size or regression.

SSC07-04 Lumbar Spine MRI: Missed Opportunities for Abdominal Aortic Aneurysm Screening

Monday, Nov. 27 11:00AM - 11:10AM Room: S104B

Participants
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PURPOSE

The U.S. Preventive Services Task Force (USPSTF) recommends one-time sonographic screening for abdominal aortic aneurysms (AAAs) in male smokers ages 65-75 and other selected individuals in this age group based on risk factors. Patients in this age range are frequent utilizers of lumbar spine MRI, in which the abdominal aorta is typically fully imaged. The purpose of this study was to assess the potential utility of lumbar spine MRI performed for other purposes as an alternative mechanism for AAA screening.

METHOD AND MATERIALS

All consecutive lumbar spine MRI exams performed without contrast at a single academic tertiary care center over a one year period (4/1/2016-3/31/2017) in patients ages 65-75 were retrospectively reviewed. Maximal anteroposterior and transverse dimensions of the abdominal aorta were measured using axial T2-weighted images, supplemented with sagittal T2-weighted images if assessment was limited by field-of-view or artifact. The detection rate of AAA, defined as dilation of the aorta to a diameter of >=3 cm, size of AAAs detected, and frequency with which AAAs were reported, were assessed. Differences in aortic diameters and aneurysm detection rates between genders were compared with the unpaired two-sample t-test.

RESULTS

395 lumbar spine MRIs, were reviewed, 240 (60.8%) in women and 155 (39.2%) in men, with mean +/- standard deviation (SD) age of 70.2 +/- 3.2 years. Mean +/- SD maximal abdominal aortic diameter was 2.6 +/- 0.4 cm overall, greater in men (2.7 +/- 0.5 cm), compared to women (2.4 +/- 0.4 cm), p<0.001. AAAs were detected in 38/395 (9.6%) cases, with mean +/- SD size of 3.4 +/- 0.8 cm; 33/38 (86.8%) were >=3 and <4 cm, 3/38 (7.9%) were >=4 and <5.5 cm, and 2/38 (5.3%) were >=5.5 cm. AAAs were more frequent in men (27/155, 17.4%) compared to women (11/240, 4.6%), p<0.001. Of 38 AAAs detected, only 4 (10.5%) were reported by the interpreting radiologist; 3/4 (75%) of which corresponded to aneurysms >=4 cm.

CONCLUSION

Lumbar spine MRI performed in the USPSTF AAA screening age range, especially in men, facilitates detection rates of AAA on par with sonographic screening. However, in typical lumbar spine assessment, AAAs are frequently underreported, particularly for smaller aneurysms.

CLINICAL RELEVANCE/APPLICATION

Routine evaluation of the abdominal aorta on lumbar spine MRI provides a frequently missed opportunity for AAA screening, which may facilitate early management and reduction in duplicative testing.

SSC07-05 Understanding Risk Profiles of Urinary Stone Formers: Lessons Learned from Analysis of CT Scans

Monday, Nov. 27 11:10AM - 11:20AM Room: S104B

Participants
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PURPOSE

Managing covered lives requires knowledge of patient risk profiles. Urinary stone formers have have a higher risk of metabolic abnormalities. We investigated findings associated with metabolic abnormalities detected on unenhanced CT: subcutaneous (SA) and visceral adiposity (VA); bone mineral density (BMD); abdominal aortic calcification (AAC); and hepatic steatosis.

METHOD AND MATERIALS

99 patients with kidney stones who had CT scans and 24-hour urine studies were retrospectively analyzed. BMD and hepatic steatosis were estimated using ROIs within a vertebral body and liver, respectively. VA and SA was estimated using single axial slice area measurements with semi-automated segmentation. AAC and SV were estimated using semi-automated software with Agaston scoring method. Univariate and multivariate linear regression were used to identify associated variables.

RESULTS

Compared to patients with a normal ratio VA to SA, patients with high VA were older (65 vs 51 yrs, p<0.0001), male (70.7% vs 30%, p=0.001), and more likely to have HTN (81% vs 45%, p<0.0001), DM (31% vs 12.5%, p=0.003), CAD (32.8% vs 7.5%, p=0.003), lower BMD (146 vs 168 HU, p<0.0001) and larger SV (256 vs 67 mm3, p=0.009). Compared to patients without AAC, patients with AAC were older (69 vs 44 yr, p<0.0001), had HTN (85% vs 34%, p <0.0001), DM (34% vs 6%, p=0.002), PVD (19% vs 3%, p=0.022), and CAD (34% vs 3%, p <0.001). Compared to patients with normal BMD, patients with low BMD were older (67 vs 50 yr, p<0.0001), male (69% vs 34%, p=0.001), had HTN (81.8% vs 24.7%, p<0.0001), increased VA (251 vs 179 cm2, p=0.003) and larger SV (259 vs 78.4 mm3, p=0.009). Only SV (OR: 1.18; p=0.005) and number of stones were predictive of surgery for stone disease (OR: 1.29; p=0.005).

CONCLUSION

CT exams for stone detection might be used to identify abnormalities that can be integrated into population health risk models and to discover comorbid conditions that may benefit from further evaluation. For example, fewer than 1/3 of older women undergo appropriate screening for low BMD. New detection of decreased BMD could lead to treatment and subsequent fracture risk reduction.

CLINICAL RELEVANCE/APPLICATION

Clinical Relevance Statement: CT exams for stone detection might be used to identify abnormalities that can be integrated into population health risk models and to discover comorbidities that may benefit from further evaluation.

SSC07-06 Impact of MR Surveillance on Long-term Breast Cancer Outcomes in Women with Stage I Primary Breast Cancer: A Microsimulation Model

Monday, Nov. 27 11:20AM - 11:30AM Room: S104B

Participants
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PURPOSE

To project long-term breast cancer (BC) outcomes when adding short-term and long-term magnetic resonance imaging (MRI) surveillance to annual mammography.

METHOD AND MATERIALS

We developed a Markov Monte Carlo microsimulation model of surveillance in women with Stage I BC treated with breast conservation therapy, stratified by age at diagnosis (45, 55, and 65) and primary cancer subtype (Luminal A, Luminal B, HER2+, and Triple Negative). Women in the model face risks of second breast cancers (2BCs), distant metastases, and death due to BC or other causes. Three strategies of annual surveillance until age 75 were compared to no screening (NS): mammography alone (MAM), alternating mammography and MRI at 6-month intervals (MAM/MR), and mammography with alternating MRI for 5 years (MAM/MR5). The model uses a lifetime horizon. Primary outcomes were risk of 2BCs, Life-Years Gained (LYG) and BC death.

RESULTS

Across all ages, women with estrogen receptor (ER) negative cancers (HER2+/ Triple Negative) had the highest risk of 2BCs; the highest incidence was for 45-year-old women with HER2+cancers, with 10-year 2BC incidence of 17.7%. The benefits of surveillance varied substantially by patient age and cancer subtype. The smallest gains were observed in 65-year-old women with Luminal A cancers: per 1,000 women, surveillance resulted in 32 LYG with MAM, 43 LYG with MAM/MR5, and 51 LYG with MAM/MR. BC deaths decreased by 3/1,000 with MAM, 4/1,000 with MAM/MR5, and 5/1,000 with MAM/MR. The largest gains were observed in 45-year-old women with Triple Negative cancers: per 1,000 women, surveillance resulted in 285 LYG with MAM, 365 LYG with MAM/MR5 and 435 LYG with MAM/MR. BC deaths decreased by 13/1,000 with MAM, 16/1,000 with MAM/MR5, and 19/1,000 with MAM/MR. Across all ages in women with ER- subtypes, over half of LYG with MAM/MR were achieved with MAM/MR5.

CONCLUSION

Addition of MRI to mammography for BC surveillance results in modest LYG and BC mortality reduction, which varies by women's age and subtype of primary cancer. For women with ER- cancers who are at highest risk of 2BC, over half of the LYG by adding MR is achieved with surveillance within 5 years of treatment.

CLINICAL RELEVANCE/APPLICATION

Life expectancy gains from post-treatment MR surveillance are modest. In women with ER- cancers, over half of life expectancy gains from MR surveillance are achieved within 5 years after treatment.

SSC07-07 Current Recommended Methods for Calculating Screening Mammography Cancer Detection Rate Systematically Underestimate Performance Compared to Benchmarks

Monday, Nov. 27 11:30AM - 11:40AM Room: S104B

Participants
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PURPOSE

Breast cancer screening benchmarks, like cancer detection rate (CDR), use research databases that achieve near complete outcomes data capture via cancer registries. Clinical practices, however, following BI-RADS and MQSA guidelines use local biopsy results. The purpose of this study is to determine when audits using biopsy lead to a statistically significant underestimation of CDR and potentially inaccurate conclusions about interpretive performance.

METHOD AND MATERIALS

We developed a simulation model that varies practice-level volume and biopsy result ascertainment rate (AR)-i.e. percent of biopsies performed of those recommended-to determine when CDR using biopsy (CDR_Bx) is expected to be statistically significantly different than benchmarks (CDR_Benchmark) from the literature. We varied mammographic volume between 2,000 and 20,000 exams and AR between 40% and 98%. We create a graphical prediction of scenarios when CDR_Bx and CDR_Benchmark will be statistically different using McNemar's test. We then calculated these metrics for our academic practice with both biopsy and registry outcomes. Finally, we overlay average annual National Mammography Database (NMD) performance metrics.

RESULTS

Our simulation demonstrates that scenarios commonly encountered in clinical practice can lead to expected significant differences between CDR_Bx and CDR_Benchmark (Figure). Low AR and high volume predispose to significant CDR underestimation (2 lightest gray areas). Our clinical practice data including 83,895 consecutive screening mammograms (1/1/2006-12/31/2013), reveals an aggregate CDR_Bx of 4.79/1000-statistically significantly inferior to the CDR_Benchmark of 5.1 ($p<0.001$), despite a high AR of 1412/1586 (89.0%) and a registry-based CDR of 5.09/1000. CDR_Bx for 4 of 8 years studied were expected to be significantly below benchmarks. Finally, average annual NMD metrics are at high risk for significant CDR underestimation.

CONCLUSION

Benchmarks for CDR derived with registry outcomes are not directly comparable to practice-level or NMD CDR, which both use biopsy outcomes with limited AR. Significant performance underestimation may result depending on volume and AR.

CLINICAL RELEVANCE/APPLICATION

Because guidelines recommend CDR calculation based on biopsy, comparison to published benchmarks has the potential to systematically underestimate performance and lead to inaccurate quality review.

SSC07-08 Resident Performance in Interpretation of Emergent MRI in Children with Suspected Acute Appendicitis

Monday, Nov. 27 11:40AM - 11:50AM Room: S104B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Ultrasound is currently the initial imaging modality of choice in children with suspected acute appendicitis with cross sectional imaging techniques limited to equivocal ultrasound studies. Of late, MRI has emerged as a more comprehensive imaging technique in many pediatric emergency room with resultant increased demand for residents to gain MR competency in diagnosing acute abdominal conditions. The purpose of this study was to assess on call resident performance in interpreting acute abdominal MRI in children with suspected acute appendicitis.

METHOD AND MATERIALS

Pediatric subjects 18 years or younger, receiving MRI examination as the first imaging assessment in abdominal pain with suspected appendicitis were included in this study. Resident performance was retrospectively analyzed from January 2013 through June 2016 in form of concordance between preliminary interpretation with the final interpretation by an attending. Particular attention was made to the residents' post graduate year (PGY) at the time of interpretation of examination.

RESULTS

Initial evaluation of 150 out of 450 subjects that met the inclusion criteria are presented in this abstract. 123/150 studies were independently evaluated by residents followed by attending overread. Out of the 122 studies, 1 was evaluated by PGY 2 resident while 82, 25 and 14 of the studies were initially evaluated by residents in their PGY 3, 4, and 5, respectively. There was a discordance rate of 9.7% for PGY3 residents, 4% for PGY 4 residents and 0% for residents in PGY5. There was a decrease in rate of discordance with each progressive year with discordance rate of 9%, 9%, 5%, and 0% in years 2013, 2014, 2015 and 2016 respectively. 67 out of 123 patients had a positive finding, 32 (48%) of these children received a diagnosis of acute appendicitis and 30 (94%) of these patients underwent emergent surgical intervention. The average duration of acquiring images was 23 minutes with an average time of 2 hours and 18 minutes till end of scan to interpretation of images.

CONCLUSION

In our facility, resident performance in MR evaluation of acute appendicitis has gradually improved with each progressive academic year from 2013 to 2016 with improved concordance rate seen with increasing post graduate year level.

CLINICAL RELEVANCE/APPLICATION

Resident performance in interpreting acute MRI abdomen during independent has improved with each progressive academic and residents' post graduate year.

SSC07-09 Large-Scale, Observational, Minimal-Risk Hypotheses-Forming Research is Encouraged and Facilitated By Using an Umbrella IRB Protocol with Expedited Intra-Departmental Sub-Study Review and Approval

Monday, Nov. 27 11:50AM - 12:00PM Room: S104B

Participants
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Michael S. Middleton, MD, PhD, San Diego, CA (*Presenter*) Consultant, Allergan plc; Institutional research contract, Bayer AG; Institutional research contract, sanofi-aventis Group; Institutional research contract, Isis Pharmaceuticals, Inc; Institutional research contract, Johnson & Johnson; Institutional research contract, Synageva BioPharma Corporation; Institutional research contract, Takeda Pharmaceutical Company Limited; Stockholder, General Electric Company; Stockholder, Pfizer Inc; Institutional research contract, Pfizer Inc

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PURPOSE

To demonstrate the safety, feasibility, and effectiveness of an IRB-approved, departmental umbrella protocol designed to facilitate observational clinical imaging research.

METHOD AND MATERIALS

We obtained IRB approval in 2007 for an umbrella protocol that allowed multiple sub-studies and sub-investigators to access and analyze medical records from patients with imaging, prospectively and/or retrospectively. The protocol was overseen by a panel of three senior radiology faculty and an experienced clinical coordinator. Each sub-study required investigator CITI certification, signed agreement to abide by the protocol, a one-page request form, and completion of a feedback questionnaire. A list of projects, adverse events, complaints, and protocol deviations were collected for each sub-study and reported to the IRB annually. The feedback questionnaire responses were summarized descriptively.

RESULTS

Over the past ten years, 106 sub-studies were submitted by 46 unique radiology department personnel for approval by our 3-person radiology panel. Turnaround times for approval varied from one day to one week. Over 105,000 medical records were accessed, 153 abstracts and publications were produced, and the study underwent nine successful annual IRB reviews with no

reports of adverse events, complaints, or protocol deviations. For 22% of sub-studies investigators would not have pursued, and for 23% of sub-studies investigators were unsure whether they would have pursued approval directly from the IRB. Investigators reported that it took an average of 14 minutes to complete the one-page sub-study application form, and they estimated that a full IRB application would have taken them 15.5 hours to complete, with a 4-month time period until study approval. Thus, this protocol may have saved radiology investigators about 1,600 person-hours to complete study requests, and expedited initiation of their studies by over 425 cumulative months (35 years).

CONCLUSION

A responsibly maintained departmental umbrella IRB protocol is safe, feasible, and effective, retaining the benefits of IRB coverage and auditability while facilitating observational clinical research.

CLINICAL RELEVANCE/APPLICATION

Large-scale, observational, minimal-risk hypotheses-forming research is encouraged and facilitated by using an umbrella IRB protocol with expedited intra-departmental sub-study review and approval.

SSC08

Science Session with Keynote: Informatics (Cybersecurity, Analytics, Education and Augmented Reality)

Monday, Nov. 27 10:30AM - 12:00PM Room: S402AB

IN

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

FDA Discussions may include off-label uses.

Participants
David J. Harvey, FRCR, Swansea, United Kingdom (*Moderator*) Shareholder, Medical Connections Ltd; Managing Director, Medical Connections Ltd

Sub-Events

SSC08-01 Know Your Enemy: Characteristics of Cyber-Attacks on Medical Imaging Devices

Monday, Nov. 27 10:30AM - 10:40AM Room: S402AB

Participants
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Yuval Shahar, PhD, Beer Sheva, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Used extensively in the diagnosis, treatment, and prevention of disease, medical imaging devices (MIDs), such as MRI or CT machines, play an important role in medicine today. MIDs are increasingly connected to hospital networks, making them vulnerable to sophisticated cyber-attacks targeting the devices' infrastructure and components, which can disrupt digital patient records, and potentially jeopardize patient health. Attacks on MIDs are likely to increase, as attackers' skills improve and the number of unpatched devices with known vulnerabilities that can be easily exploited grows. Attackers may also block access to MIDs or disable them, as part of ransomware attacks, which have been shown to be successful against hospitals.

METHOD AND MATERIALS

We conducted a comprehensive risk analysis survey, based on the Confidentiality, Integrity, and Availability (CIA) model, in collaboration with our country's largest health maintenance organization, to define the characteristics of cyber-attacks on MIDs. The survey included a range of vulnerabilities and potential attacks aimed at MIDs, medical and imaging information systems, and medical protocols and standards such as DICOM and HL7.

RESULTS

Based on our survey, we found that CT devices face the greatest risk of cyber-attack, due to their pivotal role in acute care imaging. Thus, we identified several possible attack vectors that target the infrastructure and functionality of CT devices, which can cause: 1. disruption of the parameters' values used in the scanning protocols within the CT device (e.g., tampering with the radiation exposure levels); 2. mechanical disruption of the CT device (e.g., changing the pitch); 3. disruption of the tomography scan signals constructing the digital images; and 4. denial-of-service attacks against the CT device.

CONCLUSION

Cyber-attacks on MIDs will become a major challenge to device manufacturers and healthcare providers. To ensure a safe healthcare environment and protect patients, users must be aware of the risks and understand the mechanisms behind these potential attacks.

CLINICAL RELEVANCE/APPLICATION

New approaches for detection and prevention, such as we propose to develop, should be deployed and implemented.

SSC08-02 Radiology Cybersecurity: Ratings, Trends, and Challenges

Monday, Nov. 27 10:40AM - 10:50AM Room: S402AB

Participants
Oleg S. Pianykh, Newton Highlands, MA (*Presenter*) Nothing to Disclose

PURPOSE

81% of healthcare organizations have been compromised by cyber-attacks in past 2 years. we believe that it is our principal

approach to securing medical records that has been remarkably passive and outdated. The main purpose of our work was to employ a "big data" analysis to reveal the most recent trends in radiology information security.

METHOD AND MATERIALS

DICOM handshake protocol was used to develop a fast, parallel-processing security-probing application. Testing each IP address for its openness to transmit medical data (with no actual data transferred), the application scanned the entire worldwide space of IP addresses in 4 weeks. Geolocation services were used to map each unsecure IP identified. Thus, we compiled a complete map of open DICOM/HL7 servers worldwide, with different levels of security threats. A comprehensive analysis of this data revealed some major trends in radiology security breaches.

RESULTS

At each run, our scans discovered nearly 3000 DICOM (PACS) servers worldwide, which were left open for external data access. DICOM protocol was used to categorize our findings by different levels of security threats, and geolocation data - by countries and regions. Thus, we compiled DICOM security ratings per country, per capita, and per IT infrastructure. We investigated these ratings for the past three years. Finally, we identified the most prevailing patterns of security breaches, such as cloud servers.

CONCLUSION

Medical cybersecurity should be never treated as static, declarative, or given by default. It cannot be provided by upgraded standards or regulations alone. Medical imaging archives, left wide-open to DICOM and HL7 threats, is by far the most common security problem, which needs to be addressed with a robust, standardized, and fully implemented solution. Our results demonstrate the full scope of this problem, and the areas where it needs to be addressed. The fact that radiology security is not improving over the past years is particularly alarming, and should be addressed by the clinical community.

CLINICAL RELEVANCE/APPLICATION

Our methodology helps identify and prevent hospital security breaches before they happen.

SSC08-03 Service Design and Validation of the Territory-Wide Medical Image Exchange in Hong Kong

Monday, Nov. 27 10:50AM - 11:00AM Room: S402AB

Participants
Jonathan Poon, MBChB, Hong Kong, Hong Kong (*Presenter*) Nothing to Disclose

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CONCLUSION

The project team has developed a novel service design for the implementation of an XDS-Ib based medical image exchange, tailored specifically for the healthcare environment of the territory of Hong Kong. The novel areas include the design options, the Flexible-Hybrid deployment model and validation using an objective tool.

Background

Hong Kong's eHR is a government led centralized HIE. The project team proposes a technical design of a medical image exchange for the eHR and validation. Business requirement, concerns and issues collection was done. A service design proposal was published in 3/2017. The project team proposes a grid architecture using IHE XDS-Ib profiles. Validation was performed using an objective method.

Evaluation

Among private and public, services and technical readiness varied considerably, with high patient flow between sectors. They needed technical support, data privacy/security assurance and clear guidelines on data management. Functions were; upload and validation; viewing and manipulation, via the eHR; future Image download Proposed architecture followed IHE XDS-Ib with 3 parts 1. Digital image and uploading through a DICOM Receiving Gateway 2. Validate, store and distribute by an Image Registry and Repository 3. View in an HTML5 image browser through the eHR portal Design options were identified • functional location of the Gateway • access to local archives • compression level for archival • timing for upload to centralized archives A "flexible-hybrid" approach was proposed. HCPs would be assigned to using centralized archival or distributed archival depending upon their level of technical readiness and other factors. This approach should be most able to fully leverage the advantages of both these modes.

Discussion

Assessment of the design and logic used a tool for project evaluation in the context of an evaluation of a project which is developed for the purpose of societal benefit. Comparison looked for congruence with research literature and international experience of projects with similar concepts. analysis of the service gap literature review for benefits review 13 national scale projects.

SSC08-04 A Tale of Two Protocols: An Honest Assessment of the Impact of an Extended Coverage Protocol on Discrepancy between Preliminary Trainee and Final Staff Reports

Monday, Nov. 27 11:00AM - 11:10AM Room: S402AB

Participants
Eitan Aziza, BSC, Toronto, ON (*Presenter*) Nothing to Disclose
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CONCLUSION

In light of these findings, institutions should balance the benefits of EC with the cost to trainee education.

Background

In traditional radiology programs, residents provide the requesting physician with an initial report on each study, to be reviewed by the attending radiologist, who provides a final report. Recently, hospitals have been turning to extended staff coverage (EC) models in order to lower the turnaround time to final report and improve patient care. However, the literature suggests that this staff presence may limit resident learning. This study aims to assess the utility of EC by comparing the rate of discrepant reports before and after implementing EC.

Evaluation

7,924 neuroradiology studies were reviewed in total, 5,667 under the initial model and 2,257 under the EC model. Manual report comparison was performed to determine concordance between the preliminary resident and final staff report. For discrepant reports, electronic medical records were reviewed and discrepancies were identified as major (MaD) in the presence of realized impact on patient care or clinical outcome. Cross-tabs and binomial logistic regression were used to investigate the effect of postgraduate year (PGY), study type, presence of significant findings, hour of initial read, priority, inpatient status, patient sex, and history of trauma.

Discussion

Although total discrepancy was lower with implementation of EC (8.2% vs. 7.6% EC), the rate of MaD was higher (1.2% vs. 1.6% EC). Average time from preliminary to final report decreased significantly from 12.2 hours under the previous model to 7.1 hours under EC. Rates of minor and major discrepancy under both models were found to vary significantly with study type, significant findings, and PGY. Previously, discrepancy was also found to be related to the hour of initial read and patient status, while these were not significant under the EC model. Despite the additional coverage, the average number of studies interpreted by the on-call resident per shift did not significantly change (18.6 vs. 19.1 EC). Thus, while the impact of certain variables on discordance was reduced with EC, the overall rate of major discrepancy did not improve with the implementation of EC.

SSC08-05 Educational Value of Pocket-Sized Ultrasound Devices to Improve Understanding of Ultrasound Examination Principles and Sonographic Anatomy for Medical Student

Monday, Nov. 27 11:10AM - 11:20AM Room: S402AB

Participants
Eun Young Kim, Incheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Hyun Lee, MD, Incheon, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hee Young Lee, MD, Incheon , Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yoon Kyung Kim, MD, Incheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jeong Ho Kim, MD, Incheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
In Seon Lee, MD, Incheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

It is important that medical students understand the principles of ultrasound (US) examination, because US is an important component of patient care in clinical practice. Hand-held ultrasonography has benefits for its accessibility and easy to use characteristics. The primary objective was to evaluate the educational value of hand-held US to improve interest and understanding of US examinations for medical students.

METHOD AND MATERIALS

We added a US training session comprised of a self-study learning module and a hands-on training session, to a two-week block curriculum of medical imaging for first year medical students using multiple units hand-held US on a small-group basis during a single afternoon. The forty students recruited completed a questionnaire before and after US training; these questionnaires contained 6 and 10 questions, respectively, which were rated using a five-point Likert scale. In addition, the understanding of sonographic anatomy was tested before and after the training program.

RESULTS

All 40 students completed the questionnaires and anatomy-related tests. Students found the program educationally valuable (4.37 of 5) and reported that US practice was useful for improving understanding of the principles of US examination (4.23 of 5) and sonographic anatomy (4.40 of 5). Overall confidence for performing US examinations and understanding of sonographic anatomy were significantly increased after US training (increased overall confidence score, 1.87±0.91, $P < 0.01$, and improved score regarding sonographic anatomy, 6.55±1.55, $P < 0.001$).

CONCLUSION

US training using hand-held ultrasonography is educationally valuable in terms of improving medical student interest in and understanding of US examinations.

CLINICAL RELEVANCE/APPLICATION

US training using portable pocket-sized ultrasound devices are educationally valuable for medical students. Self-study learning module and multiple pocket-sized ultrasound devices enables time-effective and iterative small-group based training.

SSC08-06 RADSVRx (Radiology Advanced eDucational System with Virtual Reality eXperience): Development and Assessment of Diagnostic Skills Through a Virtual and Augmented Reality Educational Platform

Monday, Nov. 27 11:20AM - 11:30AM Room: S402AB

Participants
Eduardo Hernandez-Rangel, MD, Orange, CA (*Presenter*) Nothing to Disclose
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Adrian A. Negreros-Osuna, MD, Monterrey, Mexico (*Abstract Co-Author*) Nothing to Disclose

Guillermo Elizondo-Riojas, MD, PhD, Monterrey, Mexico (*Abstract Co-Author*) Research Consultant, Avenu Medical, Inc
Tatiana Kelil, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To design an online and mobile VR/AR platform for radiology education, and 1) explore the potential of VR/AR in radiology education; 2) Understand the integration and limitations of VR/AR into radiology education; 3) measure user learning outcomes and feedback.

METHOD AND MATERIALS

We designed an online/mobile open access virtual and augmented reality platform for radiology education and its use with a head mount/VR viewer for a mobile phone compatible with android or iOS. The content was divided in 4 anatomical models (neuroimaging, cardiology, msk and IR) , 4 clinical cases and a virtual working station. During the annual meeting at the RSNA 2016 we invited to test the platform to 180 Participants (Medical students, residents, fellows and radiologists) to complete a survey to measure change in confidence and performance on normal/pathologic cases to assess learning. The post survey also assessed users attitudes toward the VR learning environment.

RESULTS

Of the 180 participants, 130 rated the course experience, pre-post confidence surveys, and pre-post cases. On a Seven-point Likert scale (1: strongly disagree to 7: strongly agree), participants mean reported confidence increased from pre to post VR/AR exposure with respect to: identify normal structures on a traditional CT/MRI scan (pre= 5.0 to post = 6.2, p= 0.02); identifying abnormalities on a traditional CT/MRI scan (pre = 5.3 to post= 6.4, p=0.02) On the clinical cases, the percentage of users giving a correct diagnosis increased from 64.6% (84 of 130) pre to 86.1% (112 of 130) post (p=0.2). Most participants agreed that VR/AR is an effective method for radiology education especially for medical students or radiology residency, and only 2.3% (3 of 130) disagreed with the statement that this is a potential tool that can benefit the traditional teaching method. 40% commented that VR support radiologist to integrate, educate and inform patients about their imaging studies.

CONCLUSION

The results on this pilot suggest a potential benefit in the integration of virtual reality to the traditional radiology education models, contributing to more immersive radiology educational experiences.

CLINICAL RELEVANCE/APPLICATION

VR/AR application to the traditional radiology education gives the opportunity to integrate high impact technology to a very low cost, increasing the accessibility and cost-effectiveness.

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/ Tatiana Kelil, MD - 2017 Honored Educator

SSC08-07 Can a Pay-For-Performance Approach Help to Increase Patients' Satisfaction?

Monday, Nov. 27 11:30AM - 11:40AM Room: S402AB

Participants
Achim Escher, Basel, Switzerland (*Presenter*) Nothing to Disclose
Martin Kretzschmar, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Georg M. Bongartz, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Anthony De Vere-Tyndall, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

Combining a continuous evaluation of patient's satisfaction with its outcome linked to a P4P bonus payment led to a significant increase in patient's satisfaction.

Background

To improve patients' satisfaction, a Pay-for-Performance (P4P) approach for technicians and frontdesk employees was implemented. Patients' satisfaction was measured with an electronic device allowing patients to give feedback about their overall experience by pressing a button on a color coded 4-level score from "very positive" to "very negative". Collected data was used to calculate a "satisfaction index" (SI). A bonus payment was based on the results of the SI. Depending on it each day a bonus of 5 Swiss Francs (CHF) (SI>95%) or CHF 10 (SI=100%) was awarded by the employees. Results of the survey and the cumulated bonus were frequently presented at the employee's whiteboard.

Evaluation

Measuring patients' satisfaction permanently started in 6/2016. The main key performance indicator was the SI which is a weighted measure of the four categories. The goal was to reach a minimum SI of 95%. Comparing the period 6/2016 - 11/2016 to the period from 12/2016 - 03/2016 the mean SI increased from 92.7% to 95.5%. "Very negative" feedback dropped from 1.8% to 1.1%. Positive feedback (sum of "positive" and "very positive") increased from 95.5% to 98.5%. The mean bonus payment per month increased from CHF 66.00 to CHF 103.75

Discussion

Measuring patients' satisfaction is indispensable to gain insight in patients' overall experience. Patient satisfaction is usually measured via questionnaires with a poor return ratio and consecutively unreliable results. Our approach uses an electronic device that allows patients to provide feedback within a second by pressing one out of four buttons. This eliminates the disadvantage of time-consuming questionnaires. However, the unidimensional data structure does not provide qualitative information. Using a novel P4P approach led to some resistance within the staff. However, the acceptance of this kind of motivational approach increased as soon as employees understood that they will receive a significant gratification at the end of the year.

SSC08-08 Contrast Emergency Management Training Using an Immersive Virtual Reality (VR) Headset: A Feasibility Pilot

Monday, Nov. 27 11:40AM - 11:50AM Room: S402AB

Participants
Colin J. McCarthy, MD, Boston, MA (*Presenter*) Nothing to Disclose
Raul N. Uppot, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Alexandra Penzias, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Joanne Forde, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

A simulation curriculum for contrast and emergency management has been established in our department, based at a large medical school-affiliated hospital. The annual training requires approximately two hours in a simulation laboratory, where nurses, technologists and physicians partake in simulation exercises. We developed a simulation platform for a VR headset using recorded immersive video content, and performed a pilot study to evaluate the feasibility of incorporating the technology into our existing simulation program.

METHOD AND MATERIALS

A scripted contrast emergency (severe anaphylactoid reaction) was recorded using a 360-degree camera rig and 7 high-resolution cameras (GoPro Inc). Actors were used to play the physician, technologist and nurse during the management of a simulated patient. A high-fidelity mannequin (SimMan 3G) was used during the case, and the mannequin's vital signs, behavior and voice were controlled by an instructor. A Dynamic Medical Immersive Training Environment (DynaMITE) was used to display the content on a VR headset (Samsung Gear VR). All participants undertook a feedback survey before and after viewing the immersive training content, which included questions on a Likert scale about usability and side effects.

RESULTS

19 staff members agreed to participate in the pilot study, including nurses, technologists and physicians. 16 participants had previously attending an in-person contrast simulation. The majority (n = 12) had not used a VR headset before. When asked if they thought the VR headset had a role in training physicians, 14 answered yes and the remaining 5 participants answered "maybe". 3 of the 19 participants reported dizziness / nausea when wearing the headset, and the majority of users believed the image quality to be high. 7 people believed that contrast simulation using a VR headset could replace in-person training at the simulation lab, and 8 people believed it would be complementary to the existing training.

CONCLUSION

In-person training requires presence at a simulation center for 2 hours, and immersive simulation using a VR headset may be useful as an adjunct to existing radiology emergency simulations, particularly at off-site imaging centers without access to a high-fidelity mannequin.

CLINICAL RELEVANCE/APPLICATION

Immersive content, delivered on a head-mounted VR display, may allow for an expansion of existing simulation training.

SSC08-09 Informatics Keynote Speaker: Cybersecurity in Radiology

Monday, Nov. 27 11:50AM - 12:00PM Room: S402AB

Participants
David J. Harvey, FRCR, Swansea, United Kingdom (*Presenter*) Shareholder, Medical Connections Ltd; Managing Director, Medical Connections Ltd

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ABSTRACT

There are many aspects to cybersecurity in radiology, and it is important to look beyond the problems posed by the traditional data stealing "hacker" to wider threats against the confidentiality, availability and integrity of the data held by radiology departments. There has been widespread coverage of data theft from many organisations, and institutions have taken measures to protect their patients' privacy, but other threats that must also be considered include those against availability (such as ransomware) and even potentially those which could deliberately insert false and damaging data into radiology systems. Most of the computer systems in a radiology department communicate via DICOM and HL7, which were developed decades ago, before such threats were considered, and special consideration should be given to mitigation of the weaknesses and opportunities that they present to adversaries.

SSC09

Musculoskeletal (Metabolic, Functional and Quantitative)

Monday, Nov. 27 10:30AM - 12:00PM Room: E450B

BQ CT MK

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

Participants
Robert D. Boutin, MD, Davis, CA (*Moderator*) Nothing to Disclose
Gregory Chang, MD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSC09-01 Low Paraspinous Muscle Attenuation on Computed Tomography (CT) Predicts All-cause Mortality in the National Lung Screening Trial

Monday, Nov. 27 10:30AM - 10:40AM Room: E450B

Participants
Robert D. Boutin, MD, Davis, CA (*Presenter*) Nothing to Disclose
Stephen B. Kritchevsky, PhD, Winston-Salem, NC (*Abstract Co-Author*) Nothing to Disclose
Haiying Chen, MD, Winston-Salem, NC (*Abstract Co-Author*) Nothing to Disclose
Caroline Chiles, MD, Winston-Salem, NC (*Abstract Co-Author*) Advisory Board, ImBio, LLC
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PURPOSE

To examine the association between paraspinous muscle CT attenuation at baseline and at year-2 follow-up with all-cause mortality over 6 years in older men and women in the National Lung Screening Trial (NLST).

METHOD AND MATERIALS

Association of muscle attenuation and all-cause mortality was examined in 1176 men and 672 women, age 70-74 years, from the CT arm of the NLST. Analysis of low-dose chest CTs at baseline and year-2 follow-up was performed. Using a clinical PACS workstation (iSite version 3.6, Philips Healthcare), left paraspinous muscles were segmented at the level of T12 vertebra. Associations between baseline muscle attenuation and change in muscle attenuation with all-cause mortality were determined using logistic regression models. Four models were used, stratified by sex: 1) unadjusted; 2) adjusted for age, race and BMI; 3) Model 2 plus smoking; 4) Model 3 plus chronic conditions (cancer, COPD, emphysema, hypertension, heart disease, stroke).

RESULTS

At a mean 6 years of follow-up, 201 (17.1%) men and 81 (12.1%) women were deceased. In men, mean (SD) paraspinous muscle attenuation was 37.0HU (10.9) at baseline and 35.7HU (12.5) at year-2. In women, mean (SD) paraspinous muscle attenuation was 32.3HU (11.4) at baseline and 31.6HU (11.8) at year-2. In men, baseline muscle attenuation was inversely associated with all-cause mortality in all 4 models (Model 4: OR = 0.85; CI = 0.72, 0.99; p=0.04). In women, the association did not reach significance (Model 4: OR = 0.95; CI = 0.73, 1.23; p=0.70). In men and women, the change in muscle attenuation from baseline to year-2 was not associated with mortality.

CONCLUSION

In older men but not women, decreased paraspinous muscle attenuation, indicative of increased fatty infiltration, was associated with increased all-cause mortality. Two-year change in muscle attenuation was not associated with mortality.

CLINICAL RELEVANCE/APPLICATION

Opportunistic measurement of muscle attenuation on chest CT examinations may help improve the accuracy of health-related outcome prediction models in older adults.

SSC09-02 Opportunistic Utility of Appraising BMD via RADIOMICS (Texture Analysis and Data Mining) of Proximal Femur and L-1 Vertebra on routine CT Abdomen and Pelvis

Monday, Nov. 27 10:40AM - 10:50AM Room: E450B

Participants
Shanker Raja, MD, Bellaire, TX (*Presenter*) Nothing to Disclose
Sharad P. George, MD, Dhahran, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose

William L. Plishker, PhD, College Park, MD (*Abstract Co-Author*) Employee, IGI Technologies

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PURPOSE

Introduction: Osteoporosis remains substantially underdiagnosed, furthermore, more than 80% of pts with osteoporosis-related fractures have never had BMD testing. Though QCT is fairly accurate, it is not routinely used. Recently textural analysis (TEX) and data mining (DATmin) i.e. RADIOMICS has emerged as a promising endeavor in medical imaging. We have assessed the utility of supervised DATmin a panel of TEX features extracted from CT abdomen and pelvis (CTAP).

METHOD AND MATERIALS

Retrospective review of a unique cohort of pts. [females=17, age= 51.7 (36-74) yrs.] with breast Ca. undergoing concurrent CTAP and BMD (LUNAR, GE, Waukesha). All scans were acquired per accepted protocols. For extraction of textures, 2D ROI were drawn on a representative coronal slice, the Rt. Femoral Neck (FNk), Wards triangle (WT), Trochanter (Troc) and L-1 were flagged using BMD as guidance, on a MIMSOFTWARE (Cleveland, OH, USA) review workstation. Images were exported as DICOM-RT, to a home built TEX computing module in MATLAB. A panel of 42 TEX features were computed from each of the ROI. The extracted TEX features were data mined, using supervised classification in WEKA (Univ. of Waikato, New Zealand), the ground truth was class definition by BMD. The following algorithms were evaluated: J48, NaiveBayes, and Random Forest, with both leave one out 10 fold, and split 66:33 as training and validation sets.

RESULTS

Among the three classifiers Naive Bayes was the best classifier, followed by Random Forest and J48. With percent split validation using Naive Bayes, 100% were correctly classified as (nor=4, osteopenia=2) the percent correct vs. incorrect classification for Troc, FNk, and L-1 were 83:17; 67:33; and 33:67 respectively. The ROC for the four ROIs were 100, 73, 63 and 13% respectively.

CONCLUSION

In our series of extracted TEX features from different sites, WT was the most accurate, followed by Troc, FNk and least L-1 using NaiveBayes classifier. Analysis in a larger cohort, as well as incorporating additional algorithms (fractals, wavelets etc) is anticipated to improve test performance.

CLINICAL RELEVANCE/APPLICATION

Data Mining of opportunistically extracted TEX features appears to be a promising screening tool for BMD at no extra cost in pts. undergoing CTAP.

SSC09-03 3T MRI of Proximal Femur Microarchitecture Discriminates between Subjects Without and With Fragility Fractures

Monday, Nov. 27 10:50AM - 11:00AM Room: E450B

Participants
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Cheng Chen, Iowa City, IA (*Abstract Co-Author*) Nothing to Disclose
Arakua Welbeck, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Punam K. Saha, PhD, Iowa City, IA (*Abstract Co-Author*) Nothing to Disclose
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Gregory Chang, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine if 3T MRI of proximal femur microarchitecture can discriminate between subjects without and with fragility fracture.

METHOD AND MATERIALS

This prospective study had institutional review board approval and was HIPAA compliant. From the Osteoporosis Center at our institution, we recruited 80 subjects without fragility fracture (78 female, 2 males; median age = 61.0 years, interquartile range = 10.0 years; median body mass index = 21.0 kg/m2, interquartile range = 3.8 kg/m2) and 41 subjects with fragility fracture (36 females, 5 males; median age = 63.0 years, interquartile range = 15.3 years; median body mass index = 22.1 kg/m2, interquartile range = 5.9 kg/m2). All subjects underwent 3T MRI of the same hip as scanned by DXA to assess bone microarchitecture. Standard statistical methods were used to assess discriminatory ability of parameters and correlations between total hip BMD and microarchitecture.

RESULTS

Femoral head trabecular plate edges and rods (AUCs=0.610-0.637; CIs=0.507-0.531 to 0.714-0.742), femoral neck trabecular plate edges, rod disruption, and plate-to-rod ratio (AUCs=0.616-0.620, CIs= 0.504-0.509 to 0.726-0.730), Ward's triangle trabecular isolation, plate-to-rod ratio, and plate width (AUCs=0.613-0.649, CIs=0.509-0.543 to 0.718-0.754), and inter-trochanteric bone volume fraction and trabecular isolation, plate edges, rod disruption, number, and separation (AUCs=0.617-0.642, CIs=0.505-0.541 to 0.728-0.743) could discriminate fracture cases from controls. Total hip BMD (AUC=0.480, CI=0.370-0.591) could not discriminate fracture cases from controls. Within the intertrochanteric region only, total hip BMD demonstrated weak correlations with bone volume fraction, trabecular isolation, plate edges, rod disruption, number, and separation (rho = -0.214 to 0.215, $p < 0.05$ for all).

CONCLUSION

3T MRI of proximal femur microarchitecture can discriminate between subjects without and with fragility fracture and may provide added information about fracture risk beyond BMD.

CLINICAL RELEVANCE/APPLICATION

3T MRI of proximal femur microarchitecture discriminates between subjects without and with fragility fractures and therefore may provide better quantitative assessment of bone than DXA scan

SSC09-04 New Dietary Strategies Addressing the Specific Needs of Elderly Population for a Healthy Aging in Europe: The NU-AGE Approach for Ageing, a Link Between Body Composition Assessed by DXA and Inflammation

Monday, Nov. 27 11:00AM - 11:10AM Room: E450B

Participants
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PURPOSE

Demographic trends show progressive ageing of the population and increasing incidence of age-related diseases. Current evidence emphasizes the role of low-grade chronic inflammation in the process of ageing, and body composition(BC) has been shown to undergo significant changes with ageing. The aim of the present work is to outline the correlation between fat and lean mass distribution, assessed by dual-energy X-ray absorptiometry(DXA),and inflammatory markers.

METHOD AND MATERIALS

A total of 1295 volunteers free of major overt diseases, ageing 65-79 years, were enrolled in 5 European countries(Italy, France, United Kingdom, Netherlands, and Poland). Whole-body DXA scans to assess BC, and blood samples were taken. BC analysis was focused on 6 pivotal markers: fat mass/lean mass(FM/LM), androidFM/LM, android/gynoidFM, lean mass index(LMI), appendicular lean mass index(ALMI), and skeletal muscle mass index(SMI). Plasma levels of pro-inflammatory markers C-reactive protein(CRP) and leptin, and anti-inflammatory marker adiponectin were assayed.

RESULTS

CRP and leptin levels were found to positively correlate with FM, while negatively with LM. CRP showed weak correlations, while a strong positive correlation($p<2.2e-16$) was observed between leptin levels and FM/LM($r=0.807$), and androidFM/LM($r=0.736$). Leptin negatively correlates with SMI($r=-0.739$) and ALMI($r=-0.280$). Consistently, adiponectin was negatively correlated with android/gynoidFM($r=-0.593$). Surprisingly, adiponectin was positively correlated with the FM/LMratio($r=0.223$) and negatively correlated with LM($r=-0.477,-0475,-0.296$ with ALMI,LMI and SMI, respectively).

CONCLUSION

Assessment of fat and lean mass is essential, and DXA is a gold standard technique. Insights into the pathophysiology of inflammation are provided by BC analysis. Leptin was the inflammatory marker that better correlated with BC markers of FM and central adiposity, while adiponectin showed a negative correlation with android adiposity, reinforcing the protective role of gynoid distribution in metabolism. Discordance between adiponectin levels and BC "protective factors"should be further addressed to understand their differential role in inflammation and metabolism modulation.

CLINICAL RELEVANCE/APPLICATION

DXA BC parameters correlate with plasma inflammatory markers, and may be useful to obtain a picture of patients' risk status.

SSC09-05 Reproducibility of Trabecular Bone Score and Bone Mineral Density at Different Scan Modes on a Phantom: What Is the Effect of a Fictitious Soft Tissue Increase?

Monday, Nov. 27 11:10AM - 11:20AM Room: E450B

Participants
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PURPOSE

Trabecular Bone Score (TBS) provides an indirect index of trabecular microarchitecture from lumbar spine (LS) dual energy x-ray absorptiometry (DXA). TBS mean values have been reported to be negatively influenced by increasing body mass index (BMI), due to the augmented thickness of superimposed soft tissue. In this phantom study we evaluated the effect of a fictitious increase of soft tissue thickness on TBS and bone mineral density (BMD) reproducibility (REP).

METHOD AND MATERIALS

An Hologic spine phantom was scanned with a QDR-Discovery W Hologic densitometer. Fresh pork rind layers of 5mm were used to simulate the in-vivo soft tissues. For each scan mode [fast array (FA), array, high definition (HD)] 25 scans were consecutively performed, without phantom repositioning, at 0 (no layers), 1 and 3cm of thickness. The coefficient of variation (CoV) was calculated as the ratio between standard deviation and mean; percent least significant change (LSC%) as 2.77×CoV; REP as the complement to 100%of LSC%. BMD unit: g/cm2, TBS is unitless. Data are provided as mean ± standard deviation.

RESULTS

Considering the three scan modes, REP ranged at 0-cm between 99.0%-99.4% (BMD) and 98.2%-98.8% (TBS). REP at 3-cm: 98.7%-98.9% (BMD), 97.4-98.2% (TBS). The difference in terms of REP decrease between BMD and TBS was comparable at 0 and 3 cm of soft-tissue thickness (-0,8 at 0 cm, -0,7 at 3 cm). Both BMD and TBS significantly decreased with increasing soft tissue, but the reduction was more pronounced for TBS. The greatest difference for BMD and TBS was found at FA: BMD = 0.987±0.010 (0cm) - 0.980±0,013 (3cm), difference of -0,007 (-0.67%, p<0.001); TBS = 1.420±0.026 (0cm) - 1.337±0.024 (3cm), difference of -0.083 (-6,17%, p<0.001). BMD mean differences between 0-3 cm were always lower than BMD LSC, while TBS mean differences were always higher than TBS LSC.

CONCLUSION

TBS REP was overall lower compared to BMD REP. There was a comparable decrease between BMD REP and TBS REP whit increasing soft-tissue layers. Both BMD and TBS are negatively influenced by increased soft tissue thickness, but only TBS variations exceed the LSC.

CLINICAL RELEVANCE/APPLICATION

For an identical bone quality, TBS may be lower in patients with high BMI values.

SSC09-06 Prediction of Osteoporotic Fractures from Routine CTs Using Large Scale Collectives: Data Handling, Image Analysis and First Clinical Results Derived from Over 250,000 Patients

Monday, Nov. 27 11:20AM - 11:30AM Room: E450B

Participants
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PURPOSE

To evaluate if bone density derived from large scale routinely acquired CTs can be used as predictive marker for osteoporotic fractures and included within a clinical diagnostic routine.

METHOD AND MATERIALS

2,300 patients with osteoporotic fractures were identified from clinical admission data and cross-checked against the PACS database using a new, in house developed software, PACS-Crawler, to identify patients with CT scans performed for other indications. Two groups were identified; group 1 encompassing 954 patients with scans at least three months before fracture, and group 2 comprised of 1223 patients with scans around the time of fracture. The data was anonymized and moved en-masse to a 32 core cluster using the PACS-Crawler software. There, bone extraction was performed using a customized imageJ-based plug-in and density percentiles were automatically extracted. Mean bone density and standard deviation were compared to a normative collective of 250,000 patients using a Mann-Whitney-U test, tests were considered significant at P< 0.05.

RESULTS

There was no significant difference in bone density of patients in group 1 (P=0.36) and 2 (P=0.27) and those without fractures. However, compared separately by anatomical region there was a significantly lower bone density in patients with osteoporotic fracture in comparison with the normal collective in head CTs (P<0.01). This difference was more pronounced in male than in female patients.

CONCLUSION

Although there was no significant difference considering bone density overall, significant differences in bone density between patients with osteoporotic fracture and the normal collective were visible in one of the most frequently performed CT scans, the cranial CT. In the future this analysis will be refined and extended to different anatomical regions and substructures.

CLINICAL RELEVANCE/APPLICATION

In this work, we have established a software pipeline for big data searching, relaying and processing. Our first results show that thus extracted parameters may be relevant and implementable in a clinical context in terms of osteoporotic fracture risk analysis.

SSC09-07 Automated Muscle Analysis Tool (AMAT) for Large Scale CT Image Analytics

Monday, Nov. 27 11:30AM - 11:40AM Room: E450B

Participants
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PURPOSE

To develop and validate an Automated Muscle Analysis Tool (AMAT) for measuring muscle attenuation and cross-sectional area in large CT datasets.

METHOD AND MATERIALS

AMAT was developed using open-source medical image analysis tools: Advanced Normalization Tools (ANTs) and the Oxford Centre for Functional Magnetic Resonance Imaging of the Brain Software Library (FSL). AMAT employs a three-dimensional (3D) stage to identify the level (e.g.T12 vertebra) and a two-dimensional (2D) stage to segment the muscle (e.g. left paraspinous muscle). Both stages involve four main steps: 1) pre-processing, 2) template construction, 3) region of interest labeling, and 4) warping. AMAT was validated in 113 non-contrast chest CT exams (slice thickness 0.625-2.0 mm) in 73 men and 40 women, age 70-74 years, in the CT arm of the National Lung Screening Trial. For validation, left paraspinous muscle was manually segmented at T12 level, using Mimics software (version 19.0; Materialise, Leuven, Belgium) with muscle thresholds set at -29 to150 HU. For the 3D stage, the accuracy error of AMAT was based on the number of mm between the locations chosen by AMAT and the human reader. For the 2D stage, accuracy was determined by comparing the muscle cross-sectional areas and attenuations derived by AMAT to the values obtained manually.

RESULTS

AMAT development followed an iterative process, where each step was continually improved based on previous trials. Mean (SD) values for paraspinous muscle attenuation were 44.7HU (6.0) for manual and 45.5HU (6.3) for AMAT. Mean (SD) values for paraspinous muscle cross-sectional area were 15.5 cm2 (3.0) for manual and 13.9 cm2 (3.3) for AMAT. For the 3D stage, mean accuracy error was 11.8mm (4%); range: 0.2-44.7mm (0-14%). For the 2D stage, mean accuracy error for muscle attenuation was 1.6HU (4%); range: 0-6.2HU (0-13%). Mean accuracy error for muscle cross-sectional area was 2.0cm2 (13%); range: 0.1-7.8cm2 (0-54%).

CONCLUSION

Initial validation results of AMAT are promising. Iterative correction of deficient procedures will continue to improve the accuracy of AMAT.

CLINICAL RELEVANCE/APPLICATION

Current CT image analysis of muscle cross-sectional area and attenuation requires time consuming manual segmentation. AMAT will allow for automated large-scale analytics of muscle metrics on CT examinations that could be adapted to other muscle groups and body regions including abdomen, pelvis, and extremities.

SSC09-08 Sex Differences in Body Composition and Association with Cardiometabolic Risk

Monday, Nov. 27 11:40AM - 11:50AM Room: E450B

Participants
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PURPOSE

Body composition differs between men and women, with women having proportionally more fat and men more muscle mass. Fat distribution is an important determinant of cardiometabolic risk, with certain ectopic fat depots [visceral adipose tissue (VAT), intramyocellular (IMCL) and intrahepatic lipids (IHL)] being more detrimental than others [femorogluteal subcutaneous adipose tissue (SAT)]. We hypothesized that there are sex-differences in body composition and ectopic fat depots and that these are associated with a sex-specific cardiometabolic risk profile.

METHOD AND MATERIALS

Our study was IRB-approved and HIPAA compliant. Written informed consent was obtained. We recruited 200 young, non-diabetic, overweight and obese subjects who were otherwise healthy (109 women, 91 men, mean age: 37±10 years, mean BMI: 35.2±5.8 kg/m2). After an overnight fast, subjects underwent DXA and CT for body composition, 1H-MRS at 3T of soleus muscle for IMCL and right hepatic lobe for IHL quantification, serum glucose, insulin and lipids. Men and women were compared by ANOVA. Linear regression analyses between body composition measures and cardiometabolic risk markers were performed.

RESULTS

Women and men were of similar age and BMI (p=0.4). Women had higher %fat mass by DXA and lower lean mass vs men (p<0.0001). However, men had more VAT and VAT/abdominal SAT, muscle mass (p<0.0001), IMCL (p=0.0008) and IHL (p=0.005), while women had more femoral SAT (p<0.0001). Compared to women, men had higher measures of cardiometabolic risk, including serum triglycerides, apolipoprotein B, fasting insulin and HOMA-IR (p<=0.005). However, in women, VAT, IMCL, and IHL were strongly associated with these measures of cardiometabolic risk (p<=0.004), while in men these associations were weaker or non-significant.

CONCLUSION

Obese men have relatively higher VAT, IMCL, IHL, muscle and lean mass, while obese women have more %fat mass and femoral SAT. This female anthropometric phenotype is associated with a better cardiometabolic risk profile at a similar BMI compared to men. However, ectopic fat is more strongly associated with adverse cardiometabolic risk factors in women compared to men.

CLINICAL RELEVANCE/APPLICATION

The female pattern of fat distribution is associated with improved cardiometabolic risk compared to men at similar BMI, while ectopic fat in women portends greater metabolic risk.

SSC09-09 Sarcopenic Obesity and Cardiometabolic Risk in Young Adults with Obesity

Monday, Nov. 27 11:50AM - 12:00PM Room: E450B

Participants
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PURPOSE

Sarcopenic obesity, reduced skeletal muscle mass in the setting of obesity, is an important risk factor for cardiometabolic disease in the elderly, but it is unknown whether relatively lower skeletal muscle mass for BMI in young adults, i.e. relative sarcopenia, contributes to cardiometabolic risk. We hypothesized that relative sarcopenia is associated with cardiometabolic risk markers in young adults with obesity.

METHOD AND MATERIALS

Our study was IRB-approved and HIPAA compliant. Written informed consent was obtained. We recruited 188 young overweight and obese subjects who were otherwise healthy, including without diabetes mellitus (100 women, 88 men, mean age: 36.8±9 years, mean BMI: 35.0±5.7 kg/m2). All subjects underwent DXA and CT for body composition, an oral glucose tolerance test (OGTT), fasting serum insulin, lipids and inflammatory markers. DXA appendicular lean mass (ALM)/BMI was used as a measure of relative sarcopenia and subjects were divided by the ALM/BMI median. Groups were compared by ANOVA.

RESULTS

Women with lower ALM/BMI (relative sarcopenia) had a higher mean 120-min glucose level (p=0.02) and higher glucose area under the curve on OGTT (p=0.003), lower HDL cholesterol (p=0.02), higher apolipoproteinB (ApoB) and ApoB/LDL (p=0.02), higher hsCRP (p=0.005) and fibrinogen (p<0.0001) and lower muscle attenuation, suggestive of fatty infiltration (p=0.003) compared to women with higher ALM/BMI, despite similar age (p=0.7) and weight (p=0.5). Men with lower ALM/BMI had higher mean insulin (p=0.001), HOMA-IR (p=0.003), hsCRP (p=0.008) and fibrinogen (p=0.007), and lower muscle attenuation (p=0.006) compared to men with higher ALM/BMI, despite similar age (p=0.6) and weight (p=0.4).

CONCLUSION

Relative sarcopenia (lower ALM/BMI) is associated with measures of cardiometabolic risk in young adults with obesity, and these effects are stronger in women than in men. Our study suggests that relative sarcopenia may be an under-appreciated mechanism linking obesity to cardiometabolic risk, and prospective studies are needed to determine whether relative sarcopenia predicts incident cardiometabolic disease over time.

CLINICAL RELEVANCE/APPLICATION

Relative sarcopenia may be an under-appreciated mechanism linking obesity to cardiometabolic risk in young adults with obesity, a high-risk group for developing cardiometabolic disease.

SSC10

Nuclear Medicine (Pulmonary and Cardiovascular Imaging)

Monday, Nov. 27 10:30AM - 12:00PM Room: S505AB

CH CT NM 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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Sub-Events

SSC10-01 Improved Pulmonary Nodule Detection Using a Next Generation 18F-FDG PET Imaging System

Monday, Nov. 27 10:30AM - 10:40AM Room: S505AB

Participants
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PURPOSE

One diagnostic indication for FDG PET is to determine whether a pulmonary nodule is benign or malignant based on the uptake of the nodule. However, FDG PET is limited by a relatively low spatial resolution (5 mm) that can lead to underestimation of tracer uptake and detectability in small lesions. The objective of this study was to evaluate the detection rate for pulmonary nodules using a next generation digital PET/CT system using Silicon Photomuliplier (SiPM) technology for increased contrast recovery and lower background variability in patients with known malignancies.

METHOD AND MATERIALS

76 consecutively enrolled patients who were referred for cancer staging by 18F-FDG PET/CT underwent scans on the standard of care (SoC) and new digital system (Discovery Meaningful Insights) from September-December 2016. Images from the SoC PET/CT were reconstructed using time-of-flight (ToF) and ordered subset expectation maximization (OSEM) protocols. Images from digital PET/CT were reconstructed using ToF and a Bayesian penalized likelihood algorithm. Two experienced, nuclear medicine trained readers reviewed both scans for each patient in random order, blinded to clinical information and recorded the location and standardized uptake value (SUV) measurement for each nodule. Differences in acquisition protocols were measured based on the distribution of the analyzed data and difference in detection rates assessed by McNemar's test.

RESULTS

Excluding one patient who had innumerable metastatic nodules on both scans, the number of lesions detected on the digital and standard of care PET/CT were 35 and 20, respectively. Of the 57 patients with negative standard of care scans, 7 (12%) demonstrated FDG-avid pulmonary nodules on the digital PET/CT. More lesions were detected on digital PET/CT in four patients who had nodules identified by both methods. Detection rates remained the same for 65/76 patients (86%), including 51 who were negative on both scans. Digital PET/CT nodules had a higher SUVmax compared to the standard of care (2.0; IQR 0.9-6.0 versus 1.3; 0.6-3.9, $p < 0.001$).

CONCLUSION

Digital PET/CT system detects more FDG avid pulmonary nodules. FDG PET for diagnosing pulmonary nodules and staging metastatic disease to the lungs will require re-evaluation with this new, more sensitive platform.

CLINICAL RELEVANCE/APPLICATION

The new digital PET/CT system can provide higher resolution, and is recommended for the detection of pulmonary nodules.

SSC10-02 Estimating Lung Carbon Monoxide Diffusion Rates with Positron Emission Tomography

Monday, Nov. 27 10:40AM - 10:50AM Room: S505AB

Participants
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PURPOSE

Regional assessments of gas exchange could be highly useful for assessing the efficacy vascular-targeted treatment responses in pulmonary arterial hypertension. We performed a pilot study in healthy volunteers to determine whether carbon monoxide (CO) transfer in the lungs could be estimated with 15O-CO positron emission tomography (PET).

METHOD AND MATERIALS

Healthy volunteers were imaged twice in a Siemens Biograph 40 PET/CT scanner. After fully emptying their lungs, volunteers sharply inhaled 20-40 mCi of 15O-CO to maximal inspiration, held their breath for a minimum of 10 seconds, then exhaled during a 7-min dynamic scan acquisition starting at ~30 sec prior to inhalation. End-expiration CT scans were obtained for attenuation correction. From first principles, it is straightforward to show that the logarithmic time-derivative of the alveolar CO concentration is proportional to the pulmonary function testing (PFT) lab-estimated CO transfer rate, KCO, during breath hold. We estimated the maximum total rate of CO transfer from the whole-lung image region as the logarithmic derivative at the inflection point after the peak (image-region clearance rate, IRCR). We input the IRCR with the peak and steady-state CO concentrations as predictors controlling for inter-patient inhalation differences into a multiple linear regression model with the PFT values as the response. Intraclass correlation coefficients (ICC) and Bland-Altman analysis characterized correlation and reproducibility.

RESULTS

Nine healthy volunteers completed the study procedures. One volunteer with a very high KCO (43% above reference values) was excluded so as not to overly influence the regression model. The IRCR was highly correlated with the KCO by Bland-Altman analysis. ICCs were 0.99 and 0.92 for Scan 1 and Scan 2 IRCR values, respectively, vs KCO. The reproducibility of the IRCR was also high (ICC = 0.92).

CONCLUSION

This pilot study demonstrates a high correlation between PET-measured IRCR and PFT-measured KCO, suggesting that 15O-CO PET imaging may be useful for measuring regional differences in CO diffusion.

CLINICAL RELEVANCE/APPLICATION

Estimating regional CO diffusion would be a highly useful biomarker of treatment efficacy for pulmonary vascular-targeted therapies for pumonary arterial hypertension.

SSC10-03 82-Rb PET/CT in Malignant Tumors: First Systemic Analysis

Monday, Nov. 27 10:50AM - 11:00AM Room: S505AB

Participants
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Amir H. Khandani, MD, Chapel Hill, NC (*Presenter*) Consultant, Progenics Pharmaceuticals, Inc; Consultant, WorldCare International, Inc; Consultant, F. Hoffmann-La Roche Ltd;

PURPOSE

To quantitatively and qualitatively document 82-Rb (Rb) uptake in malignant tumors.

METHOD AND MATERIALS

18 malignant tumors in 18 patients incidentally captured on Rb cardiac PET/CT were included. Ratios of SUVmax (SUV) of each lesion (SUVL) to SUV of the mediastinal blood pool (SUVMBP), lung (SUVLU) and subcutaneous fat (SUVSCF) were calculated (qualitative assessment). Paired t-test and correlation analysis was used to assess the agreement between ratios of SUVL and SUVMBP, SUVLU, SUVSCF on rest and stress images. Lesions (L) were also qualitatively assessed for their uptake (UT) using scores 1 (SCF UTMBP UT). All assessments were conducted on rest and stress images.

RESULTS

Histology: 16 lung cancer (13 NSCLC; 2 small cell; 1 well diff carcinoid), 1 ductal breast cancer and 1 follicular lymphoma. Size range: From 1.0 to 5.0 cm. Mean + SD and median: 2.6 + 1.0 and 2.7, respectively. Quantitative assessment: SUVL/SUVMBP, SUVL/SUVLU and SUVL/SUVSCF ranged from 0.5 to 3.0, 0.5 to 6.2 and 1.5 to 20.3, respectively, on rest images and 0.3 to 3.7, 0.3 to 6.9 and 1.4 to 20.6, respectively, on stress images. Mean + SD and median for SUVL/SUVMBP, SUVL/SUVLU and SUVL/SUVSCF were 1.4 + 0.7 and 1.3, 2.9 + 1.5 and 2.7 and 11.4 + 5.5 and 11.1, respectively, on rest images, and 1.5 + 0.8 and 1.5, 2.7 + 1.6 and 2.5 and 10.6 + 5.5 and 10.4, respectively, on stress images. There was no statistically significant difference between rest and stress values for SUVL/SUVMBP, SUVL/SUVLU and SUVL/SUVSCF. Correlation analysis between rest and stress values for SUVL/SUVMBP, SUVL/SUVLU and SUVL/SUVSCF showed very strong correlation with correlation coefficients of 0.82, 0.89 and 0.91, respectively. Qualitative assessment: There were 10 lesions with score 3, 6 lesions with score 2 and 2 lesions with score 1.

CONCLUSION

Malignant lesions can be readily depicted and their uptake quantified on Rb PET/CT. Specifically, using the ratio of SUVmax of lesions to SUVmax of subcutaneous fat, there is a high target-to-background ratio of Rb signal.

CLINICAL RELEVANCE/APPLICATION

Quantitative Rb PET/CT has the potential to be used as a clinical imaging tool to quantify tumor perfusion.

SSC10-04 Correlation of V/Q Scans and Pulmonary Artery Pressures to Determine Pulmonary Endarterectomy

Outcomes

Monday, Nov. 27 11:00AM - 11:10AM Room: S505AB

Participants
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James A. Scott, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine if there is a correlation between the counts found on perfusion images pre and postoperatively relative to the pulmonary artery pressure changes in patients who underwent endarterectomy for chronic pulmonary embolism.

METHOD AND MATERIALS

IRB approved and HIPAA compliant single center retrospective study of all patients who underwent pre and post endarterectomy VQ scans for chronic pulmonary embolism in the period of 2008-2015. Studies were acquired at outside institutions were excluded. Pulmonary artery pressures prior and posterior to surgery available in the EMR were further analyzed. ROIs were manually selected in posterior views only using the Polygon tool from the Siemens MI applications. Each lung was divided in two for a total of 4 segments. Mirror tool was used to reproduce the contour selection in the contralateral side increasing repeatibility. Measurements for each segment included: size, total counts and pixels. Operative notes were used to select segments in which surgery was successful. Pearson and Spearman's Rho correlation tests were applied.

RESULTS

102 cases had pre and postoperative VQ scans, only 73 had concurrent PA measurements. Surgeons correctly predicted the outcome in 50/73(68%) of cases relative to pre and post segmental total-count difference. 121 segments in 50 subjects underwent successful surgery and were further analyzed. All preoperative PA pressures (average 77.2) demonstrated a decrease (average 28.3) or positive outcome.PA pressures decreased on average 38% after surgery. Moderate positive correlation was found between PA pressure drop and the increase in total-counts in those segments where clot was removed, R=0.501 p=0.003. The segment with the highest percentage of improvement with surgery was the right lower lung 16% followed by right upper 14.4%, left upper 13% and left lower 10.5% of total counts.

CONCLUSION

Pulmonary segmental VQ scan total counts have a moderately positive proportional correlation with the degree of PA pressure change seen on pre and post endarterectomies.

CLINICAL RELEVANCE/APPLICATION

VQ perfusion quatitations may be used to determine the surgical outcome of endarterectomy for chronic pulmonary embolism and are a good representation of the proportion of pulmonary pressure drop after surgery. Serial VQ scans can reliably be used in the surveillance of post endarterectomy patients as a screening tool for monitoring disease improvement or recurrence.

SSC10-05 Relationship of Carotid Artery F-18 NaF Uptake and Cerebral Ischemia: Comparison with F-18 FDG

Monday, Nov. 27 11:10AM - 11:20AM Room: S505AB

Participants
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PURPOSE

Atherosclerosis is characterized by the formation and progression of plaque which is a dynamic and complex process involving various pathophysiologic steps including inflammation and calcification. F-18 FDG (FDG) is the most widely validated PET tracer for the evaluation of atherosclerotic inflammation. F-18 sodium fluoride (NaF) provides potential discrimination between active unstable microcalcification and established dormant calcification. The purpose of this study was to evaluate the relationship between NaF uptake in carotid artery and cerebral ischemic changes on MRI in comparison with FDG.

METHOD AND MATERIALS

A total of 24 patients with carotid artery stenosis of 50% or greater determined by using ultrasonography were examined with NaF PET/CT, FDG PET/CT and brain MRI. In one patient, only unilateral carotid artery was used because of indwelling stent. PET emission scanning of the neck region with a 15-min acquisition of one bed position was performed at 60 min after each radiotracer injection. NaF and FDG uptake in carotid arteries were quantified using maximum standardized uptake value (SUVmax). MRI findings were characterized as mild ischemic changes (grade 1), moderate ischemic changes (grade 2), and severe ischemic changes (grade 3) in bilateral cerebral hemispheres.

RESULTS

Twenty-three hemispheres were considered grade 1; 17, grade 2; and 7, grade 3 on MRI. The mean (±S.D.) NaF SUVmax in grade 3 (3.32±0.93) was significantly higher than that in grade 1 (2.02±0.59) and grade 2 (2.22±0.54). There was no significant association between FDG SUVmax and MRI grade.

CONCLUSION

These preliminary results suggest that NaF uptake in carotid artery seems to be useful for the assessment of cerebral ischemic changes.

CLINICAL RELEVANCE/APPLICATION

NaF uptake in carotid artery may be useful for the assessment of cerebral ischemic changes.

SSC10-06 Added Value of Myocardial Perfusion SPECT/CT Studies: Detection of Incidental Pulmonary Artery Dilatation

Monday, Nov. 27 11:20AM - 11:30AM Room: S505AB

Participants
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PURPOSE

To evaluate the incidence of undiagnosed pulmonary artery dilatation using gated CT images in patients with normal myocardial perfusion.

METHOD AND MATERIALS

This was a retrospective review of 200 consecutive patients who underwent a myocardial perfusion SPECT/CT study with a normal myocardial perfusion. The gated CT images were reviewed using a validated mean main pulmonary artery diameter (mPAD) measurement method that has previously been correlated with pulmonary artery pressure measured by right heart catheterization. The indication for the test and patient characteristics were collected. Previously reported mPAD cut-offs (>29.5mm and >31.5mm) were used to stratify patients. The frequency distribution was tabulated for the discrete variables and chi-square test was used for statistical comparison. Continuous variables were compared by non-parametric Mann-Whitney U test and correlations were dony by spearman-rank correlation.

RESULTS

Of the 200 patients, 100 were men and 100 were women. The mean age was 58.7 years. The most common indication was dyspnea (58.9%) followed by pre-operative work-up (22.3%) and chest pain (13.9%). The mean mPAD measurement was 26.3mm. There was a significant correlation between BMI and mPAD (ρ 0.28; $p<0.001$). In our cohort of patients, 23% (46/200) had a mPAD >29.5mm and 13.5% (30/200) patients had a mPAD of >31.5mm suggesting a high prevelance of incidental pulmonary arterial dilatation. Among patients undergoing a myocardial perfusion study for pre-operative work-up, 35.6% patients had a mPAD >29.5mm and 26.7% had a mPAD >31.5mm. There was a higher prevelance of congestive heart failure (62.5% vs 19.6%; $p<0.001$) and hypertension (78.3% vs 21.7%; $p<0.02$) in patients with mPAD >29.5mm. Similarly, there was a high prevelance of congestive heart failure ($p<0.001$), hyperlipidemia ($p<0.04$) and hypertension ($p<0.04$) in patients with mPAD >31.5mm

CONCLUSION

Incidental pulmonary artery dilatation can be detected in as many as 23% of patients with normal myocardial perfusion using the gated CT images and can be an invaluable tool in the early detection of dilated pulmoary arteries in patients with a low index of clinical suspicion

CLINICAL RELEVANCE/APPLICATION

Gated CT images of myocardial perfusion studies can detect incidental pulmonary arterial dilatation and can be evaluated at no extra-cost or procedure to the patient and should be evaluated in all myocardial perfusion studies.

SSC10-07 Quantitative Assessment of Cardiac FDG Uptake During a Long-term Follow-up of Steroid Therapy in Patients with Cardiac Sarcoidosis

Monday, Nov. 27 11:30AM - 11:40AM Room: S505AB

Participants
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PURPOSE

Several studies have confirmed that FDG PET has a high diagnostic accuracy in detecting active myocardial inflammation caused by cardiac sarcoidosis (CS). The aim is to estimate the long-term prognostic value of it during corticosteroid therapy.

METHOD AND MATERIALS

Fifty-two consecutive patients (pts) with CS (23 men and 29 women; 54 ± 10 y) were enrolled in the study. A final diagnosis of CS was made based on the guidelines which were recently revised by the Japanese Circulation Society in 2016. After establishing the diagnosis, all pts received corticosteroid therapy, which was initiated with 30 mg/day of predonisone, followed by gradual tapering over a period of 6-12 months to a maintenance dose of 5-10 mg/day. They underwent FDG PET/CT having a low carbohydrate diet with < 12-h overnight fasting and an injection of heparin. On the PET/CT fusion images, a standard uptake value (SUV) was obtained in the heart and ascending aorta to generate a target-to-background ratio (TBR).

RESULTS

Twenty-five pts had 2 serial PET scans, 10 had 3 serial scans, and 11 had more than 3 scans, resulting there were 151 PET scans.

The time interval between two serial scans was 9.8 ± 8.9 months (2 to 54 months). In 20 pts who were followed at baseline and within 6 months after the initiation of steroid therapy, TBRs significantly decreased from 4.95 ± 2.71 to 2.74 ± 1.30 (P < 0.0001). During the long-term follow-up (5.3 ± 1.9 years), there were 31 pts (59.6%) with adverse cardiac events (2 cardiac deaths; 14 arrhythmias which needed emergency treatment with implantable devices; and 15 hospital admissions due to severe heart failure, while 21 pts remained stable or were improved clinically. In 7 pts, inflammatory exacerbation appeared with an increase in TBR. Eventually, there were smaller percent reduction in TBR among the pts with adverse events than those without (19.9 ± 41.5 vs. 51.9 ± 18.2, P = 0.04).

CONCLUSION

Cardiac events of serious consequences appeared in the majority of patients with cardiac sarcoidosis (CS) during the long-term follow-up of corticosteroid therapy. FDG PET could detect cardiac inflammatory process, hence it would be a predictive biomarker for prognosis of CS.

CLINICAL RELEVANCE/APPLICATION

Adverse cardiac events appeared in the majority of patients with cardiac sarcoidosis (CS) during the long-term follow-up of steroid therapy. FDG PET could detect inflammatory process, hence it would be a predictive biomarker of prognosis of CS.

SSC10-08 Detection and Monitoring of Cardiac and Extra-Cardiac Thoracic Sarcoidosis Using F-18 FLT PET/CT: Comparison with F-18 FDG PET/CT

Monday, Nov. 27 11:40AM - 11:50AM Room: S505AB

Participants
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PURPOSE

F-18 FDG (FDG) PET has been proposed to play a role in the diagnosis and therapeutic monitoring of sarcoidosis. However, assessing inflammatory lesions in cardiac sarcoidosis using FDG can be challenging because of normal myocardium uptake. The purpose of this study was to compare the uptake of 3'-deoxy-3'-18F-fluorothymidine (FLT) and FDG in the evaluation of detection and monitoring of cardiac and extra-cardiac thoracic sarcoidosis.

METHOD AND MATERIALS

FLT and FDG PET/CT studies were performed in 20 patients with newly diagnosed sarcoidosis. A follow-up PET/CT scan was also performed after immunosuppressive therapy in 5 patients. 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 (SUVmax).

RESULTS

Two patients had cardiac sarcoidosis, 7 had extra-cardiac thoracic sarcoidosis, and 11 had both cardiac and extra-cardiac thoracic sarcoidosis. Before therapy, 4/20 FDG scans for cardiac region were visually rated as inconclusive because FDG pattern was diffuse, whereas no FLT scans were rated as inconclusive. The sensitivity of FDG PET/CT for detection of cardiac lesions was 85% and the specificity, 100%. The corresponding values for FLT PET/CT were 92% and 100%, respectively. The mean FDG SUVmax of cardiac lesions was significantly higher than that of FLT SUVmax (P<0.005). Before therapy, both FDG and FLT PET/CT detected all 24 extra-cardiac lesions. The mean FDG SUVmax of extra-cardiac lesions was significantly higher than that of FLT SUVmax (P<0.001). After therapy, 3/5 FDG scans for cardiac region were visually rated as inconclusive, whereas no FLT scans were rated as inconclusive. The mean FDG SUVmax and FLT SUVmax of both cardiac and extra-cardiac lesions after therapy were lower than those of before therapy.

CONCLUSION

These findings suggest that FLT PET/CT could detect and monitor cardiac and extra-cardiac thoracic sarcoidosis as well as FDG PET/CT.

CLINICAL RELEVANCE/APPLICATION

FLT PET/CT could detect and monitor cardiac and extra-cardiac thoracic sarcoidosis as well as FDG PET/CT.

SSC10-09 Z-Score for Cardiac Transthyretin Amyloidosis (ATTR)

Monday, Nov. 27 11:50AM - 12:00PM Room: S505AB

Participants
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PURPOSE

Definitive diagnosis of cardiac involvement in Transthyretin amyloidosis (ATTR) requires myocardial biopsy, that is invasive, expensive and it may be complicated by adverse events. Although scintigraphy, using bisphosphonates, has been proposed as an accurate method for the detection of myocardial TTR amyloid load, a consensus on scan interpretation is lacking. Purpose of the present study is to overtake the qualitative analysis using a semi-quantitative approach to easily and objectively classify the degree of myocardial amyloid load in ATTR patients.

METHOD AND MATERIALS

N.6939 99mTc-MDP bone scans, consecutively performed at our Institution, for oncological or rheumatologic conditions (2012-2016), were retrospectively reviewed, using qualitative inspection, to identify those displaying any cardiac uptake. A visual score (Perugini et. al1) and a heart-to-soft tissue (mid-thigh) semi-quantitative uptake ratio have been assigned to the selected scans. A group of 65 healthy controls (HC) (i.e. no cardiac uptake / visual score 0) have been used for comparison and Z-score creation.

RESULTS

N. 56/6939 (0.8%) patients (41M/15F) aged 79±7.35 years showed significant cardiac uptake of 99mTc-MDP on visual inspection. N.39 (70%) were assigned a visual score 1, N.14 (25%) a score 2 and 3 (5%) a score 3. The mean proposed semi-quantitative ratio was 3.8±1.5 for visual score 1, 8.6±3.1 for visual score 2 and 15.9±3.3 for visual score 3. The HC group patients (visual score 0) showed a ratio of 2.75 ± 0.7. Mean calculated Z-Score using HC group as reference was 1.54 for visual score 1, 7.94 for visual score 2 and 17.07 for score 3.

CONCLUSION

The proposed heart-to-mid-thigh semi-quantitative ratio proved to be an easy method to quantify the cardiac uptake of 99mTc-MDP. Z-score showed a good correlation with the score proposed by Perugini et. al and it could offer a more quantitative approach than visual analysis. Further investigations, including genetic analysis, will be needed to help identify amyloid subtypes namely wild-type ATTR (ATTRwt) or genetic ATTR, the latter susceptible of therapeutic options.

CLINICAL RELEVANCE/APPLICATION

Transthyretin-cardiac amyloidosis is rare and underdiagnosed. Early detection is increasingly important in light of the emerging therapies. 99mTc-bisphosphonate tracers have proved highly sensitive for a noninvasive diagnosis

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SSC11

Neuroradiology (Functional MRI)

Monday, Nov. 27 10:30AM - 12:00PM Room: N229

MR NR

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

FDA Discussions may include off-label uses.

Participants
Joshua S. Shimony, MD, PhD, Saint Louis, MO (*Moderator*) Nothing to Disclose
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Sub-Events

SSC11-01 Impact of Glycemic Control and Cardiovascular Disease Measures on Hippocampal Functional Connectivity in African Americans with Type 2 Diabetes: A Resting State fMRI Study

Monday, Nov. 27 10:30AM - 10:40AM Room: N229

Participants
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PURPOSE

This study tests the hypothesis that inadequate Type 2 diabetes (T2D) management, including fine gradations of glycemic control, increasing measures of cardiovascular disease (CVD) and renal disease, leads to decreased hippocampal connectivity in African Americans (AA).

METHOD AND MATERIALS

The study includes 155 AA with T2D, 57% female with mean age of 59.2 years for whom diabetes management was quantified. Subjects had a mean diabetes duration of 14.5 years, hemoglobin A1c (HbA1c) of 7.97%, estimated glomerular filtration rate (eGFR) of 86.6 mL/min/1.73m2, and coronary artery calcium (CAC) score of 475.4mg. An 8min resting state fMRI was acquired and structural and functional MRI were co-registered, normalized to MNI space, and mean fMRI time courses per region were computed, and then pairwise region connectivity using Pearson's correlation was computed. The regions and connections form a graph of nodes and edges. Correlation was thresholded to retain the top 10% edges. The degree of each region which represents the overall connectivity of the region to the rest of the brain was computed to form a brain health measure. A linear support vector regression model was fit to predict the brain health measure using 10-fold cross-validation, while permutation testing was used to compute model reliability. The predictor set consists of diabetes measures: HbA1c, renal disease measures: eGFR, c-reactive protein (CRP), and urine albumin-to-creatinine ratio (ACR), and CVD measure: CAC. Our model is fully adjusted for education, age, sex and BMI.

RESULTS

The functional connectivity of the hippocampus was found to be significantly impacted by HbA1c and CAC with R2=1.9%, p=0.00047. Lower functional connectivity of right hippocampus (hippocampal degree) was associated with poor glycemic control (higher HbA1c) and greater calcified plaque (higher CAC). The results complement previous research demonstrating an inverse association between CAC and Montreal Cognitive Assessment test scores.

CONCLUSION

This work provides new evidence that elevated HbA1c and CAC are associated with decreasing functional connectivity of the right hippocampus in AAs with T2D.

CLINICAL RELEVANCE/APPLICATION

The results suggest that maintaining fine degree of glycemic control and cardiovascular health may support optimal hippocampal function, a structure critical for successful memory retrieval.

SSC11-02 Functional MRI Neuroimaging Study of Earnings Management Decision by Business Managers

Monday, Nov. 27 10:40AM - 10:50AM Room: N229

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Although functional MRI (fMRI) techniques have been increasingly used to study human cognitive functions, there has been a lack of research on the applications of fMRI on brain activation of business managers. Specifically, there is research gap in using fMRI to examine managers' earning management decisions. Therefore, the current study to report on a newly developed paradigm for neuroimaging study of neuro-accounting research, and the new findings related to brain activation associated with earnings management as a mechanism to avoid violating debt covenants.

METHOD AND MATERIALS

The participants were 52 local business owners and managers, males and females, age 18 to 60 years old. All participants had some educational background in accounting, business or finance and significant employment in managerial capacity. To probe the related neurocircuits, we designed different scenarios in which firms are either close (CLOSE) or far (FAR) from violating debt covenants. The subject is assigned a role of a manager to choose whether or not to manage earnings in order to avoid debt covenant violations and the subject's managing style is evaluated in every scenario. The influences of subject's perception of his/her supervisor managing style are also evaluated in every scenario.

RESULTS

We found that there was greater pre-frontal cortex (PFC) activation in CLOSE than in FAR scenarios. These results suggest that earning management decisions under high levels of financial stress requires more PFC cognitive functions. We also found that there was greater activation in the bilateral nucleus accumbens (NA) and the left amygdala (Amy) in CLOSE than FAR scenarios.

CONCLUSION

The final findings reveal different activation in emotion response and cognitive processing when the company is close vs. far from violating debt covenants which influences the manager's managing style and performance evaluation approach on manager's earning management decision and related brain activation. The final findings also suggest influences of manager's perception of his/her supervisor's managing style on manager's emotion responses during earning management decision making.

CLINICAL RELEVANCE/APPLICATION

FMRI can demonstrate brain activation associated with earnings management behavior to avoid violating debt covenants by business managers.

SSC11-03 Application of fMRI in the Assessment of Neuronal Activity in Patients with Fragile X Syndrome

Monday, Nov. 27 10:50AM - 11:00AM Room: N229

Participants
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PURPOSE

Fragile X syndrome (FXS) is the most common inheritable mental disease in children. The main cause of the disorder is CGG•GCC repeat expansion in 5' promoter region of the FMR1 gene. Commonly during the routine MRI study, the changes in brain structures in patients with fragile X syndrome are not observed. Thus the application of fMRI technique that provides information on the structure of neural networks in brain, is of a primary interest for diagnostics of the fragile X syndrome, as well as it is used for patients during examination in neurology and psychiatry. The aim of the study was to assess the neural activity of different brain regions in patients and the control group by resting state fMRI.

METHOD AND MATERIALS

The fMRI was performed on «Achieva» (Philips) scanner with a magnetic field strength of 1.5 T. Study involved two groups of patients: 5 children with confirmed fragile X syndrome and 8 healthy volunteers. Independent Component Analysis and seed-based correlation analysis were used. Statistical analysis was performed using FSL (fMRI Brain Software Library).

RESULTS

The fMRI study revealed a default mode network of brain function in patients with the fragile X syndrome, as well as in the control group. Furthermore, it was found that a default mode network of the brain in patients with fragile X syndrome and control groups do not have statistical significance ($p>0.05$), which may indicate that the basal activity of neurons in patients with fragile X syndrome it is not reduced. Also we have found a significant ($p<0.05$) reduction the functional connectivity within the prefrontal cortex of the frontal-parietal hemispheric network in the resting state in patients with fragile X syndrome.

CONCLUSION

New data of functional status of the brain in patients with fragile X syndrome were received. The significant reduction the functional connectivity within the prefrontal cortex of the frontal-parietal hemispheric network in the resting state in patients with fragile X syndrome was found.

CLINICAL RELEVANCE/APPLICATION

Neurology, psychiatry, genetics

SSC11-04 fMRI Markers of Decision-Making under Uncertain Conditions

Monday, Nov. 27 11:00AM - 11:10AM Room: N229

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To describe imaging markers of decision-making under certain and uncertain conditions in normal individuals, in order to provide baseline activity in which to compare impaired decision-making in such pathological states as schizophrenia, ADHD, and obsessive-compulsive disorder.

METHOD AND MATERIALS

Nineteen healthy subjects ages 18-35 completed a novel decision-making card-matching task using a Phillips T3 Scanner. Functional data were collected in six functional runs of a single shot echo-planar imaging sequence (TR = 2 s, TE = 35 ms, 30 slices, 3 mm slice thickness, inplane resolution 3 mm × 3 mm) and a T1-weighted structural image (1 mm3 voxel size). In one condition of the card-matching task, the participant was certain of the rule to apply to match the cards; in the other condition, the participant was uncertain. We performed cluster-based comparison of the two conditions using FSL FEAT.

RESULTS

The uncertain > certain comparison yielded 3 large clusters through general linear model (GLM) analysis using FSL FEAT - a midline cluster that extended through midbrain, the thalamus, bilateral prefrontal cortex, the striatum, and bilateral clusters that extended through the parietal cortex and occipital cortex. The certain > uncertain comparison yielded bilateral clusters in the insula that extend into the boundary of the parietal and temporal lobe, as well as a medial frontal cluster.

CONCLUSION

The involvement of the insula, parietal cortex, temporal cortex, ventromedial cortex, and orbitofrontal cortex that showed increased activation in the certain condition are generally associated with rule certainty and reward, which reinforces the notion that certainty is inherently rewarding. For the uncertain condition, we expected to see involvement of the prefrontal cortex, parietal cortex in resolving uncertainty, as well as involvement of the striatum, thalamus, amygdala and hippocampal were expected in rule updating; however, the unexpected involvement of occipital cortical involvement and midbrain involvement may be attributed to increased visual attention and increased motor control.

CLINICAL RELEVANCE/APPLICATION

We have established a network of functional brain regions involved in certain and uncertain decision-making conditions using fMRI and a novel paradigm on which to explore pathological disease states.

SSC11-05 Impaired Executive Control Function in Unilateral Temporal Lobe Epilepsy Revealed by Extrinsic Brain Network Connectivity: A Resting-state Functional fMRI Study

Monday, Nov. 27 11:10AM - 11:20AM Room: N229

Participants
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PURPOSE

To investigate functional connectivity (FC) between resting-state networks (RSNs) in unilateral intractable temporal lobe epilepsy (TLE) patients with abnormal executive control function (ECF).

METHOD AND MATERIALS

Forty left TLE patients and twenty-three volunteers were recruited for resting-state fMRI scanning. The patient groups were

divided into two subgroups according to ECF performance: ECN decreased group as subgroup 1 (G1) and ECN normal group as subgroup 2 (G2). The healthy control group (HC) included all 23 volunteers. All the subjects were received neuropsychological tests, including Wisconsin Card Sorting Test (WCST) and Montreal Cognitive Assessment (MoCA). Group-information-guided independent component analysis (GIG-ICA) was employed to estimate RSNs of all subjects. A general linear model with age, sex and education as covariates was used to analyze which pairs of internetwork FC reached significant differences ($p<0.05$) among G1, G2 and HC. Pearson correlation between FC, clinical features and neuropsychological performances were also observed though partial correlation analysis with age, sex and edu as covariates ($p<0.05$).

RESULTS

Eleven meaningful RSNs were identified though empirical analysis. G2 exhibited decreased FC between ECN and DMN network when compared with G1 ($p=0.000$, bonferroni corrected) and HC ($p=0.000$, bonferroni corrected). However, G1 showed no significant difference with control group. Furthermore, FC of patients had significantly negative correlation with WCST performance and duration of disease ($p=0.000$), but have no correlation with MoCA. Besides, significantly positive correlation were also found between FC with age-onset ($p=0.000$). However, there was no significant correlation between FC and neuropsychological tests of HC.

CONCLUSION

Our study suggested that FC abnormal between ECN and DMN may potentially act as an imaging biomarker candidate, which can not only differentiate ECF normal and ECF impairment, but also can reflect ECF impairment degree of TLE patients. Furthermore, such FC pattern may also provide us new insight into understanding ECF pathophysiological mechanisms of unilateral intractable TLE.

CLINICAL RELEVANCE/APPLICATION

Neuropsychological performance was closely related to functional connectivity between large-scale networks which can be well depicted by fMRI.

SSC11-06 Accuracy of Resting-State fMRI Language Networks in Brain Tumor Patients: Comparison Between Blind Seed-Based Analysis versus Independent Component Analysis

Monday, Nov. 27 11:20AM - 11:30AM Room: N229

Participants
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PURPOSE

Compare concordance of language networks derived fromSeed Based Analysis (SBA) resting-state fMRI in patients with brain tumors with Independent Component Analysis (ICA)

METHOD AND MATERIALS

Resting state fMRI was performed and language networks identified for patients presenting for presurgical task-fMRI mapping between 1/1/2009 and 7/1/2015. 79 patients were analyzed of which 49 met the inclusion criteria (presence of brain tumors without history of prior brain surgery, adequate task-fMRI performance). Language networks were obtained from rs-fMRI using ICA with 50 components and SBA using blind seed in the IFG from the rs-fMRI maps. Seeds generated from maximal task-fMRI activation in the IFG were used as control. Rs-vs-task-fMRI concordance for each resultant map was measured using Dice coefficients across varying fMRI thresholds. Multi-threshold Dice coefficient volume under the surface (DiceVUS) and maximum Dice coefficient (MaxDice) were calculated. ANOVA was performed to determine significant differences in DiceVUS and MaxDice between the methods of analysis.

RESULTS

Paired T-test showed there is no statistical difference between blinded-SBA and ICA-50 ($P<0.4694$). Also, there is statistical difference between task-SBA and blinded-SBA ($P<0.001$) and task-SBA and ICA-50 ($P<0.0178$).Group mean DiceVUS and MaxDice were highest for the task-based SBA than both blind-SBA and ICA. Paired T-test demonstrate no significant diffference between the blind-SBA and ICA. ANOVA with Tukey HSD demonstrated statistically significant differences for both DiceVUS and MaxDice between blind-SBA and ICA. The violin plot (figure 6) demonstrates the data distribution relative to the mean for ICA, SBA, RBA (AMPLE) and blind-SBA (left, right, optimal; respectively). ICA and SBA demonstrate similar degree of variability of values across subjects relative to the mean and kernel density estimation (KDE).

CONCLUSION

We demonstrate that blind rs-FMRI and ICA have similar accuracy in identifying language networks on rs-fMRI. Both the group mean MaxDice and DiceVUS were greater for task-SBA than ICA and blind-SBA.

CLINICAL RELEVANCE/APPLICATION

Blind-SBA analysis can be utilized to reliably identify neuronal language networks on pre-operative studies, especially in patient who are unable to perform all the tasks required in conventional task-fMRI.

SSC11-07 Self-Regulation of the Primary Auditory Cortex Activity via Directed Attention Mediated By Real-Time fMRI Neurofeedback

Monday, Nov. 27 11:30AM - 11:40AM Room: N229

Participants
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PURPOSE

To determine the potential efficacy of treating auditory cortex hyperactivity by self-regulation of the primary auditory cortex (A1) based on real-time functional magnetic resonance imaging neurofeedback training (fMRI-NFT).

METHOD AND MATERIALS

10 healthy volunteers with normal hearing (no more than 1 frequency >40 dB on a standard audiogram) underwent 5 fMRI-NFT sessions. Each session was composed of a simple auditory fMRI followed by 2 runs of A1 fMRI-NFT. FMRI data was acquired using 2D, single-shot echo planar imaging during all 3 runs using a 3T. The auditory fMRI was comprised of 6 blocks, each containing a 20s period of no auditory stimulation followed by a 20s period of white noise stimulation at 90 dB. A1 activity, defined from a region using the activity during the preceding auditory run, was continuously updated during fMRI-NFT using a simple bar plot, and was accompanied by white noise (90 dB) stimulation for the duration of the scan. Each fMRI-NFT run contained 8 blocks, each separated into a 30s relax period followed by a 30s lower period. Subjects were instructed to watch the bar during the relax condition and actively lower the bar by decreasing A1 activity during the lower condition. The average A1 activity was measured from the simple auditory task from each session. Average A1 deactivation was extracted from each fMRI-NFT run, representative of A1 self-regulation performance.

RESULTS

A one-way ANOVA evaluated the effect of session on A1 activity during the simple auditory task. The main effect of session was not significant ($p = 0.41$, sphericity assumed, two-tailed). A 5x2 (session by run) ANOVA was carried out on A1 deactivation during fMRI-NFT. There was a significant effect of session ($p = 0.0275$, sphericity assumed, one-tailed) and a significant interaction effect ($p = 0.0395$, sphericity assumed, one-tailed). The most successful subjects reportedly adopted mindfulness tasks associated with directed attention.

CONCLUSION

For the first time, fMRI-NFT has been applied to teach A1 self-regulation using more than 1 session. This is important to therapeutic development as it is unlikely a single fMRI-NFT session will reverse the effects of tinnitus.

CLINICAL RELEVANCE/APPLICATION

Chronic tinnitus has implications of impaired auditory and attentional networks. Our study indicates that fMRI-NFT may provide an innovative approach to alter of these systems simultaneously.

SSC11-08 Characterization of Obsessive-Compulsive Disorder Using a Multiparametric Classification Approach Based on Resting-State fMRI

Monday, Nov. 27 11:40AM - 11:50AM Room: N229

Participants
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PURPOSE

Obsessive-compulsive disorder(OCD)is a common,heritable and disabling neuropsychiatric disorder.Recent advances in resting-state functional magnetic resonance imaging(rs-fMRI)have facilitated the abnormality of a specific network of cortico-striato-limbic regions.However,the vast majority of these studies published so far have been based on average differences between groups.Whether functional neuroimaging could be used to inform the clinical assessment of individual OCD patients remains unclear.The machine learning approach is a promising technique which allows the classification of individual observations into distinct groups and bears the advantage of individualized judgement.Thus,in current study,we aimed to apply one of the machine learning approach known as Support Vector Machine(SVM)to distinguishing drug-naive OCD patients from healthy control subjects(HCS)based on various rs-fMRI parameters.

METHOD AND MATERIALS

A total of 54 drug-naive OCD patients and 54 age,sex,handedness and years of education well matched HCS were recruited in current study.The rs-fMRI were obtained via a 3.0 T GE MRI system.Four different rs-fMRI parameter maps including amplitude of low-frequency fluctuation (ALFF),fractional amplitude of low frequency fluctuation (fALFF),regional homogeneity (ReHo) and functional connectivity strength (FCS) were separately calculated using REST software.Subsequently,all these rs-fMRI parametric maps were used to discriminate OCD patients from HCS based on leave one-out cross-validation approach with SVM implemented in the PROBID software package.We also drew a receiver operating characteristic(ROC)curve to help evaluate the performance of each parameter.

RESULTS

The classification accuracy,sensitivity and specificity for SVM classifier of each rs-fMRI parameter are presented in the Figure.Overall,the SVM classification accuracies for the four rs-fMRI parameters were all above 74%.The highest classification accuracy(95.37%,$p<0.001$)was achieved when ALFF maps were employed.

CONCLUSION

Our findings suggest that the four rs-fMRI parameters would exhibited significant differences in predicting diagnosis of OCD,and ALFF showed the highest accuracy,which is fit to be an assistant measure in clinical practice to help identify OCD at the individual level.

CLINICAL RELEVANCE/APPLICATION

Application of SVM to ALFF maps could be used to aid the identification of OCD in clinical practice.

SSC11-09 Identification of the Sensorimotor Network in Brain Tumor Patients Using Resting-State Functional MRI

Monday, Nov. 27 11:50AM - 12:00PM Room: N229

Participants
Lucidio P. Nunes JR, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Evaluate the ability of resting-state fMRI in localizing the sensorimotor network (SMN) and its individual components in patients with brain tumors, using independent component analysis (ICA) and seed-based analysis.

METHOD AND MATERIALS

This is a retrospective analysis of 29 patients with brain tumors presenting for fMRI mapping. ICA with a predetermine output of 20 components was performed for each patient. Eight seed-based analyses were performed, with seeds allocated in the medial, knob-like area and lateral precentral gyrus and in the posterior superior frontal gyrus of each hemisphere. The ability of identifying a complete SMN or any of its parts, composed by bilateral primary sensorimotor cortex (PSMC) and bilateral supplementary motor area (SMA) with ICA and seed-based analysis was subjectively assessed. For each of the precentral gyrus seed-based analysis, the capacity of localizing the correspondent region of the seed in the contralateral hemisphere was also assessed.

RESULTS

ICA identified a complete SMN in 13 patients (44%), the left PSMC in 18 patients (62%), the right PSMC in 18 patients (62%), the left SMA in 18 patients (62%) and the right SMA in 18 patients (62%). Combined analysis of the correlation maps generated by all seeds identified a complete SMN in 15 patients (51%), the left PSMC in 17 patients (58%), the right PSMC in 18 patients (62%), the left SMA in 28 patients (96%) and the right SMA in 27 patients (93%). Combined ICA and seed-based analysis identified a complete SMN in 20 patients (68%), the left PSMC in 22 patients (75%), the right PSMC in 22 patients (75%), the left SMA in 28 patients (96%) and the right SMA in 27 patients (93%). Seed-based analysis of the precentral gyrus identified the correspondent area in the contralateral hemisphere in 154 of 174 analyses (88%).

CONCLUSION

Combining ICA and seed-based analysis increases the ability of resting-state fMRI in identifying the SMN and its components. Seed-based analysis consistently identifies the correspondent area of the seed in the contralateral hemisphere.

CLINICAL RELEVANCE/APPLICATION

Resting-state fMRI can be used to identify the sensorimotor network, this being especially valuable when brain lesions generates morphological distortion and patients are unable to perform the tasks required by conventional task-fMRI.

SSC12

Neuroradiology (White Matter Diseases: Do They Matter?)

Monday, Nov. 27 10:30AM - 12:00PM Room: N226

MR NR

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

FDA Discussions may include off-label uses.

Participants
Peter B. Barker, DPhil, Baltimore, MD (*Moderator*) Nothing to Disclose
Ronald L. Wolf, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSC12-01 Clinical Use of Brain MRI Biomarkers for Multiple Sclerosis: A Health Economical Study in the United States

Monday, Nov. 27 10:30AM - 10:40AM Room: N226

Participants
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CONCLUSION

The accurate and reproducible assessment of MRI lesions and brain atrophy in MS is not only clinically important, but also has major health economic benefits thanks to the reduction of medication costs. [1] Sa et al. 2015 [2] Gauthier et al., Journal Neurological Sciences 2009 [3] Giovannoni et al. Brain Health 2015 [4] Hartung et al., Neurology. 2015 26 [5] Rio et al., EJN 2012 [6] Rojas et al., Neurological Research 2014

Background

Since Multiple Sclerosis (MS) is an incurable chronic disease, the focus of therapy is to slow down the relapses and disability progression. Currently, over 10 disease modifying treatments are clinically approved for relapsing remitting MS. However, providing the best treatment for each patient remains a major challenge as over 25-30% of treatments have a suboptimal effect [1,2]. It is shown that personalized and accurate monitoring of MRI lesions and brain atrophy allows the prediction of disability progression, relapses and treatment effect [3]. This work assesses the health economic benefit.

Evaluation

A two scenario decision-tree model is used comparing the situation with and without accurate monitoring of MRI lesions (T2/Gd enhancing and evolution) and brain atrophy. We estimate that yearly 10000 therapy initiations or switches take place in the US, with an average medication cost of $60k [4]. Considering that 26% of these treatments are suboptimal [1] for 3.9 years [5], current costs of failing treatments are about $600M. With an accurate monitoring of MRI lesions and atrophy, the probability to detect treatment failure is 3.1 times higher [6], reducing the average time on suboptimal treatment to 1.3 years. This results in a cost saving of about $400M (67%).

Discussion

In order to realize such a significant cost saving, efforts are required to introduce accurate and reproducible assessments of MRI lesions and atrophy into the radiological reporting [3]. Today, counting lesions and identifying new (and enlarging) lesions is time consuming and prone to variability (intra-rater and inter-rater), and accurately assessing brain atrophy is not even possible by human eye. Automated quantification by software imposes itself as a solution.

SSC12-02 Longitudinal Persistence of Meningeal Enhancement on Post-Contrast 7 Tesla FLAIR MRI in Multiple Sclerosis

Monday, Nov. 27 10:40AM - 10:50AM Room: N226

Awards
Student Travel Stipend Award

Participants
Samuel N. Jonas, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Izlem Izbudak, MD, Baltimore, MD (*Abstract Co-Author*) Institutional Grant support, Biogen Idec Inc; Consultant, Alexion Pharmaceuticals, Inc; Institutional Grant support, Siemens AG;

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PURPOSE

Multiple sclerosis (MS) is a chronic demyelinating disorder associated with increased magnetic resonance signal on T2-weighted sequences within characteristic white matter regions of the brain and spinal cord. Recently, post-contrast FLAIR has emerged as a technique for evaluating meningeal inflammation, an under-recognized facet of MS pathophysiology. We have recently reported the incidence of this finding on 7 Tesla (7T) MRI. In this study, we aimed to determine if the presence of meningeal enhancement on 7T MRI in MS is a transient or persistent phenomenon.

METHOD AND MATERIALS

11 patients with MS were prospectively scanned at two time points, approximately 1 year apart, on a Philips 7T Achieva magnet between September 2014 and May 2016. Magnetization-prepared FLAIR (MPFLAIR) images were acquired at 0.7mm3 resolution before and after administration of 0.1mmol/kg of gadoteridol. Co-registered pre- and post-contrast scans were reviewed by two independent judges: one board certified neurologist and one PGY-3 radiology resident. Foci of meningeal enhancement were annotated using Medical Image Processing, Analysis & Visualization (MIPAV) v. 7.3.0. Discordant lesions that were marked by one but not both judges were reviewed by a third judge: a board certified neuroradiologist. Finalized annotations were classified into 4 subtypes: pachymeningeal nodules (PN), leptomeningeal nodules (LN), subarachnoid amorphous (SA), and dural venous rim (DVR). Follow-up images were then reviewed to determine if they changed between time points.

RESULTS

The median number of enhancing meningeal foci detected per subject on the initial scan was 9 (range 1-15). 86% percent of foci identified on the initial scan were again identified on the follow-up scan; 14% resolved. In 7 of 11 subjects, follow-up scans revealed foci not present on the initial scan. When stratified by morphologic subtype, persistence was observed in 92% PN, 67% LN, 68% SA, and 95% DVR.

CONCLUSION

The majority of enhancing meningeal foci on 7T MPFLAIR are longitudinally persistent in MS. The likelihood of persistence appears dependent on the morphologic features and location of enhancement.

CLINICAL RELEVANCE/APPLICATION

It is critical to determine to what extent meningeal enhancement persists on MRI over time in MS patients, as it will inform future study of the clinical relevance of this phenomenon.

SSC12-03 Edge Density Mapping of Cerebral White Matter in Persons with Cerebral Microbleeds in the Rotterdam Study

Monday, Nov. 27 10:50AM - 11:00AM Room: N226

Participants
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PURPOSE

Cerebral microbleeds reflect presence of small vessel disease and as such are known to be related to white matter disease (hyperintensities and atrophy). Yet, little is known on the overall influence they may have on specific white matter tracts. We studied edge density mapping of white matter in persons with and without microbleeds.

METHOD AND MATERIALS

This study is based on subjects from the population-based Rotterdam Study. Non-demented, stroke-free subjects previously assessed with lobar microbleeds (n = 17) and controls without microbleeds (n = 14) were selected from the larger study population. In all subjects, diffusion tensor imaging (DTI) with 64 directions was available for edge density mapping from a 3T MR Scanner. Edge density images (EDI) were computed from edges involved in a previously defined consensus connectome with each voxel's edge density defined as the number of consensus edges passing through the voxel of interest. To enable comparison between EDI maps of different subjects, EDI maps were registered to MNI152 space. Principal components analysis was done to extract specific EDI maps that separate the microbleed group from control with machine learning using support vector machine learning with leave one out cross validation.

RESULTS

Average age was 64.1 (S.D. 4.5; range 55-73), 45% women. There were no statistically significant differences in age or gender between the microbleed and control group. The microbleed group had an average of 2.43 lobar microbleeds. EDI imaging identified principle components in the posterior corona radiata, splenium of the corpus callosum, and superior longitudinal fasiculus ($p = 10 \times 10\text{-}4$). Figure 1 highlights these three areas in light blue. The area under the curve for these three areas identifying white matter abnormalities on microbleed scans was 87.8%. The sensitivity was 95% and specificity was 70%.

CONCLUSION

Edge density imaging identifies abnormalities in white matter in persons with lobar microbleeds with high accuracy and sensitivity. This suggests the importance of future studies to better elucidate applications of connectome image to vascular brain aging.

CLINICAL RELEVANCE/APPLICATION

Edge density imaging is a new type of connectome mapping that identifies tract-specific white matter abnormalities in persons with cerebral microbleeds. These results suggest this method can identify white matter abnormalities in relation to other brain imaging biomarkers of disease.

SSC12-04 Axial, Radial and Mean Diffusivity in FLAIR-Positive Lesions and Normal-Appearing White Matter in Young Adult Multiple Sclerosis Patients

Monday, Nov. 27 11:00AM - 11:10AM Room: N226

Participants
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PURPOSE

This study investigated axial, radial and mean diffusivity in FLAIR-positive lesions and normal-appearing white matter (NAWM) in young adult MS patients.

METHOD AND MATERIALS

FLAIR and DTI were acquired on 12 relapse-remitting MS patients (18-33yo, 1.5-10 year disease duration, 0-4 EDSS scores) and 12 age- and sex-matched healthy controls at 3T. DTI parameters (axial, radial and mean diffusivity: AD, RD, MD) were calculated. DTI parameters were tabulated for ROIs of the FLAIR positive lesions, NAWM in MS, and corresponding regions in controls. Comparisons were also made with EDSS, disease duration, lesion volume and counts.

RESULTS

In FLAIR positive ("established") lesions, axial, radial and mean diffusivity in MS were significantly higher than controls (AD:1.54±0.22 versus 1.19±0.24, P=0.0002; RD:1.00±0.22 versus 0.73±0.24, P=0.004; MD:1.18±0.22 versus 0.88±0.24, P=0.0008), suggesting edema or cell loss. Covariances of diffusivity data amongst pixels within the ROIs in MS were lower than controls (AD:0.24±0.07 versus 0.40±0.14, P=0.002; RD:0.35±0.06 versus 0.56±0.29, P=0.001; MD:0.28±0.07 versus 0.49±0.21, P=0.004), suggesting reduced tissue heterogeneity. In NAWM, radial and mean diffusivity in MS were significantly smaller than controls (RD:0.58±0.04 versus 0.72±0.04, P=0.001; MD:0.75±0.03 versus 0.83±0.04, P=0.001), but axial diffusivity was not (AD:1.09±0.02 versus 1.08±0.13, P=0.05+). Changes in radial and mean diffusivity suggest early and widespread cytotoxic injury. Covariances of diffusivity data of NAWM in MS were lower than controls (AD:0.31±0.02 versus 0.49±0.13; RD:0.22±0.02 versus 0.44±0.11; MD:0.21±0.02 versus 0.45±0.06, P=0.001 for all), suggesting reduced tissue heterogeneity. DTI parameters were not significantly (P=0.05+) correlated with EDSS, disease duration, lesion volume, and lesion counts.

CONCLUSION

Diffusivity data revealed cell loss in established lesions and cytotoxic injury in NAWM in young adult MS patients. Covariances of diffusivity data corroborated reduced tissue heterogeneity in established MS lesions and NAWM.

CLINICAL RELEVANCE/APPLICATION

DTI diffusivity data provide insights in the pathophysiology of MS in young adults. Diffusivity data may serve as imaging biomarkers of early disease pathophysiology in MS.

SSC12-05 The Relationship Between Brain White Matter Hyperintensity Burden Assessed Ante-mortem and Post-mortem

Monday, Nov. 27 11:10AM - 11:20AM Room: N226

Participants
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PURPOSE

Many studies have used ex vivo MRI to investigate the association of white matter hyperintensity (WMH) burden with age-related

Many studies have used ex-vivo MRI to investigate the association of white matter hyperintensity (WMH) burden with age--related neuropathologies while eliminating the interval between imaging and death (ante-mortem interval, AMI). All such investigations assume that WMH burden assessed ex-vivo is identical to that observed in-vivo, but that has not yet been established. Thus, the purpose of this work was twofold: 1) to investigate the relationship between WMH burden assessed in-vivo and ex-vivo on the same older adults, and 2) to test the hypothesis that WMH burden assessed ex-vivo is higher than that assessed in-vivo for longer AMI.

METHOD AND MATERIALS

83 older adults (90±7 years of age) recruited from two longitudinal, cohort studies of aging, underwent both in-vivo and ex-vivo brain MRI. The average AMI was 2.2±1.5 years. The average post-mortem interval (PMI; from death to immersion in fixative) was 8.1±4.7 hours. The average PMI to imaging was 30 days. A rater trained by an expert assessed WMH severity based on the original Fazekas scale. WMH burden was defined as the maximum of the periventricular and deep white matter WMH ratings. Intra-class reliability and agreement with the expert were assessed. In-vivo and ex-vivo ratings were compared for all participants. Two groups of participants were defined based on whether the WMH burden rating increased from in-vivo to ex-vivo MRI or not (excluding participants that already had the maximum rating in-vivo), and logistic regression of two groups was used to test the hypothesis that increased WMH burden ex-vivo is associated with longer AMI.

RESULTS

Intra-rater reliability (ICC=0.76) and agreement with the expert (ICC=0.80) were both strong. WMH burden generally stayed constant or increased from in-vivo to ex-vivo MRI. Logistic regression showed that for every one year increase in AMI, the odds of greater WMH burden ex-vivo increase by 59% (p=0.04).

CONCLUSION

This study demonstrated no drastic differences between in-vivo and ex-vivo WMH burden, providing strong evidence that WMH burden assessed ex-vivo is of the same nature as WMH burden assessed in-vivo. Any differences observed were probably due to additional pathology developing during the AMI.

CLINICAL RELEVANCE/APPLICATION

This study indicated no drastic differences between in--vivo and ex--vivo WMH, suggesting that WMH ex-vivo may be linked to in-vivo WMH, and thus may be used to assess neuropathological WMH correlates.

SSC12-06 Occupational Hazards of High Flight: A Proposed Mechanism of Neuronal Injury in Pilots and Aircrew Personnel with Hypobaric Exposure

Monday, Nov. 27 11:20AM - 11:30AM Room: N226

Participants
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PURPOSE

Discover cellular mechanisms that lead to cerebral white matter hyperintensities in human pilots following non-hypoxic hypobaric exposure utilizing magnetic resonance spectroscopy (MRS) and arterial spin labeling (ASL). Human exposure to non-hypoxic hypobaria is associated with increased white matter hyperintensities, degradation of axonal integrity, and decrements in neurocognitive processing. The pathophysiologic mechanism underlying this is unknown. We hypothesized that using MRS and ASL could offer insight into cellular changes occurring after acute hypobaric exposure in hypobaric naïve trainees.

METHOD AND MATERIALS

85 U.S. Air Force (USAF) aircrew trainees were evaluated while undergoing their initial occupational hypobaric exposure. Standard USAF procedure is approximately a 30-minute exposure to 25,000 feet. Three high-resolution MR imaging scans were obtained - T-24 hours, T+24 hours, and T+72 hours. Quantitative analysis of ASL and frontal white matter MRS was performed. Fifty-five healthy USAF control subjects meeting the same physical and physiological criteria minus hypobaric exposure served as controls. Paired two-tailed t-tests were used for comparison.

RESULTS

ASL showed an upregulation of both white and gray matter cerebral blood flow at both T+24 and T+72 hours in the exposed subjects (white matter p=0.003/0.020; gray matter p=0.053/0.041) with no significant change in the control's white matter cerebral blood flow. Exposed subjects had a decrease at T+24 in N-acetylaspartate (p=0.065) and myo-inositol (0.027) with no significant change in controls.

CONCLUSION

Significant declines in markers of neuronal integrity suggest that oxidative stress is evident within 24 hours of hypobaric exposure. The increase in cerebral blood flow measured by ASL in subjects exposed to hypobaric conditions is a response to oxidative damage and is evidence of increased metabolic demand. This study provides evidence that white matter hyperintensity formation may occur because of repeated oxidative stress without adequate time for healing. Cerebral white matter hyperintensities in this population are likely a function of both cumulative effects as well as frequency of hypobaric exposure.

CLINICAL RELEVANCE/APPLICATION

Understand the neuropathophysiologic mechanism of hypobaric induced white matter injury in oder to mitigate or prevent its effects upon high altitude pilots and special operations personnnel

SSC12-07 When Pigs Fly: A Swine Model for Study of Hypobaric Non-Hypoxic Exposure Effects on the Brain

Monday, Nov. 27 11:30AM - 11:40AM Room: N226

Participants
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PURPOSE

Non-hypoxic hypobaric exposure in Air Force U-2 pilots and hypobaric chamber personnel is associated with subcortical increased white matter hyperintensities, degradation of axonal integrity, and neurocognitive processing decrements. The mechanism for this is unknown. We developed a swine model to demonstrate and quantify axonal cerebral injury following non-hypoxic hypobaric exposure utilizing advanced magnetic resonance (MR) diffusion tensor imaging, Q-space, and advanced diffusion kurtosis imaging.

METHOD AND MATERIALS

Female miniature pigs (Sus scrofa domestica) were repetitively exposed to non-hypoxic hypobaria at 30,000 feet while controls remained at 5,000 feet altitude. All subjects underwent advanced MRI imaging three times. MR imaging was obtained at baseline, immediately post-exposure, and 4 weeks post-exposure. Advanced diffusion quantification was used to include kurtosis anisotropy, multi-b-value diffusion (Q-space), and fractional anisotropy (FA). Two-tailed t-tests were used for individual and group comparisons.

RESULTS

Perfusion-diffusion index and mean kurtosis anisotropy revealed an increase in unrestricted water immediately after repetitive high-altitude exposures. Repeated imaging at 4 weeks post exposure showed normalization to pre-exposure values. Age-adjusted mean fractional anisotropy (FA) at 4 weeks post-exposure was significantly decreased in the high-altitude group when compared to controls ($p < 0.0001/0.547$).

CONCLUSION

Our study demonstrates increase in unrestricted free water immediately after repetitive high-altitude exposure that is consistent with axonal injury, not seen in the control group. The significant decrease in FA at 4 weeks suggests degradation of axonal integrity. This replicates similar MR imaging findings in humans. This study provides evidence that repetitive hypobaric exposure incites axonal damage. Moreover, it supports the utility of advanced diffusion imaging techniques such as kurtosis anisotropy. To our knowledge, this is the first study to provide evidence that repetitive non-hypoxic hypobaric exposure incites axonal damage, as well as demonstrates our swine model as a feasible vector to study hypobaric neuronal injury and, possibly, other axonal injury processes like TBI.

CLINICAL RELEVANCE/APPLICATION

Understand the neuropathophysiology of hypobaric induced white matter injury in order to mitigate or prevent effects upon aircrew and special operations personnel

SSC12-08 Histologic Validation of MRI-Detected Myelin

Monday, Nov. 27 11:40AM - 11:50AM Room: N226

Participants
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PURPOSE

Myelin detection and monitoring is of great value for diseases such as multiple sclerosis and dementia as well as for follow-up in paediatric patients. However, most MRI methods to measure myelin are challenging to perform in clinical routine. Recently, a model was published, where myelin partial volume in the brain is measured using a rapid quantitative MRI sequence. The purpose of this work was to validate the model with post-mortem histology.

METHOD AND MATERIALS

The brains of 12 fresh, intact cadavers were scanned with a quantification sequence to determine the R1 and R2 relaxation rates and proton density PD, as input for the myelin model. Subsequently, the brains were excised at autopsy and brain slices were stained with Luxol Fast Blue to verify the presence of myelin. The stained brain slices were photographed, converted to optical density and registered with the MRI images. A correlation analysis was performed between the MRI-detected and LFB-stained myelin values.

RESULTS

A correlation was found between the two methods with a mean Spearman's rho for all subjects of 0.74±0.11. Linear regression showed a mean intercept of 1.50±2.84% and a mean slope of 4.37±1.73 %/%. A lower correlation was found for the separate R1 and PD (rho = 0.63±0.12 and -0.73±0.09, respectively). For R2, the rho was very low (0.11±0.28).

CONCLUSION

The observed correlation with post-mortem histology supports the validity of the myelin measurement model using rapid MRI

The observed correlation with post-mortem histology supports the validity of the myelin measurement model using rapid MRI quantification.

CLINICAL RELEVANCE/APPLICATION

The study validated histologically that a single MRI sequence of less than 6 minutes scan time can provide myelin content estimation in the brain.

SSC12-09 Axonal Water Fraction (AWF)-Based Parcellation of the Corpus Callosum: A White Matter Tract Integrity (WMTI) Study

Monday, Nov. 27 11:50AM - 12:00PM Room: N226

Participants
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PURPOSE

Despite the corpus callosum (CC) being composed of many different anatomic white matter (WM) tracts, structurally informed intra-callosal parcellation remains a challenge as clear boundaries between WM bundles are difficult to separate. Most previous work relies on gross callosal geometry or operator-dependent manual placement of regions-of-interest. Here we present a method of intra-callosal parcellation based on white matter tract integrity (WMTI) metrics derived from two-compartment modeling of multi-shell diffusion imaging, specifically axonal water fraction (AWF) to attempt to separate CC regions based on axon density.

METHOD AND MATERIALS

21 healthy individuals(34±9 y.o) were scanned using a 3T MR scanner (Skyra, Siemens) under IRB approval. Multi-shell diffusion imaging was performed using 5 b-values (upto 2.5ms/μm2, 60 directions). The CC skeleton was acquired in a fractional anisotropy(FA) template space and was dilated to avoid volume averaging through CSF(Fig.1(top,red)). Subject AWF maps were registered to a template space. AWF values within ROIs were averaged in each coronal slice along the CC. Subdivisions were placed at local maxima of the first derivative(Fig.1(bottom)), demarcating the CC into distinct segments based on greatest degree of change in AWF. We looked at this also: extra-axonal radial diffusivity(De,perp) to see patterns across segmented regions in De,perp reflective of myelination(Fig.2).

RESULTS

Fig.1 shows the plot of AWF along the CC. Its fist derivative plot was used to partition the CC into 5 regions(Fig.1(bottom)). Our results support the work of Hofer and Franhm (Neuroimage,2006) based on tractography from manual ROI placement.

CONCLUSION

WMTI has been proposed to disentangle intra- and extra-axonal environments. This can be leveraged to partition the CC based on AWF, reflective of biophysical factors of the underlying WM microstructure. Specifically, we found relatively lower AWF and higher De,perp in region 4, the posterior callosal body, known to contain a greater number of large diameter axons with thicker myelin. This technique would be easily translatable to individual subjects, even without morphing to a template space and future work is underway in this direction.

CLINICAL RELEVANCE/APPLICATION

Compartment specific *white matter tract integrity* metrics are sensitive to the underlying white matter microstructure and specifically *axonal water fraction* is able to partition the corpus callosum.

RSNA 2017 Explore. Invent. Transform.
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SSC13

Physics (CT: Dual Energy and Spectral CT)

Monday, Nov. 27 10:30AM - 12:00PM Room: S404AB

BQ CT PH

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

SSC13-01 Organ-Specific Context-Sensitive Single and Dual Energy CT (DECT) Image Reconstruction, Display and Analysis

Monday, Nov. 27 10:30AM - 10:40AM Room: S404AB

Participants
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PURPOSE

To combine mutually exclusive CT image properties (reconstruction kernels, monoenergetic reconstruction, dual energy classification or display settings) into a single organ-specific image reconstruction and display.

METHOD AND MATERIALS

Given a CT rawdata set there are manifold parameters for CT image reconstruction and display. To name a few of them: reconstruction algorithm and parameters, dual energy spectral properties and display settings. Often, specific settings are tied to certain organs and thus several reconstructions are required to fully exploit the diagnostic potential of the CT data. We propose a method to locally reconstruct the desired image properties by using an atlas-based context-sensitive reconstruction. Each voxel of the atlas indicates the probability of the voxel belonging to a certain organ. By aligning the atlas onto one target volume, the anatomical structures are automatically segmented and classified into the organs heart, vasculature, liver, kidney, spleen and lung. Moreover, each voxel is assigned to different tissue types (bone, fat, soft tissue and vessels). Reconstruction and display parameters most suitable for the organ, tissue type, and clinical indication are chosen automatically from a predefined set of reconstruction parameters on a per-voxel basis. The approach was evaluated using patient data acquired with a dual source CT system.

RESULTS

Ten contrast-enhanced DECT patient datasets in arterial and portal venous phase were used. We are able to reconstruct each tissue type with the most appropriate kernel by using prior anatomical knowledge. The resulting, context-sensitive enhanced images simultaneously combine the indication specific advantages of different parameter settings without experiencing algorithm related artifacts. A direct comparison with conventionally reconstructed and displayed images revealed no information loss in the compound image. Dual energy overlays or tissue classification information are shown wherever appropriate.

CONCLUSION

With the use of our context-sensitive reconstruction and display approach, the images present significantly more information to the reader simultaneously and dealing with multiple image stacks is unnecessary.

CLINICAL RELEVANCE/APPLICATION

The proposed method improves the clinical workflow and bears the potential to increase the rate of clinically relevant incidental findings.

SSC13-02 Spectral CT Analysis Using Custom Plugins for a Clinical DICOM Viewer

Monday, Nov. 27 10:40AM - 10:50AM Room: S404AB

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PURPOSE

Spectral CT potentially reduces energy-dependent artifacts and produces more quantitatively accurate images. As recognized early in CT development, this is especially true for spectral CT based on projection-space decomposition using a physics-centric basis set.

METHOD AND MATERIALS

Spectral CT fingerprinting is our term for the statistical analysis of the intrinsic 2D information content for tissue attenuation in all current forms of spectral CT, including dual source and dual layer detector. Since current clinical workflow does not facilitate spectral analysis outside specific applications (ex. iodine maps, fat quantification), we developed novel tools for spectral CT image analysis. pyOsiriX (Blackledge et al,2016) is a recently published plugin for the popular OsiriX (Pixmeo SARL) family of DICOM viewers, including open source variants Horos (horosproject.org) and Osiri-XLV. pyOsiriX facilitates the rapid development of Python-based image analysis, modeling, and interpretation in a clinical-quality DICOM environment. We deployed pyOsiriX-based software tools that interact with Spectral Basis Images (SBIs) from a detection-based spectral CT (IQon, Philips Healthcare), as well as image-space dual source studies (Siemens).

RESULTS

The pyOsiriX Spectral CT Toolbox produces new DICOM series containing scatter plots of the native spectral CT data. We denote these 2D scatter plots as material attenuation decomposition (MAD) plots, with local MAD plots being at the slice level and the global MAD plot for the entire series. The toolkit facilitates bi-directional segmentation between the volume and MAD plots, as well as annotation with libraries of known materials and tissues. Analysis results natively support both ROI tools and multi-planar reformatting. For more complicated tasks, a single slice or entire series can be seamlessly exported to NIH ImageJ/FIJI where analogous scatterplot tools are available alongside an extensive image processing library.

CONCLUSION

The pyOsiriX Spectral CT Toolbox is a robust framework for exploring intrinsic 2D spectral data and provides a more global viewpoint of the spectral CT information content than standard material decompositions and monoenergetic results.

CLINICAL RELEVANCE/APPLICATION

Analysis of spectral CT data using such tools may allow subtle changes in contrast to be better understood in terms of the underlying tissue composition and pathology.

SSC13-03 Investigation on the Repeatability of Coronary Artery Calcium Quantification Using Contrast-Enhanced Dual-Energy Computed Tomography Scans in Comparison with Unenhanced Single-Energy Scans

Monday, Nov. 27 10:50AM - 11:00AM Room: S404AB

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PURPOSE

To assess the repeatability of coronary artery calcium (CAC) scoring using contrast-enhanced dual-energy (DE) scans and compare it with conventional CAC scores obtained from unenhanced single-energy (SE) CT images.

METHOD AND MATERIALS

Synthetic vessels with iodinated blood (diameters 4 and 4.5mm) containing calcium stenoses (hydroxylapatite) of different sizes and densities were scanned in a chest phantom using a DE coronary CT angiography protocol (90kV/Sn150kV, SOMATOM Force, Siemens) with 3 doses (mAs/CTDIvol: automatic exposure control/7mGy, 160mAs/21mGy and 260mAs/32mGy) and 10 repeats. Images were reconstructed at 3mm slice thickness, with Qr36 kernel, using FBP and ADMIRE-3 (IR). As a control, a set of vessel phantoms without iodine was scanned using a standard SE CAC score protocol (automatic exposure control/3mGy). Calcium volume, mass and Agatston scores were estimated for each stenosis. For DE data, image-based three-material (calcium, iodine, soft tissue)

decomposition was applied to remove iodine before scoring. Calcium scores for 4 stenoses were analyzed (degree of stenosis: 50%, density: 300 and 450HU at 120kV). Within-subject coefficient of variation (wCV) was calculated for each stenosis and imaging condition and across corresponding scores from DE and SE data.

RESULTS

The repeatability of calcium scores varied depending on the size and density of the stenosis: wCV decreased as size and/or density of calcium increased. wCVs for DE based calcium scores were strongly impacted by image noise: higher dose reduced variability and IR outperformed FBP at the same dose level in terms of wCV. The mean wCVs of volume scores of all stenoses for DE dataset with FBP/IR from low to high doses were 0.14±0.08/0.12±0.05, 0.14±0.05/0.08±0.04, and 0.10±0.05/0.04±0.10. Only 260mAs dose level with IR yielded comparable wCV to those from SE data (0.04±0.02). All trends were consistent for volume, mass and Agatston scores.

CONCLUSION

It is feasible to extract calcium scores from contrast-enhanced images using DE based material decomposition methods. However, to achieve similar repeatability of calcium scores to that from conventional unenhanced SE CT images, much higher radiation dose is required.

CLINICAL RELEVANCE/APPLICATION

Although DE based iodine-removal method may eliminate the need for unenhanced SE scans dedicated for CAC score, our findings suggest significantly higher dose is needed to achieve good repeatability.

SSC13-04 Quantification of Cisplatin Concentration by using Material Decomposition Algorithm at 3rd Generation Dual Source Dual-Energy CT: An Experimental Phantom Study

Monday, Nov. 27 11:00AM - 11:10AM Room: S404AB

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PURPOSE

Intra-arterial infusion or embolization with high-dose cisplatin has been performed following selective angiography for locally advanced head and neck cancer or hepatocellular carcinoma. The purpose of this study was to assess the ability of dual source dual-energy computed tomography (DECT) to quantify cisplatin concentration by using the material decomposition algorithm.

METHOD AND MATERIALS

Fifteen agarose-based phantom syringes that contained various concentrations of iodine (0, 1.0, 2.0 mgI/mL) and cisplatin (0, 0.5, 1.0, 2.0, 3.0 mgPt/mL) were scanned with DECT at 80 kV and Sn150 kV. Cisplatin-specific slope was determined using iodine-free agarose and cisplatin phantoms. Then, cisplatin maps were reconstructed from dual-energy calculation by using three-material decomposition algorithm of agarose, iodine, and cisplatin. HU values from six consecutive images on cisplatin maps were obtained for each phantom by placing regions of interest. The relationships between HU values on cisplatin maps and cisplatin concentration for each iodine concentration were assessed by using Spearman rank correlation coefficient (ρ) and linear regression analyses. To assess the influence of iodine on cisplatin measurements made by using cisplatin maps and cisplatin concentration, the linear regression lines for HU values on cisplatin maps and cisplatin concentrations were compared by using analysis of covariance at three levels of iodine concentration.

RESULTS

Cisplatin maps could identify the lowest cisplatin concentration of 0.5mgPt/mL. Significant linear correlations were found between HU values on cisplatin maps and cisplatin concentrations for each iodine concentration (ρ=0.980-0.981, $P<.001$). At higher iodine concentrations, the linear coefficients for HU values on cisplatin maps decreased. Analysis of covariance showed significant differences between 2.0 mgI/mL and 0 or 1.0 mgI/mL ($P<.001$) and no significant difference between 0 and 1.0 mgI/mL ($P=.068$).

CONCLUSION

Cisplatin maps generated from material decomposition algorithm allow to identify the cisplatin concentration of 0.5mgPt/mL or more. In the presence of 2.0 mgI/mL iodine concentration, cisplatin maps led to underestimation of cisplatin concentration.

CLINICAL RELEVANCE/APPLICATION

Third generation dual source DECT can estimate tissue cisplatin concentration, potentially confirming appropriate high-dose distribution during intra-arterial infusion or embolization with cisplatin.

SSC13-05 Improved X-Map for Acute Ischemic Stroke Imaging Using Non-Contrast-Enhanced Dual-Energy CT

Monday, Nov. 27 11:10AM - 11:20AM Room: S404AB

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PURPOSE

A novel imaging technique ("X-map") has been developed to identify acute ischemic lesions for stroke patients using non-contrast-enhanced dual-energy CT (Noguchi K, et al., Cerebrovasc Dis, 26:34-41, 2017). Using the 3-material decomposition technique, the original X-map ("X-map1") eliminates fat and bone from the images, suppresses the gray matter-white matter tissue contrast, and enhances signals of edema induced by ischemia. There were the following three problems with the X-map1: (1) faint biases near the skull; (2) X-map1 values being qualitative, not quantitative; and (3) presence of many false positives. The aim of this study was to address these problems.

METHOD AND MATERIALS

We improved both an iterative beam hardening correction method (iBHC) and the X-map algorithm. The new iBHC modeled x-ray physics more accurately including off-focal spot radiations. The new X-map ("X-map2") first converted CT pixel values to the truly physics-based characteristic coefficients that are unique to the local tissue materials such as gray matter or white matter. The X-map2 then calculated an increased water density for each pixel, which is called the ischemia index (AISC), with the value of 100 indicating 100% normal tissue (no edema) and 0 indicating 100% water (complete edema).

RESULTS

The new iBHC provided quantitatively accurate pixel values: Pixel values near the skull were biased by 12-to-20 HU with the old iBHC, whereas the bias with the new iBHC was as small as -3-to-2 HU. Performed on the improved iBHC image, the X-map1 presented an ischemic lesion correctly; however, there were suspicious false-positive lesions and the size of the ischemic lesion was smaller than DWI-MRI image. In contrast, the X-map2 provided much fewer false-positive lesions and the correct ischemic lesion size. The extent of the lesion with AISC<90 agreed with the ischemic lesion presented in DWI-MRI.

CONCLUSION

We have improved both iBHC and X-map algorithms. The combined method decreased false positives, improved the agreement with DWI-MRI, and provided quantitative index values.

CLINICAL RELEVANCE/APPLICATION

When acute ischemic lesions, intracranial hemorrhage, and thrombus are identified correctly and confidently, the most effective therapeutic option can be chosen within 45 min of patient arrival.

SSC13-06 Cross-platform Comparison of Lower Limits of Iodine Detection with Single Source, Dual Source, and Rapid Kilovoltage Switching Dual Energy CT Platforms

Monday, Nov. 27 11:20AM - 11:30AM Room: S404AB

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PURPOSE

To evaluate and compare the accuracy and lower limits of iodine quantification across multiple dual energy CT platforms, including single source, dual source, and rapid kilovoltage switching platforms.

METHOD AND MATERIALS

A commercially available phantom was used to evaluate iodine concentrations of 10, 7.5, 5, 2.5, 2 and 0 mg/ml. As there were no commercially available iodine phantoms below 2 mg/ml, an in-house phantom was developed using serial dilutions of Omnipaque 300 mg/ml to evaluate iodine concentrations of 3, 1.5, 1, 0.6, 0.3, and 0.15 mg/ml. The phantom was scanned on single source (Siemens Definition Edge), dual source (Siemens SOMATOM Force), and rapid kilovoltage switching (GE Revolution HD) CT scanners. Scan parameters were adjusted across platforms to maintain a CTDIvol of approximately 25 mGy, and images were reconstructed at 3 mm thickness. No iterative reconstruction was employed. Images were post-processed and analyzed utilizing the vendors' respective dual-energy workstation platforms, Syngo.via, and GE AW server.

RESULTS

1 mg/mL was the lowest visually perceptible concentration across all platforms. CNR at 1 mg/mL was best (2.7) on the dual source platform with monoenergetic 40 keV images, and improved progressively for all platforms on monoenergetic images as keV settings were lowered. The single and dual source platforms improved in linear fashion, while the rapid kVs platform was best modeled by a polynomial function. Both dual source and rapid kVs platforms demonstrated linear response in measured iodine concentration (R2=0.99). The lowest CNR required to be visually perceptible with optimization of window/level settings and viewing environment was approximately 1.2-1.3. On the rapid kVs platform, the Iodine material basis pair images demonstrated superior CNR to monoenergetic images, even at 40 keV.

CONCLUSION

The lowest iodine concentration that was visually discernible was 1.0 mg/ml across all platforms. The highest CNR achieved at this concentration was 2.7, by the dual source scanner on monoenergetic 40 keV images.

CLINICAL RELEVANCE/APPLICATION

Dual energy CT can accurately quantify iodine concentration across a wide dose-range, down to a minimum of approximately 1 mg/ml, which may allow its use as a quantifiable biomarker.

SSC13-07 Comparing Imaging Performance across Spectral Computed Tomography Platforms

Monday, Nov. 27 11:30AM - 11:40AM Room: S404AB

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PURPOSE

To evaluate the imaging performance across different spectral Computed Tomography (CT) platforms, including: kVp-Switching CT, Dual-Source CT, and Dual-Layer CT.

METHOD AND MATERIALS

A semi-anthropomorphic abdomen phantom for CT performance evaluation was imaged on different spectral CT systems: kVp-Switching (Discovery CT750 HD, GE, United States), Dual-Source (Somatom Definition Flash & Force, Siemens Healthineers, Germany) and Dual-Layer CT (IQon Spectral CT, Philips Healthcare, The Netherlands). Scans were repeated three times for each radiation dose levels (CTDIvol: 10 mGy, 20 mGy and 30 mGy). To be able to better compare results all data were reconstructed in a non-iterative mode and dose modulation was switched off. The phantom was imaged with different extension rings to simulate obese patients and was equipped with a specific spectral insert, which included the following materials: water-, adipose-, muscle-, liver-, bone-like materials and a variation of iodine concentrations. Over the range of available virtual mono-energetic images (VMI) noise as well as quantitative accuracy of VMI Hounsfield Units (HU), and iodine concentrations were evaluated.

RESULTS

Over the range of VMI levels the HUs could be determined with high accuracy when comparing to the theoretical values. For kVp-Switching and Dual-Source CT an increase in noise could be observed towards lower VMI levels. A patient size dependent increase in iodine concentrations error can be observed for all platforms. For a medium patient size the iodine concentration bias was for the three dose levels (CTDIvol: 10 mGy, 20 mGy and 30 mGy): 0.344 mg/ml, 0.348 mg/ml and 0.314 mg/ml (kVp-Switching), 0.741 mg/ml, 0.736 mg/ml and 0.730 mg/ml (Dual-Source), and 0.240 mg/ml, 0.192 mg/ml, and 0.134 mg/ml (Dual-Layer).

CONCLUSION

Iodine concentrations as well as VMI HUs could be accurately determined across different spectral CT systems. In non-iterative reconstruction mode, the noise behaviour of dual-layer CT is independent of the keV VMI level, while an increase in noise is observed for kVp-Switching and Dual-Source CT.

CLINICAL RELEVANCE/APPLICATION

Current high-end spectral CT scanners allow accurate material quantification using different techniques. This should allow to move toward quantitative CT imaging in the clinical day-to-day routine.

SSC13-08 Diagnostic Spectral Image Quality Achievable in Obese Patients Using Detector Based Dual Energy CT

Monday, Nov. 27 11:40AM - 11:50AM Room: S404AB

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PURPOSE

Currently, tube based dual energy CT scanners have limited ability to scan patients with large body habitus due to their low energy limitations. The purpose of our study is to assess the image quality and interpretability of monoE 70 KeV and iodine images obtained on a spectral detector CT scanner (SDCT) in obese patients.

METHOD AND MATERIALS

IRB approved, HIPAA compliant retrospective review of 15 patients over 270 lbs (122.5 kg) who underwent a CT of the abdomen and pelvis using the Philips IQon Spectral detector CT at our institution between December 2016 and March 2017 was performed. Body mass index of the 15 patients ranged from 33.87 kg/m² - 71.48 kg/m² with weights in the range of 271 lbs - 366 lbs. Two fellowship trained, board certified radiologists reviewed the images, specifically the conventional and monoE 70KeV for image quality and graded contrast to noise ratio (CNR) on a five point scale between 1 for conventional imaging superiority to 5 for monoE 70KeV superiority. Iodine map sequences were analyzed for image quality and homogenous interpretability based upon a five point scale (1-5) with 1 being uninterpretable to 5 being completely interpretable.

RESULTS

When comparing the conventional images to the monoE 70KeV images, there was a 100% concordance between the two reviewers that the monoE 70KeV images were superior to conventional images with an average score of 4.57 for reviewer 1 and 4.64 for reviewer 2. In regards to the iodine map, reviewer 1 had an average score 4.07 and reviewer 2 had an average score of 4.57. These values fall between a score of 4 and 5, with 4 being a score where the iodine map is completely interpretable, except for one organ and 5 being a score for iodine maps being completely interpretable. None of the iodine map ratings fell below a score of 3, where the iodine map is interpretable with more than one organ limitation.

CONCLUSION

SDCT scanner permits spectral imaging in obese patients who were previously considered inappropriate for dual energy scanning. MonoE 70KeV provided superior image quality in obese patients as compared to conventional images.

CLINICAL RELEVANCE/APPLICATION

Diagnostic image quality of obese patients can be achieved using the IQon SDCT.

SSC13-09 Feasibility of Dual-Energy CT for Zinc Quantification in an Experimental Phantom Model

Monday, Nov. 27 11:50AM - 12:00PM Room: S404AB

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PURPOSE

Cumulative evidence indicates that zinc may play a key role in the development of liver and pancreatic cancers. We investigated the feasibility of using dual-energy CT to quantify zinc and to differentiate it from iodine in a phantom experiment.

METHOD AND MATERIALS

Multiple 1.3-cm test tubes were filled with four zinc chloride (2 to 22 mgZn/mL), four iodine (1 to 7 mgI/mL with Iohexol 350 mgI/mL) and two mixed zinc/iodine solutions (75% zinc-to-25% iodine and vice versa), targeting clinically relevant CT numbers on the order of 25 to 150 HU. These were placed into an 85-cm-circumference torso-shaped water phantom, simulating the abdomen of a medium-sized patient. Polyethylene bags filled with vegetable fat were serially wrapped at the periphery of the water phantom to mimic large (110-cm) and extra-large (120-cm) patient sizes. The three phantom sizes were imaged in dual-energy (80/140 kVp, 600 mA) and single-energy (120 kVp) modes using a single-source dual-energy 64-MDCT scanner with fast kV switching. For reference purposes, the same scans were repeated by scanning the plastic test tubes in air. CT radiation output was kept constant for all acquisitions. Material-specific and attenuation information were extracted from raw-data.

RESULTS

A custom linear mixing algorithm was generated from dual-energy monochromatic datasets to obtain zinc maps, which yielded estimates of zinc concentration with RMSE of 0.8 mg/mL across dilution levels and phantom sizes. The lowest 2.8 mgZn/mL solution was measured to have 2.5+/-0.4 mgZn and was significantly higher than Zn estimates in the background (0.2+/-0.6 mgZn, $P<0.001$, 1-sided t-test), demonstrating that trace levels of Zn are detectable. Iodine maps from the commercially-available software yielded a RMSE of 0.5 mgI/mL. The system was unable to reliably discriminate zinc from iodine when both materials were present within the same sample.

CONCLUSION

Dual-energy CT can quantify zinc in an experimental phantom model. Dual-energy may not be able to reliably distinguish between zinc and iodine within the same tissue sample, thus suggesting that a separate dual-energy noncontrast acquisition may be needed for optimized in-vivo zinc quantification.

CLINICAL RELEVANCE/APPLICATION

Non-invasive quantification of zinc with dual-energy CT may prove useful in oncologic imaging as quantitative biomarker for early identification of malignancy and, possibly, for development of targeted therapies.

SSC14

Physics (Diagnostic X-Ray Imaging: Techniques, Radiation Dose)

Monday, Nov. 27 10:30AM - 12:00PM Room: S503AB

PH SQ

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

Participants
James A. Seibert, PhD, Sacramento, CA (*Moderator*) Advisory Board, Bayer AG
Hilde Bosmans, PhD, Leuven, Belgium (*Moderator*) Co-founder, Qaelum NV Research Grant, Siemens AG

Sub-Events

SSC14-01 Improved Detection of Foreign Bodies on Radiographs Using X-Ray Dark-Field and Phase-Contrast Imaging

Monday, Nov. 27 10:30AM - 10:40AM Room: S503AB

Participants
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PURPOSE

To investigate whether the detection of foreign bodies (FB) can be improved using dark-field and phase-contrast radiography compared to conventional (transmission) radiographs.

METHOD AND MATERIALS

Experiments were performed using ex vivo pig paws that were prepared with differently sized FB of metal, wood and glass (n=10 each). Paws without FB served as controls (n=30). All images were acquired using an experimental grating-based large object radiography system. A reader study was performed to investigate the diagnostic value of adding dark-field and / or phase-contrast images to transmission images. Five blinded readers (2nd to 4th year radiology residents) were asked to assess the presence or absence of any FB.

RESULTS

Sensitivity for the detection of metal FB was 100% for all readers. The sensitivity for the detection of wooden FB increased from 0-10 % for transmission images to 70-80% when dark-field images were added. For the detection of glass FB, sensitivity increased from 80-100% for transmission images to 90-100% when adding phase-contrast images. Sensitivity for the detection of any foreign bodies was highest when transmission, dark-field and phase-contrast images were viewed simultaneously (87-93%), compared to 60-67% for the sole analysis of transmission images. Specificity was 97-100% across all readers and radiography modalities.

CONCLUSION

Analysis of dark-field images led to a substantially improved detection of wooden FB compared to the sole analysis of transmission images. Detection of glass FB was slightly improved when adding phase-contrast images.

CLINICAL RELEVANCE/APPLICATION

Improved detection of glass and wooden FB on radiographs can facilitate their removal and prevent infectious complications from missed FB.

SSC14-02 Assessing the Relevance of Testing Tube Voltage against the 1kV Remedial or 2kV Suspension Levels in Digital Mammography

Monday, Nov. 27 10:40AM - 10:50AM Room: S503AB

Participants
Kristina Wigati, Leuven, Belgium (*Presenter*) Nothing to Disclose
Lesley Cockmartin, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Guozhi Zhang, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Dimitar Petrov, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Current protocols give strict guidelines on remedial and suspension levels for tube voltage accuracy. This work examines whether breaching these limits results in unacceptable image quality in digital mammography.

METHOD AND MATERIALS

Images were acquired on a Siemens Inspiration system using (1) the contrast-detail phantom for mammography (CDMAM), evaluated with cdcom computerized reading, and (2) the 3D structured L1-phantom, containing acrylic beads of different diameters in water and inserted lesions (microcalcifications, spiculated and non-spiculated mass models). Five readers evaluated detectability of the inserts in a four-alternative forced-choice study. Images were acquired under automatic exposure control with tube voltage of 29kV for CDMAM and 30kV for the L1-phantom, and then for 2 lower and 2 higher tube voltage settings. Figures of merit are threshold gold thickness (T) for the 0.1 and 2mm disks for CDMAM and threshold diameter (dtr) for the L1-phantom. Mean glandular dose (MGD) was calculated using the Dance formula.

RESULTS

Threshold diameters (dtr) and their 95% confidence interval were 0.114[0.110-0.118]mm at 30kV for microcalcifications in the L1-phantom. Deviations of -1kV or +1kV did not result in significant changes in dtr, with values of 0.117[very wide]mm and 0.118[0.117-0.119]mm respectively. Likewise for -2kV, dtr was 0.110[0.109-0.112]mm, for +2kV however a slight increase in dtr was found (0.122[0.119-0.126]mm). For spiculated and non-spiculated masses similar results were obtained with dtr ranging from 4.7[4.0-5.5]mm to 4.6[2.9-6.4]mm and from 4.3[3.9-4.8]mm to 4.0[1.7-6.3]mm in going from 28kV to 32kV, respectively. Confidence intervals for T for the 0.1mm as well as for the 2mm disk were overlapping for all tube voltage levels tested. Doses ranged from 0.91 to 1.14mGy for the L1-phantom and from 1.02 to 1.29mGy for CDMAM.

CONCLUSION

Deviations in tube voltage of ±1 and ±2kV, corresponding to current remedial and suspension limits, left image quality figures for calcifications and masses largely unaffected but caused changes in dose of up to 20%.

CLINICAL RELEVANCE/APPLICATION

It is unlikely that exceeding tube voltage limits will result in suspension of a system for image quality reasons. Measuring tube voltage is required for dosimetry.

SSC14-03 Coronary Angiography with a Photon-Counting Detector: Initial Results

Monday, Nov. 27 10:50AM - 11:00AM Room: S503AB

Participants
Thorsten Sellerer, MSc, Garching bei Munchen, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the potential of coronary angiography with a spectral photon-counting detector as an alternative to digital subtraction angiography (DSA).

METHOD AND MATERIALS

The coronary arteries of a whole pig heart were imaged with a spectral photon-counting detector after injection of contrast material (Ultravist-370, Bayer Healthcare, Germany). The photon-counting detector (Dectris Ltd., Baden, Switzerland) allows the separation of a polychromatic x-ray spectrum into four distinct energy bins. For this experiment the thresholds of the energy bins were placed at 35, 48, 55 and 66 keV. The heart has been imaged with the following parameters: 90 kVp with 4 mm aluminium filtration, 24 mAs and SID of 165 cm. To generate an iodine only image from a single acquisition, the data were decomposed into basis material line-integrals of iodine and soft tissue equivalents by an in-house developed algorithm.

RESULTS

The combination of a spectral photon-counting detector and material decomposition allowed to generate an iodine only image (featuring only the vascular structures) and a soft tissue image. Especially small vessels, which are previously hidden by the soft-tissue, could be clearly visualized. Compared to a conventional image, the contrast between vessels and soft-tissue is enhanced under the penalty of increased image noise. This increase is due to anti-correlated noise, which is common for any spectral imaging technique. Proper handling of the anti-correlated noise by an in-house developed dedicated de-noising algorithm, resulted in a superior contrast-to-noise ratio of the iodine only image (14.47) compared with the conventional image (9.66).

CONCLUSION

Spectral photon-counting angiography allows in a single acquisition to generate iodine only images. Current DSA techniques allow

high-contrast imaging of coronary arteries, however, require two consecutive acquisitions. The proposed technique provides similar contrast quality with a single acquisition and eliminates the possibility of motion artefacts which are common in DSA imaging.

CLINICAL RELEVANCE/APPLICATION

Spectral photon-counting detectors extend the possibilities of X-ray coronary angiography, which already is an invaluable tool for the diagnosis of heart diseases.

SSC14-04 Pixel Size Has No Measurable Influence on Detection and Identification of Bone Abnormalities in Hand Radiographs

Monday, Nov. 27 11:00AM - 11:10AM Room: S503AB

Participants
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Thibaut Wirth, PhD, Moirans, France (*Abstract Co-Author*) Application engineer, TRIXELL-THALES (France).

PURPOSE

To evaluate the influence of pixel size on detection and identification of bone abnormalities on hand radiographs obtained from a digital flat-panel.

METHOD AND MATERIALS

Radiographic images of the hands were acquired in 50 patients with proven rheumatoid arthritis using a high-resolution detector (85 µm pixel). A dedicated software was developed to generate, from the high-resolution image, a set of images with pixel sizes ranging from 100 to 200 µm. Image zoom was then adapted in order to standardize image size presentation on a workstation whatever the pixel size. The set of images with variable pixel size were randomly distributed into 3 reading sessions and read independently by 3 experienced musculoskeletal radiologists. Each radiologist was asked to draw a box (ROI) around each abnormality detected in the metacarpo-phalangeal joints and to classify it among 3 predefined types, namely erosions, demineralization and geodes. Finally, 2 radiologists reviewed during a consensual reading all the abnormalities mentioned by any of the 3 readers to decide if each abnormality was actual and review its classification. The results of each separate reading were then compared to those of the consensual reading in order to compute both detection rate (presence/absence) and identification rate (image type) of each reader for each pixel size.

RESULTS

Detection probability is close to 40 % for any of the 3 readers and surprisingly barely depends on pixel size within the range from 85 to 200 µm. However, once detected, an abnormality has a high probability (close to 80%) of being correctly identified. Again, no significant influence of the pixel size was found.

CONCLUSION

Besides mammography and dental, hand radiograph in rheumatic diseases is the most demanding in terms of need for fine detail detection. However, no impact of the pixel size in the 85-200 µm range was found on lesion detection and identification.

CLINICAL RELEVANCE/APPLICATION

The quality of clinical diagnosis in hand radiography shows no improvement when pixel size decreases from 200 µm to 85 µm.

SSC14-05 Performance Assessment of a Clinical X-Ray Angiography Detector with Low Electronic Readout Noise

Monday, Nov. 27 11:10AM - 11:20AM Room: S503AB

Participants
Kenneth A. Fetterly, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

PURPOSE

For x-ray angiography systems, detector electronic readout noise results in sub-quantum-limited performance at low x-ray dose levels, compromises image quality, and limits the ability to reduce patient fluoroscopy dose rates to very low levels. The purpose of this work is to assess performance of a new clinical x-ray angiography detector with low electronic noise.

METHOD AND MATERIALS

The MTF, NPS, and DQE of a standard and low electronic noise angiography detectors were measured over the dose range 2.6 to 65 nGy per frame. The pixel pitch of the standard and low noise detectors was 0.184 and 0.164 mm, respectively and both detectors had crystalline CsI scintillators. X-ray generation was controlled manually and the NPS of electronic noise only was measured using dose 0 nGy per frame. The 81 kVp x-ray beam incident to the detector was filtered with 0.3 mm Cu and attenuated with 6.35 cm Al. MTF was calculated from an image of a 1.0 mm Cu edge positioned at a slight angle with respect to the pixel matrix. Areal NPS was calculated from 100x100 pixel regions of interest from 50 frames acquired with rates 7.5, 15, and 30 s-1. Spatio-temporal NPS was calculated to assess lag. Mean photon fluence 34 mm-2 nGy-1 (~1 pixel-1 nGy-1) was use to estimate DQE.

RESULTS

The pixel value versus dose response of both detectors was linear with gain ~4.8 nGy-1. The MTF of the standard detector was higher than that of the low noise detector. NPS measurements demonstrated that the electronic noise of the standard detector was equivalent to ~5 nGy x-ray quantum noise whereas that of the new detector was ~0.5 nGy equivalent. That neither detector

demonstrated lag is consistent with the short decay time of the scintillators. The two detectors had equivalent quantum-limited low frequency DQE which did not vary with frame rate. Whereas electronic noise compromised DQE of the standard detector for dose less than ~15 nGy per frame, DQE of the new detector was quantum-limited for dose as low as 2.6 nGy.

CONCLUSION

In contrast to the standard detector for which electronic noise compromises DQE for per frame dose less than ~15 nGy, the low electronic noise detector demonstrated quantum-limited performance to very low radiation dose levels.

CLINICAL RELEVANCE/APPLICATION

The low electronic noise detector may facilitate very low radiation dose rate fluoroscopic imaging for a variety of clinical indications for both pediatric and adult patients.

SSC14-06 How Important Is the Quality of the Medical Display in Dental Radiology?

Monday, Nov. 27 11:20AM - 11:30AM Room: S503AB

Participants
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Saulo L. Sousa Melo, DDS, PhD, Iowa City, IA (*Abstract Co-Author*) Nothing to Disclose
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CONCLUSION

The quality of the display has an important impact on perceived image quality, visibility of important anatomical features and inter- and intra-observer variability. A medical display scores significantly better on these aspects compared to a consumer display.

Background

Over the past decade, dental imaging has grown significantly as the prevalence of oral diseases worldwide has increased and there is an expanded awareness of oral health. Analog dental imaging systems that utilize cassettes, film and intensifying screens are rapidly being replaced by digital systems where images are visualized on displays. In general radiology the importance of a high quality medical display has been widely accepted, but in dental applications often consumer level displays are still being used. Some countries such as Germany (DIN 6868-157) have passed legislation to impose minimum quality requirements for dental displays. This paper aims at understanding the importance of the display system is in the overall dental imaging chain.

Evaluation

A retrospective reader study was performed. 16 cases of 4 different modalities (Intraoral radiography; Panoramic radiography; Cone-Beam CT; Cephalometric skull radiography) were read by 4 observers on two different displays. The first display was a medical display (Barco Nio Color 3MP; resolution 2048x1536, 1400:1 contrast, 500 cd/m² brightness) and the second display was a consumer display (Dell Ultra Sharp 24 inch; resolution 1920x1080, 1000:1 contrast, 250 cd/m² brightness). Readers answered questions about image quality and visibility of anatomical features using a 7-point scale.

Discussion

Pooled over the 4 different modalities the medical display scored higher than the consumer display with statistical significance. Observers judged the medical display as having better image quality and easier to perceive important anatomical structures. Also a statistically significant advantage was found in favor of the medical display for each modality individually. When analyzing inter- and intra-observer variability it was found that using a medical display reduced variability and increased reading consistency. This result was also statistically significant.

SSC14-07 Optimizing Infant Osseous Survey Techniques for a Digital Radiography Portable

Monday, Nov. 27 11:30AM - 11:40AM Room: S503AB

Participants
Loretta M. Johnson, PhD, Birmingham, AL (*Presenter*) Nothing to Disclose
Daniel Vergara, MS, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose
Ramses Herrera, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Programming and posting an infant osseous survey chart has decreased the kVp and the exposure indices used for radiography of infants in our neonatal and continuing care nurseries.

Background

During routine quality control image review, a manager noticed an infant leg imaged with 70 kVp and 5 mAs (deviation index +12.7), and he requested a physicist develop an infant osseous survey technique chart for the relatively new Carestream Revolution DRX digital radiography (DR) portable in the neonatal nursery. From our work on neonatal chest and abdomen exams last year, we had some Lucite and Cornish hen phantom studies, and for this bone project, we obtained additional data with Lucite and aluminum phantoms, line-pair phantoms, and a low-contrast phantom, the UAB Fluoro Test Tool (Fluke Model 07-645). We also reviewed 200 images of bone exams of infants weighing between 1095 and 7945 grams (premature infants to 9 months old), noting their image quality as well as the Carestream exposure index (relative x-ray exposure).

Evaluation

The line-pair phantoms and low-contrast phantom were imaged under thicknesses of Lucite appropriate to the thicknesses of these

infants (5.5 to 15 cm, AP and lateral), and they appeared the most clear with 40 to 55 kVp, with specific voltages preferred for specific thicknesses. These phantom studies, along with prior Cornish hen and Lucite phantom studies, also yielded a range of mAs for each kVp and phantom thickness that produced images within our target exposure index range. We then correlated infant bone exams by body part thickness, kVp, mAs, and exposure index, to further narrow our desired technique ranges.

Discussion

The infant osseous survey chart was first posted a month ago, and fifty infant bone images have been acquired since then. Only one of these images exceeded our target exposure index range; the previous month, eleven of 29 infant bone images exceeded our target exposure index range.

SSC14-08 Dose Reduction to the Lens of the Patient's Eye when Using Small Lead Shields over the Temporal Region of the Head and its Effect on Image Quality for Neuro Cone-Beam Computed Tomography (CBCT) Scans and Interventional Fluoroscopic Procedure

Monday, Nov. 27 11:40AM - 11:50AM Room: S503AB

Participants
Zhenyu Xiong, MS, Buffalo, NY (*Presenter*) Research support, Toshiba Medical Systems Corporation
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PURPOSE

The purpose of this study was to evaluate the effectiveness and feasibility of placing small lead shields over the thin bone in the temple region of the skull to reduce radiation dose to the lens of the eye during CBCT scans and interventional fluoroscopically-guided procedures of the head.

METHOD AND MATERIALS

EGSnrc Monte Carlo software modeled the x-ray source of a C-arm fluoroscope and was used to determine the lens dose for single x-ray projections and CBCT scans (different kVps and protocols) for the Zubal computational head phantom, which is based on a CT scan of an adult male whose eye lenses were individually segmented. The eye lens dose was calculated without and with small lead patches of different thicknesses placed over the temporal region. Also CBCT scans were taken with a clinical C-arm system on anthropomorphic head phantoms with lead patches, 0.1 mm to 0.3 mm thick, and the images were compared to assess the effect of the shields on image quality.

RESULTS

For single lateral x-ray projections, a 0.1 (0.3) mm thick lead patch reduced the dose to the left-eye lens by 40%-60% (55%-80%) from 45° to 90° RAO and to the right-eye lens around 30% (55%) from 70° to 90° RAO. For the low, middle and high frame-number CBCT protocols, the reduction of lens dose with 0.1 (0.3) mm thick lead patch is 11.3% (20.3%), 22.2% (40.7) and 27.4% (53.2%) at 110 kVp, respectively. Moreover, the reduction of lens dose with a 0.1 mm thick lead patch decreases from 26% to 21% when the tube peak voltage increases from 90 kVp to 120 kVp for the middle frame-number protocol. For the anthropomorphic phantom CBCT scans, the lead patch introduces streak artifacts that are primarily evident in the orbital region but insignificant in the brain region where most neuro-interventional activity occurs.

CONCLUSION

The use of small lead shields placed over the temple region of the head can reduce the patient's dose to the eye lens considerably without significantly compromising image quality in neuro imaging procedures.

CLINICAL RELEVANCE/APPLICATION

A simple method is presented to reduce the patient's lens dose and thus the risk of cataract induction for neuro-interventional procedures.

SSC14-09 Simulation of Microcalcifications for a Breast Phantom Made through Inkjet Printing

Monday, Nov. 27 11:50AM - 12:00PM Room: S503AB

Participants
Lynda C. Ikejimba, PhD, Silver Spring, MD (*Presenter*) Nothing to Disclose
Bahaa Ghammraoui, Silver Spring, MD (*Abstract Co-Author*) Nothing to Disclose
Stephen J. Glick, PhD, Silver Spring, MD (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

A new type of method was developed to create a breast phantom with realistic microcalcifications through inkjet printing. With a range of MC detectability, the phantom can be used for regular QC and for observer studies.

Background

Breast phantoms serve as an integral part of assessing clinical systems as part of ongoing quality control (QC) as well as for conducting reader studies. Existing breast phantoms may comprise materials with unrealistic properties, or simulate breast structure that is not fully anthropomorphic. This work presents the use of novel materials with inkjet printing to simulate the fibroglandular, adipose, and microcalcification (MC) tissues of the breast, in order to create realistic phantoms for use in QC and reader studies

Evaluation

A digital voxelized breast phantom was first generated using analytical expressions, modelled after a breast with 27% glandular density. Inkjet printing was then used to realize the phantom. To print the fibroglandular-mimicking components, pigmented ink doped with iohexol was created, and printed onto an adipose background consisting of parchment paper. To simulate the MCs, two approaches were taken. For the first, an ink was made by dissolving potassium iodide (KI) salt into a mixture with pigmented ink. For the second, disks of hydroxyapatite, the main component in certain MCs, were created from powder via mechanical press, then crushed, sieved, and placed in a stencil with regular pentagon patterns. Both effective and linear attenuation coefficients of the various materials were measured on a clinical mammography system and by using energy dispersive x-ray spectroscopy systems, respectively.

Discussion

As expected, the linear attenuation of the hydroxyapatite closely modeled that of real MCs. The effective linear attenuation of the KI ink alone was sufficiently high as well, with a single layer of ink. The signal strength can be increased by printing over the signals multiple times, or decreased by reducing the concentration of the salt. Signals of varying strength would be used to achieve different levels of MC difficulty in the phantom.

SSC16

Vascular Interventional (IO-Liver Cancer)

Monday, Nov. 27 10:30AM - 12:00PM Room: E352

GI IR VA

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

FDA Discussions may include off-label uses.

Participants
Alda L. Tam, MD, Houston, TX (*Moderator*) Medical Monitor, Galil Medical Ltd; Research Grant, AngioDynamics, Inc;
Juan C. Camacho, MD, Charleston, SC (*Moderator*) Nothing to Disclose

Sub-Events

SSC16-01 Investigation of Risk Factors for Primary Treatment Failure and Local Recurrence after Radiofrequency Ablation and Microwave Ablation for Hepatocellular Carcinoma

Monday, Nov. 27 10:30AM - 10:40AM Room: E352

Awards
Student Travel Stipend Award

Participants
Joseph McDevitt, MD , Dallas, TX (*Presenter*) Nothing to Disclose
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Murthy Chamarthy, MD, Bridgeport, CT (*Abstract Co-Author*) Nothing to Disclose
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Sanjeeva P. Kalva, MD, Dallas, TX (*Abstract Co-Author*) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Healthcare
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PURPOSE

Our study's aims were to 1) compare treatment response between radiofrequency ablation (RFA) and microwave ablation (MWA) for hepatocellular carcinoma (HCC) and 2) identify tumor characteristics associated with treatment failure and time-to-local recurrence.

METHOD AND MATERIALS

Patients with HCC treated with percutaneous RFA or MWA between January 2007 and June 2016 were reviewed. Tumor size and location, Child-Pugh score and Barcelona Clinic Liver Cancer (BCLC) stage were abstracted. Complications were characterized by SIR criteria and primary efficacy was determined using mRECIST on CT or MRI performed 4-8 weeks after ablation, with secondary efficacy determined similarly after retreatment. Predictors of treatment failure (residual disease) and time-to-recurrence were analyzed using logistic regression and Cox regression analysis, respectively. Follow-up was censored at time of repeat HCC-directed therapy, including liver transplant.

RESULTS

Local ablative therapy, including 104 RFA and 68 MWA, was performed in 145 patients with 152 unique masses. Tumor stages included 29 (19%) BCLC stage 0 and 123 (81%) BCLC A HCC. Tumor diameters were <2 cm in 82 (54%) HCC, 2-3 cm in 50 (33%), and >=3 cm in 20 (13%) cases. HCC were within 5 mm of a blood vessel in 35 (23%) cases. There were 4 (3%) major and 15 (9%) minor complications. Of 144 HCC with imaging to assess response, primary efficacy was achieved in 119 (83%) cases and secondary efficacy in 128 (89%) tumors. Tumor diameter, vascular proximity, and method of ablation (RFA or MWA) were not associated with treatment failure; however performing biopsy at time of ablation was associated with treatment failure (RR=3.2, 95% CI: 1.2-8.9, P=0.02). There were 24 (19%) local recurrences, with median time to recurrence of 25 months (95% CI=20-29 months). Treatment modality was not associated with time-to-recurrence, but HCC diameter >=3cm was associated with shorter time-to-recurrence (HR=3.9, 95% CI=1.4-10, P=0.003).(Figure)

CONCLUSION

Percutaneous RFA and MWA had similar efficacy and time to local recurrence. Performing biopsy at the time of ablation was associated with lower efficacy and tumors larger than 3 cm were associated with local recurrence.

CLINICAL RELEVANCE/APPLICATION

Performing a biopsy at the time of procedure may decrease the efficacy of local ablative therapies.

SSC16-02 Image-Guided Intratumoral Hyperthermia-Enhanced Chemo-Destruction of Radiofrequency-Ablated

Hepatic Tumor Margins

Monday, Nov. 27 10:40AM - 10:50AM Room: E352

Awards
Trainee Research Prize - Fellow

Participants
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Qiang Li, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Qiaoyou Weng, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Kun Qian, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Yiming Zhou, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Xiaoming Yang, MD, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To explore the opportunity using radiofrequency ablation (RFA)-associated peritumor hyperthermia (RFH) to specifically enhance doxorubicin (Doxo) destruction of residual tumor cells at margins of ablated hepatic tumors.

METHOD AND MATERIALS

This study included in-vitro experiments with VX2 tumor cells and in-vivo validation experiments by creating New Zealand white rabbit models of liver VX2 tumors. Both in-vitro and in-vivo experiments were divided into four groups with different treatments of (i) combination therapy of Doxo (13.9mM) plus RFH at 42? for 20min or intratumor-injected Doxo (4mg/Kg) plus RFA at 65? for 10 min; (ii) RFH-RFA alone; (iii) Doxo alone; (iv) saline. Therapeutic effect on cells was evaluated by confocal microscopy, MTS assay and apoptosis analysis (n=6 per group). In in-vivo experiments, hepatic VX2 tumors in 12 rabbits were created via a laparotomy, and the created hepatic tumors were treated by using a multipolar perfusion-thermal RFA electrode system, which could simultaneously deliver Doxo specifically to the RF ablated tumor margin zones under fluoroscopy and ultrasound guidance. Ultrasound imaging was used to follow the tumor growth over times, and imaging findings were correlated by subsequent histological confirmation.

RESULTS

Of in-vitro experiments, laboratory examinations demonstrated the lowest cell proliferation (53.47±2.01 vs 92.03±2.24 vs 76.23±3.80 vs 100%, $p<0.01$), the highest apoptotic index (21.08±3.05% vs 2.67±0.59% vs 12.1±2.34% vs 1.43±0.37%, $p<0.01$), and the decreased survival cells in combination therapy, compared with three control therapies. Of in-vivo experiments, ultrasound imaging further showed the smallest tumor size with combined therapy compared with other three groups (1.29±1.10 vs 1.69±0.05 vs 1.81±0.13 vs 2.01±0.07), which were confirmed by histological examinations.

CONCLUSION

This study indicates the possibility of using RFA-associated peritumor RFH in enhancing the effectiveness of intratumoral chemo-destruction of RFA-treated tumor margins, which may enable us to develop a new interventional oncology technique to eliminate the high recurrence incident post RFA in treating the patients with solid liver malignancies.

CLINICAL RELEVANCE/APPLICATION

Our study may be developed as an alternative to target theresidual tumor cells in the margin of RF ablated liver cancer.

SSC16-03 Early Response Assessment by Diffusion-Weighted MR Imaging versus PET/CT for Prediction of Survival of Patients Undergoing Y90-Radioembolisation of Hepatic Metastases

Monday, Nov. 27 10:50AM - 11:00AM Room: E352

Participants
Alexandra Barabasch, MD, Aachen, Germany (*Presenter*) Nothing to Disclose
Nils A. Kraemer, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexander Heinzel, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate whether evidence of early response 4-6 weeks after lobar Y90-treatment in Diffusion-weighted liver-MRI (DW-MRI) provides prognostic information, and how it compares to information provided by PET/CT or established oncological factors known to impact survival.

METHOD AND MATERIALS

IRB-approved prospective intra-individual comparative study on 36 consecutive patients (25 female) with liver metastases (20 colorectal, 14 breast, 2 other) aged 60 ± 10 years who underwent 18FDG-PET/CT and DWI-MRI before and early (4-6 weeks) after Y90-RE. Kaplan-Meier-curves and log-rank-test as well as multivariate cox-regression-analyses were used to compare patients' survival depending on response detected by DW-MRI vs. PET/CT, and depending on established variables such as pre-treatment ECOG-performance-status (0 vs. 1), hepatic tumor-load (<25% vs. >=25%), or presence vs. absence of extra-hepatic disease.

RESULTS

35 patients were followed until their death, one is alive 125 weeks after treatment. Median survival was 36 weeks. Response was observed by PET/CT in 18/36 patients (50%). Median survival in PET-responders vs. non-responders was 39 vs. 27 weeks (p= 0.60). Response was observed by DW-MRI in 24/36 patients (67%). Median survival in DWI-responders vs. non-responders was 53 weeks vs. 20 weeks (p = 0.01). At multivariate analysis, response based on DWI was the only independent prognosticator of survival (p < 0.01). ECOG-performance-status, hepatic tumor-load, and presence of extrahepatic metastases did not correlate with survival.

CONCLUSION

In patients with hepatic metastases undergoing Y90-RE, early response detected by DW-MRI provides prognostic information that goes beyond what is obtainable from common clinical criteria, and that is superior to PET/CT.

CLINICAL RELEVANCE/APPLICATION

Response assessment for patients undergoing RE should preferably be done by DW-MRI.

SSC16-05 Combined Therapy of TACE and RFA vs Surgical Resection for Single 2 to 3 Cm HCC: A Propensity Score Matching Analysis

Monday, Nov. 27 11:10AM - 11:20AM Room: E352

Participants
Hyo-Jae Lee, Gwang Ju, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jin Woong Kim, MD, Jeollanamdo, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Young Hoe Hur, Jeollanam-Do, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seul Gi Choi, Gwangju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Hee Heo, MD, Hwasun-Gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyo Soon Lim, MD, Jeollanam-Do, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang Soo Shin, MD, Gwangju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yong-Yeon Jeong, MD, Chonnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare therapeutic outcomes between radiofrequency ablation (RFA) combined with transcatheter arterial chemoembolization (TACE) and surgical resection (SR) for treatment of HCC ranging from 2 to 3 cm in size which is coming under Barcelona Clinic Liver Cancer class A disease.

METHOD AND MATERIALS

From January 2009 to March 2016, 70 patients (47 men, 40-90 years) underwent combined therapy of TACE and RFA and 84 patients (69 men, 36-81 years) underwent SR. The average tumor size was 2.6 cm ± 3.4, ranging from 2 to 3 cm. Local tumor progression (LTP), intrahepatic distant recurrence (IDR), disease-free survival (DFS), and overall survival (OS) rates were compared between two groups before and after applying propensity score matching. Major complications and length of hospital stay were compared.

RESULTS

During follow-up, LTP had developed in 9 of 70 (12.9%) patients in combined group and in 7 of 84 of (8.3%) in SR group (P = .262). IDR was identified in 24 of 70 (34.3%) in combined group and in 24 of 84 (28.6%) in SR group (P = .252). 1-, 3-, 4-, and 5-year DFS rates were similar between two groups (82.6%, 53.2%, 53.2%, and 37.6%, respectively vs. 84.5%, 63.6%, 59.2%, and 52.1%, respectively; P = .278), and 1-, 3-, 4-, and 5-year OS rates were also similar (94.2%, 81.2%, 74.1%, and 59.4%, respectively vs. 95.2%, 86.3%, 84.0%, and 80.3%, respectively; P = .081). After propensity score matching (n = 98), LTP, IDR, DFS, and OS rates still showed no significant differences between two groups (P = .725, P = .826, P = .484, and P = .578, respectively). The major complication rate was not significantly different between two groups (P = .596). The length of hospital stay was significantly longer in SR group (P = <.001).

CONCLUSION

Before and after propensity score matching, there were no significant differences in long-term therapeutic outcomes between combined and SR groups. In addition, combined therapy of TACE and RFA is relatively safer rather than SR. Therefore, combined therapy of TACE and RFA may be used in lieu of SR for single 2-3 cm HCC with potentially similar outcomes.

CLINICAL RELEVANCE/APPLICATION

In clinical practice, combined therapy of TACE and RFA maybe preferred over SR for treatment of 2 to 3 cm HCC for several reasons, such as limited liver function or concern for surgical complications. However, there are few evidence of therapeutic outcomes for single 2 to 3 cm HCC solely between combined therapy group and SR group.

SSC16-06 Combined Treatment, TACE and Microwave Ablation in Patients with HCC

Monday, Nov. 27 11:20AM - 11:30AM Room: E352

Awards
Student Travel Stipend Award

Participants
Mohamed M. Zaitoun, MBChB , Zagazig, Egypt (*Presenter*) Nothing to Disclose
Saeed B. Elsayed, MD, Zagazig, Egypt (*Abstract Co-Author*) Nothing to Disclose
Sameh Saber, Zagazig, Egypt (*Abstract Co-Author*) Nothing to Disclose
Farouk Hassan, MD,PhD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ahmed Altaher A. Farag, PhD, Nasr City, Egypt (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare the feasibility and benefit of combined therapy (TACE+MW ablation) versus TACE or microwave ablation alone in the treatment of HCC larger than 3 cm and smaller than 5 cm

METHOD AND MATERIALS

During 3 years, 150 consecutive patients with HCC larger than 3 cm and smaller than 5 cm were divided into 3 groups, group (1) 50 HCC patients underwent TACE, group (2) 50 HCC patients underwent MW ablation and group (3) 50 HCC patients received combined therapy with TACE followed by MW ablation after 1 month. Mean age was 57 years, 94 (62.7%) were males. Follow up with Triphasic CT was performed after 1 month then every 3 months for 1 year.

RESULTS

After 1 month, complete response was detected in 27 cases (54%) in group (1), 22 cases (44%) in group (2) and 50 cases (100%) in group (3) ,partial response in 8 cases (16%) in group (1), 5 cases (10%) in group (2) and progressive disease in 15 cases (30%) in group (1) and 23 cases (46%) in group 2. Recurrence rate after 1 year was 38 cases (72%) in group (1), 40 cases (80%) in group 2 and 9 cases (18%) in group 3. Disease free survival rate at 12 months was 12 cases (24%) in group 1, 10 cases (20%) in group 2 and 41 cases (82%) in group 3.

CONCLUSION

Combined therapy (TACE+MW ablation) in HCC larger than 3 cm and smaller than 5 cm is better than TACE or RF ablation alone concerning the recurrence rate and disease free survival rate.

CLINICAL RELEVANCE/APPLICATION

(dealing with combined treamtment of HCC) 'TACE with microwave ablation is better than each modality alone in the treatment of HCC.'

SSC16-07 Stratification and Prognosis for Advanced-Stage Hepatocellular Carcinoma Treated with TACE Monotherapy or TACE Plus Sorafenib

Monday, Nov. 27 11:30AM - 11:40AM Room: E352

Participants
Binyan Zhong, MD, PhD, Nanjing, China (*Presenter*) Nothing to Disclose
Caifang Ni, MD, PhD, Suzhou, China (*Abstract Co-Author*) Nothing to Disclose
Gao-Jun Teng, MD, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

We aim to compare the efficacies between transarterial chemoembolization (TACE) monotherapy and TACE plus sorafenib in patients with advanced-stage hepatocellular carcinoma (HCC) as well as to establish a prognostic prediction model to determine who will benefit from the TACE monotherapy.

METHOD AND MATERIALS

This multicentric retrospective study included 169 (115 in training cohort and 54 in validation cohort) patients with advanced-stage HCC (Barcelona Clinic Liver Cancer stage C) between January 2010 and December 2014. In training cohort, 77 (67.0%) underwent TACE monotherapy (TACE group), and the remaining 38 (33.0%) patients received TACE plus sorafenib (combination group). Among them, in TACE group, independent risk factors associated with prognosis were identified by univariate and multivariate analyses and a prognostic prediction model was established to find out who will benefit from TACE monotherapy. Also, a prognostic nomogram for patients in TACE group was created.

RESULTS

In training group, the median overall survival (OS) of the patients in TACE group was significantly shorter than those in combination group (7.7 months vs. 13.9 months; P <0.001). In TACE group, portal vein tumor thrombus (PVTT), number of HCC nodules, and Child-Pugh (CP) stage were independent risk factors correlated with OS. The prognostic prediction (PP) model, PP score = PVTT (0 if no, 5 if branch invasion, 6 if main invasion) + number of nodules (0 if 1, 4 if 2-3, 5.5 if >3) + CP stage (0 if A, 4 if B). Patients with PP score <5.25 had a significant longer OS than those with PP score >5.25 (13.9 months vs. 6.5 months; P <0.001). Also, a prognostic nomogram for these patients was created. Both of the two prediction model received a high accuracy when validated in validation cohort, with the concordance index of 0.858.

CONCLUSION

Advanced-stage HCC patients with PP score <5.25 may benefit most from the TACE monotherapy.

CLINICAL RELEVANCE/APPLICATION

Patients with advanced-stage HCC and with PP score <5.25 may benefit most from the TACE monotherapy instead of TACE combined with sorafenib, which might avoid sorafenib-related adverse events and high cost of sorafenib.

SSC16-08 Clinical Results of a Phase I First in Man Study of Targeted Delivery of Lyso-thermosensitive Liposomal Doxorubicin by Extracorporeal Focused-Ultrasound Hyperthermia for Liver Tumours

Monday, Nov. 27 11:40AM - 11:50AM Room: E352

Participants

Paul C. Lyon, BMBS,DPhil, Oxford, United Kingdom (*Presenter*) Nothing to Disclose
Michael Gray, PhD,BSC, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Christophoros Mannaris, PhD,BSC, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Robert Goldin, PhD,BMBS, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Robert Carlisle, PhD,BSC, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Feng Wu, MD, PhD, Congqing, China (*Abstract Co-Author*) Nothing to Disclose
Mark Middleton, PhD, BmBch, Headington, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Fergus V. Gleeson, MBBS, Oxford, United Kingdom (*Abstract Co-Author*) Consultant, Alliance Medical Limited Consultant, Blue Earth Diagnostics Limited Consultant, Polarean, Inc
Constantin Coussios, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the safety, feasibility and efficacy of targeted delivery of a lyso-thermosensitive liposomal drug in combination with localised non-ablative hyperthermia delivered non-invasively by extracorporeal focused-ultrasound (FUS).

METHOD AND MATERIALS

Patients with primary or secondary liver tumours unsuitable for curative or radical treatment but amenable to potential ultrasound-guided intervention were assessed for eligibility. A single treatment cycle of Lyso-Thermosensitive Liposomal Doxorubicin (ThermoDox®) was combined with FUS to target a single liver tumour using an ultrasound-guided extracorporeal FUS device (Model JC200, Haifu Medical).Treatments were performed under general anaesthetic. Under ultrasound-guidance a co-axial needle was placed into the target tumour to enable interchange of thermometry device and biopsy needle, utilised for measurement of tumour temperature and tissue sampling. FUS parameters (power, duty cycle, transducer motion) were optimised during treatment to achieve bulk intratumoral hyperthermia (40-44°C).Core biopsies were taken for analysis of total intratumoral doxorubicin concentration by HPLC and drug distribution by fluorescence microscopy. Patients received clinical and radiological follow-up at 2 and 4 weeks.

RESULTS

Ten patients were treated and prolonged hyperthermia was achieved in 5/6 having thermometry. Currently, the measured mean intratumoral doxorubicin post-FUS is 7.58 µg/g (±2.70) (n=4), compared to 2.48 µg/g (±1.26) (n=4) pre-FUS. 6/6 tumours have demonstrated nuclear intercalation of doxorubicin post-FUS, indicating release. PET demonstrated some unequivocal localised response in 5/9 at 2 weeks, despite only a single cycle of ThermoDox® at the standard doxorubicin dose.

CONCLUSION

The combination of lyso-thermosensitive drug delivery systems in combination with non-invasive targeted release by FUS is clinically feasible, safe and can enhance intratumoral drug delivery, leading to targeted and localised PET response, relative to control tumours receiving drug alone.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates safety, feasibility and efficacy of the non-invasive, non-ionising and highly targeted drug delivery method that FUS offers and highlights the potential to exploit this therapy for improved therapeutic outcomes in a broad range of primary and metastatic solid tumours throughout the body, across multiple drug classes.

SSC16-09 Prediction of Post TACE Necrosis of HCC Using Volumetric Enhancement on MR Imaging and Oil Deposition on CT, With Imaging and Pathologic Correlation

Monday, Nov. 27 11:50AM - 12:00PM Room: E352

Participants
Farnaz Najmi Varzaneh, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Ankur Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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Nanna Shao, MBBS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pegah Khoshpouri, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pallavi Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Manijeh Zarghampour, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Daniel Fadaei Fouladi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Robert P. Liddell, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Robert Anders, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG
Angie Jacob, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate whether volumetric enhancement on baseline MR imaging and oil deposition on unenhanced CT would predict hepatocellular carcinoma (HCC) necrosis and response post conventional TACE (cTACE).

METHOD AND MATERIALS

This HIPPA compliant retrospective study was approved by our institutional review board. The study population included 115 HCC patients (173 lesions) who underwent cTACE with MRI within 3 months before and after cTACE between 2001 and 2015. A subset of 53 HCC patients underwent liver transplant and were defined as LT group. Semiautomatic volumetric segmentation of target lesions was performed at baseline MR, and unenhanced CT post cTACE to assess the accuracy of predicting tumor necrosis after cTACE in the whole cohort and at pathology in the LT group. Predicted volumetric tumor necrosis was calculated as 100% - (%

enhancement on baseline MRI- % oil deposition on CT). Volumetric necrosis on follow up MRI was calculated as (100% - % enhancement in MRI follow-up). Correlation between predicted tumor necrosis and post cTACE volumetric necrosis on follow up MRI in the whole cohort and to percentage necrosis at pathology in the LT group was performed. P value <0.05 was considered significant.

RESULTS

Mean predicted tumor necrosis by combination imaging modalities was 61.5 %±31.6% (range, 0-100%) whereas mean percent tumor necrosis on follow-up MRI was 63.8%±31.5% (range, 0-100%). In the LT group, mean predicted tumor necrosis by combination imaging modalities was 77.6%±27.2% (range, 0-100%) whereas mean percent necrosis at pathology was 78.7%±31.5% (range, 0-100%). There was a strong significant correlation between predicted tumor necrosis and volumetric necrosis on MRI follow-up ($r= 0.889$, $p < 0.001$) and a strong significant correlation between predicted tumor necrosis and pathologic percentage necrosis ($r = 0.871$, $p < 0.001$).

CONCLUSION

Volumetric pre cTACE enhancement in MRI and post cTACE oil deposition in CT may accurately predict necrosis in treated HCC lesions.

CLINICAL RELEVANCE/APPLICATION

This method could potentially be utilized to accurately assess treatment response in HCC patients immediately following cTACE which can be confirmed by follow-up MRI.

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 Educator

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RCA23

PowerPoint Tips and Tricks (Hands-on)

Monday, Nov. 27 12:30PM - 2:00PM Room: S401AB

IN

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

Participants
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC
Sarah C. Abate, BS, Ann Arbor, MI (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review the components of an optimal slide presentation. 2) Learn about common errors made in slide preparation and how they can be avoided. 3) Review features to enhance live presentations. 4) Learn tips to ensure a smooth presentation.

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RCB23

Hands-on Introduction to Social Media: Intermediate (Hands-on)

Monday, Nov. 27 12:30PM - 2:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Amy L. Kotsenas, MD, Rochester, MN (*Moderator*) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Saad Ranginwala, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Tirath Y. Patel, MD, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Use a variety of social media venues to share images for educational purposes. 2) Understand the difference between and utility of professionally oriented social networking sites such as Docimity and LinkedIn. 3) Learn how to safely/securely communicate via social media while maintaining HIPAA requirements.

URL

http://bit.ly/RSNASocialMediaIntro

RCC23

3D Printing Clinical I

Monday, Nov. 27 12:30PM - 2:00PM Room: S501ABC

IN

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

Participants
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Moderator*) Nothing to Disclose

Sub-Events

RCC23A Creating a 3D Printing Lab in Radiology

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

LEARNING OBJECTIVES

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

RCC23B Clinical Science Applications that Leverage the Use of 3D Printing

Participants
Justin R. Ryan, PhD, Phoenix, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand key terminology and key equipment to develop casting processes from 3D printed models. 2) Understand the basic molding and casting process. 3) Understand and be able to develop casted models from 3D printing geometry for a multitude of applications.

RCC23C 3D Printing Workflow

Participants
Carlos H. Torres, MD,FRCPC, Ottawa, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Describe a 3D Printing service. 2) Review the options for 3D Printing based on medical images.

Honored Educators

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RCC23D 3D-Printing Enabling Anatomically-Accurate Phantoms and Simulators with Targeted Radiological Properties

Participants
Albert Shih, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand methods to convert medical images to mathematical representations of the surface and solid shape of targeted region (or organ). 2) Know the principle and pros and cons of different 3D-printing methods and select the best method for the specific applications to mold or fabricate the phantom with anatomically-accurate shape. 3) Develop the knowledge of various phantom materials and their radiological properties. 4) Match the fabrication methods in conjunction with 3D-printing to manufacture the simulator for training and practice.

URL

https://drive.google.com/drive/folders/1t13B_JpJvhFdzj3JQ04K34QyIXLCmphK?usp=sharing

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MSAS23

Emerging Imaging Trends in MRI Fusion Techniques (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Monday, Nov. 27 1:30PM - 3:00PM Room: S105AB

MR NM

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

FDA Discussions may include off-label uses.

Participants
Kendra Huber, RT, BS, Castle Rock, CO (*Moderator*) Nothing to Disclose
Kristen Welch, RT, New Berlin, WI (*Moderator*) Nothing to Disclose

Sub-Events

MSAS23A PET/MRI Applications and Challenges

Participants
Behrang Amini, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the technical challenges of PET/MRI. 2) Understand the similarities and differences between applications of PET/CT and PET/MR. 3) Be in a position to apply the knowledge to the creation of clinically useful images.

Active Handout:Behrang Amini

http://abstract.rsna.org/uploads/2017/17000221/Active MSAS23A.pdf

MSAS23B MR Image-Guided Adaptive Radiation Therapy

Participants
Geoffrey S. Ibbott, PhD, Houston, TX (*Presenter*) Investigator, Elekta AB; Travel support, Elekta AB

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LEARNING OBJECTIVES

1) Learn about new research into MR-guided radiation therapy and the potential applications for clinical practice. 2) Understand the technological developments necessary to combine a linear accelerator with a 1.5T magnetic field. 3) Assess the benefits of MR-guidance during adaptive treatment of tumors in specific clinical sites. 4) View examples of MR images taken during radiation delivery and dose distributions delivered in the presence of a strong magnetic field. 5) Understand the issues associated with commissioning, dosimetry, and quality assurance of MR-guided treatment machines, and techniques for addressing those issues.

ABSTRACT

The introduction of image guidance in radiation therapy has revolutionized the delivery of treatments. Modern imaging systems can supplement or even replace the historical practice of relying on external landmarks and laser alignment systems. While common kilovoltage imaging modalities provide excellent bony anatomy image quality, magnetic resonance imaging (MRI) surpasses them in soft tissue image contrast for better visualization and tracking of soft tissue tumors with no additional radiation dose to the patient. However, the introduction of MRI into a radiotherapy facility carries with it a number of complications including the influence of the magnetic field on the dose deposition, as well as the affects it can have on dosimetry systems. The development and introduction of MR-guided radiotherapy equipment will be reviewed and the benefits and disadvantages of representative technologies will be described. Clinical examples of the capabilities of MR image guidance will be discussed. The workflow of daily MR-guided adaptive treatment will be described, as well as potential benefits to patient care. Representative treatment plans will be shown, demonstrating ways in which the effects of the magnetic field can be ameliorated. The characteristics of quality assurance and dosimetry equipment that can enhance or minimize the effects of the magnetic field will be explained.

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MSCT21

Case-based Review of Thoracic Radiology (An Interactive Session)

Monday, Nov. 27 1:30PM - 3:00PM Room: S100AB

CH

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

Participants
Diana Litmanovich, MD, Haifa, Israel (*Director*) Nothing to Disclose

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Sub-Events

MSCT21A Thoracic Manifestations of Pediatric Systemic Disorders

Participants
Edward Y. Lee, MD, MPH, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Discuss clinical presentation of children with thoracic manifestations of systemic disorders. 2) Learn current imaging techniques for evaluating children with systemic disorders. 3) Review characteristic thoracic imaging findings of children with systemic disorders.

ABSTRACT

This will be an interactive session with case presentations of thoracic manifestations of pediatric systemic disorders. The cases will be presented as unkowns with audience response. Examples of important pediaric systemic disorders which have thoracic manifestations will be included.

MSCT21B Diffuse Lung Disorders

Participants
Diane C. Strollo, MD, Gibsonia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Provide an overview of diffuse lung disorders in adults, to include idiopathic, rheumatologic, smoking and inhalational, eosinophilic and miscellaneous etiologies. 2) Recognize pertinent findings on chest radiography. 3) Review thin section lung anatomy on CT and the characteristic imaging features of common and unique diffuse lung diseases. 4) Incorporate relevant clinical data to help focus the differential diagnosis. 5) Suggest when to consider biopsy or other interventions in confounding cases.

ABSTRACT

This will be an interactive session with case presentations of diffuse lung diseases in adults. Cases will be presented as unknowns with audience response. Examples of common and characteristic diffuse lung diseases will be included.

MSCT21C Infectious Disorders

Participants
Thomas E. Hartman, MD, Rochester, MN (*Presenter*) Author, Cambridge University Press

LEARNING OBJECTIVES

1) Discuss the findings of infection in immunocompetent hosts and use those to arrive at a diagnosis or focused differential. 2) Discuss the findings of infection in immunocompromised hosts and use those to arrive at a diagnosis or focused differential. 3) Describe various presentations of atypical mycobacterial disease in the lungs.

ABSTRACT

This will be an interactive session with case presentation of thoracic infections. Cases will be presented as unknowns with audience response. Examples of common and uncommon thoracic infections will be included.

MSCT21D Non-vascular Mediastinal Disorders

Participants
Theresa C. McLoud, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mcloud.theresa@mgh.harvard.edu

LEARNING OBJECTIVES

1) Understand the important anatomical components of the mediastinum. 2) Identify and localize mediastinal abnormalities on standard radiography and CT. 3) Develop and prioritize differential diagnoses of non vascular mediastinal masses and other lesions. 4) Learn the accepted management guidelines. 5) Understand the role of MRI in the diagnosis of mediastinal masses and other abnormalities.

ABSTRACT

This will be an interactive session with case presentations of mediastinal lesions. The cases will be presented as unkowns with audience response. Examples of common and unusual non vascular lesions will be included.

MSMC23

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

Monday, Nov. 27 1:30PM - 3:00PM Room: S406A

CA CH 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
Elliot K. Fishman, MD, Baltimore, MD (*Moderator*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics Inc;
U. Joseph Schoepf, MD, Charleston, SC (*Moderator*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ; ;

For information about this presentation, contact:

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schoepf@musc.edu

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 ; Research Grant, Heartflow, LLC; ;

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;

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

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

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Elliot K. Fishman, MD - 2012 Honored EducatorElliot K. Fishman, MD - 2014 Honored EducatorElliot K. Fishman, MD - 2016 Honored Educator

MSMI23

Molecular Imaging Symposium: Neurologic MI Applications

Monday, Nov. 27 1:30PM - 3:00PM Room: S405AB

NR MI

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

Participants
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Moderator*) Research Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;
Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group

Sub-Events

MSMI23A Overview of MI in Neurology

Participants
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Presenter*) Research Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

LEARNING OBJECTIVES

1) Learn recent development of molecular imaging in the field of neurosciences. 2) Understand technologies used in molecular brain imaging. 3) Discuss opportunities and challenges in molecular brain imaging.

MSMI23B MI in Dementia

Participants
Alexander Drzezga, MD, Cologne, Germany (*Presenter*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group

LEARNING OBJECTIVES

1) Gain overview on types of molecular neuropathology involved in the development of different forms of dementia and understand currently discussed disease concepts. 2) Learn about the currently available methods for imaging molecular pathology such as amyloid-deposition and tau-aggregation in dementia and their current status of validation. 3) Gain insights on the clinical value of the individual available methods and their combination with regard to earlier detection, more reliable diagnosis and therapy monitoring of disease.

MSMI23C MI in Movement Disorders

Participants
Kirk A. Frey, MD, PhD, Ann Arbor, MI (*Presenter*) Consultant, MIM Software Inc Consultant, Eli Lilly and Company Stockholder, General Electric Company Stockholder, Johnson & Johnson Stockholder, Novo Nordisk AS Stockholder, Bristol-Myers Squibb Company Stockholder, Merck & Co, Inc

MSMI23D Clinical Translation in Molecular Brain Imaging

Participants
Peter Herscovitch, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the U.S. FDA approval process for new radiopharmaceuticals for molecular brain imaging. 2) Understand the U.S., Medicare approval process for new radiopharmaceuticals for molecular brain imaging. 3) Become familiar with the features of the IDEAS Study: Imaging Dementia-Evidence for Amyloid Scanning Study. 4) Understand the evolving requirements for demonstrating the value of diagnostic imaging.

ABSTRACT

The final steps in clinical translation of molecular imaging radiopharmaceuticals for brain studies are approval by the U.S. Food and Drug Administration (FDA) for marketing and by insurance carriers for reimbursement. Given the age of patients most likely to require brain imaging studies for neurodegenerative disorders, coverage approval by the U.S. Centers for Medicare and Medicaid ('Medicare') is crucial. This talk will discuss the FDA requirements for approval of a radiopharmaceutical, with a focus on amyloid brain imaging. It should be noted that FDA approval does not necessarily lead to Medicare approval, especially for PET agents. The CMS approval process will be outlined, including the increasing need to demonstrate the ability of PET imaging to provide improved health outcomes. CMS coverage with evidence development (CED) of PET amyloid imaging agents will be described, with a focus on the design and implementation of the Imaging Dementia-Evidence for Amyloid Scanning (IDEAS) Study.

MSMI23E Brain MI: Case Review

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the FDA approval process for diagnostic radiopharmaceuticals Describe the current status of CMS coverage for diagnostic radiopharmaceuticals. 2) Describe the current status of CMS coverage for amyloid PET radiopharmaceuticals and coverage with evidence development (CED). 3) Understand the design and implementation of the Imaging Dementia—Evidence for Amyloid Scanning (IDEAS) Study.

ABSTRACT

The final steps in clinical translation of molecular imaging radiopharmaceuticals for neurological studies are approval by the U.S. Food and Drug Administration (FDA) for marketing and by insurance carriers for reimbursement. Given the age of patients most likely to require brain imaging studies for neurodegenerative disorders, coverage approval by the U.S. Centers for Medicare and Medicaid ("Medicare") is crucial. This talk will discuss the steps required that lead to FDA approval of a radiopharmaceutical, including the IND process and Phase 1, 2, and 3 clinical trials. It should be noted that FDA approval does not necessarily lead to Medicare approval, especially for PET agents. The CMS approval process will be outlined, including the increasing need to demonstrate the ability of PET imaging to provide improved health outcomes. CMS coverage with evidence development (CED) of PET amyloid imaging agents will be described, with a focus on the design and implementation of the Imaging Dementia—Evidence for Amyloid Scanning (IDEAS) Study.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

MSRO23

BOOST: CNS-Science Session with Keynote

Monday, Nov. 27 1:30PM - 2:30PM Room: S103AB

NR RO OI

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

Participants
Jun Deng, PhD, New Haven, CT (*Moderator*) Nothing to Disclose
Hui-Kuo G. Shu, MD, PhD, Atlanta, GA (*Moderator*) Speakers Bureau, Varian Medical Systems, Inc; Stockholder, General Electric Company; Stockholder, Medtronics plc; Stockholder, Mylan NV ; Stockholder, Apple Inc; Stockholder, ICON plc

Sub-Events

MSRO23-01 Invited Speaker:

Monday, Nov. 27 1:30PM - 1:40PM Room: S103AB

Participants
Hui-Kuo G. Shu, MD, PhD, Atlanta, GA (*Presenter*) Speakers Bureau, Varian Medical Systems, Inc; Stockholder, General Electric Company; Stockholder, Medtronics plc; Stockholder, Mylan NV ; Stockholder, Apple Inc; Stockholder, ICON plc

MSRO23-02 Patient Outcomes after Reirradiation of Small Skull Base Tumors Using Stereotactic Body Radiotherapy (SBRT), Intensity Modulated Radiotherapy (IMRT) or Proton Therapy (PRT)

Monday, Nov. 27 1:40PM - 1:50PM Room: S103AB

Awards
Trainee Research Prize - Fellow

Participants
Sweet Ping Ng, MBBS, Houston, TX (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The aim of this study is to generate preliminary data for our upcoming institutional phase 2 randomized clinical trial comparing stereotactic body radiation therapy (SBRT) and intensity modulated radiation therapy (IMRT)/proton beam radiotherapy (PRT) for recurrent small skull base tumors.Materials/Methods: Patients who received conformal reirradiation for recurrent small skull base tumors (Results: Of the 53 patients who met the inclusion criteria, 17 (32.1%) received SBRT, 17 (32.1%) received IMRT and 19 (35.9%) received PRT. Fifty (94.3%) patients had an ECOG performance status of 0-1, and 29 (54.7%) had a squamous cell carcinoma histology. The median initial radiation dose was 60 Gy (range: 30 – 74) and median retreatment volume was 25.5 cc (range 2.9 – 59.7 cc). The median reirradiation dose was 66 Gy (range: 50 – 70 Gy) at 2 Gy/Fx daily for IMRT/PRT and 45 Gy (range: 35 – 47.5 Gy) in 5 fractions every other day for SBRT. Thirty eight (71.7%) patients received concurrent chemotherapy with reirradiation. The median time to reirradiation was 30 months (range: 3 – 246 months). With a median follow up of 20 months (range: 3 – 153 months), the LRC, PFS and OS rates were 80.2%, 64.9%, and 88%, respectively at 1 year, and 73.4%, 55.6%, 73.5% respectively at 2 years. Six patients developed Grade 3 late toxicity. One (5.6%) patient received SBRT, 2 (11.2%) received IMRT and 3 (15.8%) received PRT. There were no Grade 4 or 5 toxicities. The 1- and 2-year late Grade 3 toxicity rates were both 6.9%. The median time to develop Grade 3 toxicity was 25.5 months. SBRT and PRT were associated with improved LRC (HR 9.5, 95% CI = 1.55 – 184.66, P=0.01; HR 8.3, 95% CI = 1.51 – 153.29,P= 0.01) compared to IMRT. There was no significant difference in PFS or OS between radiation modalities. There was no difference in ECOG status or histology by radiation modality. Retreatment volume did not significantly correlate with late toxicity rates.Conclusion: Reirradiation of small skull base tumors utilizing IMRT, PRT or SBRT demonstrated good tumor control and low rates of Grade 3 toxicity. A prospective clinical trial and longer follow-up is needed to better assess clinical outcomes and toxicity rates.

MSRO23-03 Stereotactic Radiosurgery (GK-SRS) For the Treatment of Brain Metastasis from Gastrointestinal (GI) Primary

Monday, Nov. 27 1:50PM - 2:00PM Room: S103AB

Participants
Nitika Paudel, MD, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
Thomas Kim, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Rajal Patel, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Liam Kane, BS, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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ABSTRACT

Purpose/Objective(s): The incidence of brain metastasis in patients with tumors of GI tract is on the rise owing to advancement in imaging and prolonged survival due to improvement in surgical methods, radiotherapy, and systemic chemotherapy. We aimed to

determine the efficacy of GK-SRS to control intracranial metastases from GI primaries and report on the patient outcomes. Materials/Methods: We retrospectively evaluated patients who had undergone GK-SRS at our institution for the treatment of brain metastasis from GI primaries from 2000 to 2016. Actuarial rates for overall survival (OS) and local control (LC) were calculated. The relationship between the various patient characteristics, the clinical, radiographic and treatment outcomes to the rates of local control and overall survival was determined using log-rank analysis.Results: 52 patients met the inclusion criteria with total of 142 intra cranial (IC) lesions. Median age at GK-SRS was 59 years (range 21-84). GI primary sites included colon (28), esophagus (12), rectum (5), liver (3), pancreas (2), bile duct (1) and gallbladder (1). The median treatment dose was 18 Gy (range10-20).The median time from initial diagnosis to detection of CNS metastases was 19 months (range 0-188). The median Karnofsky Performance Status (KPS) at the time of IC disease diagnosis was 90 (range 70-100). CNS was the only site of metastases in 17 patients (32.6%). Thirty-six lesions (66.6%) were surgically resected and GK-SRS was given as an adjuvant treatment. A median of 2 lesions were treated with GK-SRS (range 1-13). Six patients were treated with whole/partial brain radiation prior to receiving GK-SRS. Eleven patients underwent second course of GK-SRS for new/recurrent lesions at a median of 7 months from the first GK-SRS (range 2-25) and three of the patients underwent third course of GK-SRS.At the last MRI, 20 (37%) patients had new or progressive intracranial disease. Eleven patients (21.2%) subsequently received salvage whole brain radiation therapy to a median dose of 30 Gy (range 18-35) and the median time from GK-SRS to salvage WBRT was 4.6 months (range 1.6 – 14.9).The median follow up time from the diagnosis of IC disease was 28.3 months (range 4 to 195). Twenty-eight patients (53.8%) had no further CNS progression on their last brain MRI. Local recurrence rate at 6 months was 26.2% (95% CI, 18-38%) and 37.3% (95%CI, 26-51%) at 12 months. Median survival was 8.6 months from the time of IC disease diagnosis. In log-rank analysis, diagnosis of more than two lesions was the only significant factor for survival after IC disease diagnosis. The overall survival at 1 year was 86.6% (95% CI, 74-93%) and 19.9% (95% CI, 10.3-31.8%) at 5 years. Conclusion: GK-SRS is an effective treatment modality for the treatment of CNS metastases from GI primary. More than 2 brain metastasis at the time of initial diagnosis was found to be a significant factor to influence survival. The majority of patients were able to avoid WBRT, and long-term survivors were seen.

MSRO23-04 Limitations of MR Perfusion for Predicting Tumor Progression after Radiosurgery for Brain Metastases

Monday, Nov. 27 2:00PM - 2:10PM Room: S103AB

Participants
Karna Sura, MD, Royal Oak, MI (*Presenter*) Nothing to Disclose
Elena Olariu, PHD, Royal Oak, MI (*Abstract Co-Author*) Nothing to Disclose
Inga Grills, MD, Royal Oak, MI (*Abstract Co-Author*) Nothing to Disclose
Kurt E. Tech, MD, Grosse Pointe, MI (*Abstract Co-Author*) Nothing to Disclose
Anant Krishnan, MD, Royal Oak, MI (*Abstract Co-Author*) Nothing to Disclose
Ay-Ming Wang, MD, Bloomfield Hills, MI (*Abstract Co-Author*) Nothing to Disclose
Prakash Chinnaiyan, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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ABSTRACT

Purpose/Objective(s): To correlate pre-operative magnetic resonance (MR) perfusion with post-operative pathology for primary and metastatic brain tumors.Materials/Methods: 135 patients with a diagnosis of a malignant brain tumor underwent at least one MR perfusion study using dynamic susceptibility contrast technique between January 2013 and October 2016. MR perfusion was requested at physician discretion when conventional MR imaging demonstrated either persistent or progressive enhancement at the site of treatment. 32 patients underwent subsequent surgical resection with pathological confirmation and are subjects of this analysis. 10 brain metastases (31%) and 7 glioblastoma (22%) were the majority of the patient population. 1/10 brain metastasis patient had MR perfusion which was non-analyzable and was excluded. Correlation was made between the pre-operative MR perfusion study and the final surgical pathology. Each MR perfusion scan was independently reviewed by two radiologists. Incongruent findings between the pre-operative MR perfusion diagnosis and post-operative pathology were considered discordant.Results: The median time between MR perfusion to surgery was 24 days (range: 1-502). 3/32 patients had discordant pathology with all of the discordant pathology associated with treated brain metastases. 3/9 (33%) patients with brain metastases had discordant pathology with the MR perfusion (Table 1). For brain metastases, MR perfusion had a sensitivity of 57%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 40%. All of the discordant pathology had prior treatment with stereotactic radiosurgery. For GBM cases, the MR perfusion and surgical pathology had 100% concordance; however, the sample is limited in that all patients analyzed had a tumor with no cases of necrosis alone.Conclusion: MR perfusion following radiosurgery with brain metastases may have limited utility for predicting tumor progression versus radiation necrosis demonstrated by the 33% discordance rate based on pathology in this analysis. Prospective studies are necessary to determine the utility of MR perfusion for all CNS lesions, especially previously treated brain metastasis. Pathology TumorRadiation NecrosisMRI perfusionTumor404Radiation Necrosis325Total729Table 1: Correlation of pathology and MRI perfusion results in brain metastases

MSRO23-05 Adjuvant Radiation Therapy in Grade II Ependymomas: A Review of the National Cancer Database

Monday, Nov. 27 2:10PM - 2:20PM Room: S103AB

Participants
Jessika A. Contreras, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Pamela Samson, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Stephanie M. Perkins, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Cliff G. Robinson, MD, Saint Louis, MO (*Abstract Co-Author*) Investigator, Varian Medical Systems, Inc Research funded, Varian Medical Systems, Inc Speakers Bureau, Varian Medical Systems, Inc Research funded, Elekta AB Travel support, DFINE, Inc Speakers Bureau, ViewRay, Inc Stockholder, Radialogica, LLC
Jiayi Huang, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The role of adjuvant radiation therapy (RT) in patients with World Health Organization (WHO) grade II ependymomas after surgery remains controversial. The purpose of this study was to investigate the patterns of care of adjuvant RT for WHO grade II ependymoma and its impact on overall survival (OS) using the National Cancer Data Base (NCDB). Materials/Methods: In this study we identified 919 patients in the NCDB with a diagnosis of a WHO grade II ependymoma

treated between 2004 and 2012. Patients with metastatic disease, those who died or lost to follow-up within 2 months of surgery (to account for immortal-time bias), and those who received chemotherapy were excluded from analysis. Patients were stratified by the use of radiation therapy (RT) after surgery. OS was assessed using the Kaplan-Meier method, log-rank test and Cox proportional hazard models were used to evaluate associations between variables and overall survival. A 1:1 propensity matching was used to overcome selection bias in the allocation of RT and Kaplan-Meier analysis was performed on the matched patients. Results: A total of 516 (56%) men and 403 (44%) women were included with a median age of 48 years (range 18-90) of whom 406 (44%) received RT and 513 (56%) did not. The median time to the start of RT was 2.1 months. The median follow up was 47.9 months. Surgical extent was available in 314 (34%) patients out of which 167 (53%) had gross total resection, 79 (25%) had subtotal resection, and 68 (22%) had biopsy alone. There were no significant differences in age, sex, race, date of diagnosis, tumor location, and extent of resection between the RT vs observation groups. Median Charlson-Deyo comorbidity index (CDCI) was higher for RT. On multivariate analysis, older age at diagnosis (HR 1.04, 95% 1.03-1.05), male gender (HR 2.00, 95% CI 1.30-2.50), and CDCI= 1 (HR 1.61, CI 1.09-2.40, p=0.02) were associated with poor OS. The 5 year OS was 93% in the RT group and 92% in the observation group (p= 0.13). Further stratifying the patients by tumor location revealed that for infratentorial tumors, 5 year OS was 85% in the RT group versus 87% in the observation group (p=0.61); for supratentorial tumors, 5 year OS was 92% in the RT group versus 89% in the observation group (p=0.13). For the matched patients 5 year OS was 86% and 84% months in the RT and observation groups, respectively (p=0.29). Conclusion: WHO grade II ependymoma appears to have relatively good OS in contemporary clinical practice, and over half of them do not receive adjuvant RT. After a median follow-up of less than 5 years, adjuvant RT is not associated with significantly improved OS. Clinical benefit and strategies to optimize patient selection for adjuvant RT deserve further investigation.

MSRO23-06 Factors Associated With the Occurrence of Radiation Necrosis in Patients with Melanoma Brain Metastases Treated With Radiosurgery and Immunotherapy

Monday, Nov. 27 2:20PM - 2:30PM Room: S103AB

Participants
Tijana Skrepnik, Tucson, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

skrepnik@email.arizona.edu

ABSTRACT

Purpose/Objective(s): Radiation necrosis (RN) is a late, inflammatory reaction seen after stereotactic radiosurgery (SRS) to brain metastases (BM) typically occurring 9-18 months after SRS. At 1-year, incidence of RN in melanoma BM (MBM) treated with SRS is estimated at 6-16%[1] for a V12[2] of 3.3-5.9cm3. It is unclear how the addition of concurrent immunotherapy (IT) modifies the risk or presentation of RN for patients treated for BM. Here we examine the parameters associated with RN after SRS in patients treated with ipilumumab IT.Materials/Methods: We retrospectively reviewed twenty-five patients with 58 BM who underwent SRS and ipilimumab IT. Charts and MRIs were assessed for radiographic or pathologic (n=5) evidence of RN. Treatment consisted of SRS with a median dose of 21Gy (range 16-24Gy) and 4 cycles of IT. The V12, conformity index, GTV (cc) and PTV (cc) volumes, timing of SRS with IT, and addition of whole brain radiotherapy (WBRT) were factors analyzed in relation to overall survival (OS) and associations to RN. The diagnosis of RN was based on multiparametric MRIs and DCE perfusion imaging. Statistical analysis was performed using Kaplan-Meier with log-rank (Mantle-Cox) regression. Results: With a median follow up of 22.7 months, the median OS of this group of patients was 35.8 months. The incidence of RN was 21% (12/58) although only 5% were symptomatic. RN occurred at a median of 14.6 months after SRS (2.6-65.1months) but 25% of RN events occurred late, >24 months after SRS. The 1-, 2-, and 3-year rates of RN were 5.2%, 15.5% and 17.2% respectively. The only significant dosimetric parameter associated with RN was a V12 of 4.41 cc (1.18-10.35) versus 2.18 cc (0.45-18.6) for those with and without RN respectively (p=0.02). Seven patients had salvage WBRT at a median of 4 months after SRS, and this intervention was associated with a higher risk of RN (p=0.012). Finally, the risk of RN appears to be significantly higher when SRS was delivered before (p=0.005) or concurrently with IT (p=0.018) but not after IT (p=0.133). Patients without RN had a median OS of 22.6 months while those with RN had a median OS of 43 months (p=0.034). Conclusion: Overall, in this small cohort of patients treated with SRS and IT, RN does not appear to be occurring at a higher rate than historical series. However, we note that when SRS is delivered before or concurrently with ipilimumab, there appears to be a significantly higher incidence of RN although only a few patients become symptomatic. Surprisingly, patients developing RN appear to survive longer. V12 remains a good surrogate measure of the risk of RN. [1] Sneed, PK, Mendez J, Fogh SE et al. Risk factors for radiation necrosis after radiosurgery for brain metastases. Int J Rad Onc Biol PHys 84:S118-9, 2012. [2] Minniti G, Clarke E, Lanzetta G et al. Stereotactic radiosurgery for brain metastases: analysis of outcome and risk of brain radionecrosis. Radiat Oncol 6:48,2011.

MSRO27

BOOST: Gynecologic-Science Session with Keynote

Monday, Nov. 27 1:30PM - 2:30PM Room: S103CD

GU OB OI RO

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

Participants
Jianling Yuan, MD, PhD, Minneapolis, MN (*Moderator*) Nothing to Disclose
Tracy M. Sherertz, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

Sub-Events

MSRO27-01 Invited Speaker:

Monday, Nov. 27 1:30PM - 1:40PM Room: S103CD

Participants
Tracy M. Sherertz, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

MSRO27-02 Volumetric versus Point Based Brachytherapy Prescription in Cervical Cancer Patients Treated at a Safety Net Hospital

Monday, Nov. 27 1:40PM - 1:50PM Room: S103CD

Participants
Anthony H. Pham, MD , Los Angeles, CA (*Presenter*) Nothing to Disclose
Audrey Zhuang, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Jason C. Ye, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Koji Matsuo, MD,PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Michael A. Senikowich JR, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Richard L. Jennelle, MD, Jackson, MS (*Abstract Co-Author*) Nothing to Disclose
Omar M. Ragab, BA, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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ABSTRACT

Purpose/Objective(s): Historically, brachytherapy (BT) for cervical cancer is prescribed to Point A without reference to individual tumor extent. 3D treatment planning systems have allowed for more accurate definition of the high risk clinical target volume (HR-CTV) on CT or MRI acquired after BT applicator placement. We sought to determine the impact of prescribing to Point A versus HR-CTV in our patient population at a safety net hospital treating an underserved patient population.Materials/Methods: Treatment data for 60 BT plans in 23 consecutive patients treated at a single high-volume safety net hospital from November 2014 to October 2016 was reviewed. All patients were implanted with a CT-compatible tandem and ovoid. After applicator placement, a 2.5-mm slice thickness CT scan was obtained. Point A was marked on the corresponding CT images per ABS guidelines. Organs at risk (OARs) including bladder, rectum, sigmoid, and small bowel were contoured. Dose was optimized within the treatment planning system to provide the prescription to Point A while minimizing dose to the OARs.For our study, a single physician retrospectively contoured a HR-CTV as per GEC/ESTRO consensus guidelines. A second physician confirmed these volumes. The dose volume histograms of HR-CTV and OARs were created for each application. We calculated the dose received by at least 90% of the HR-CTV (D90%) and the volume of the HR-CTV treated to the prescription dose or greater (V100%). The total volume of tissue receiving 100% of the dose was calculated for all patients. The student's t-test was used to compare groups while a linear regression was used to assess correlation between continuous variables. PResults: Overall there were 12 patients with stage IB2, 7 patients with stage IIB and 4 patients with stage IIIB disease. On exam prior to first BT implant, 9 patients had parametrial extension with 3 of those extending to the pelvic sidewall. Median brachytherapy dose was 8Gy x 3 fractions. The median volume of the total tissue irradiated was 110.6 cc and median HR-CTV volume was 23.2 cc.With the dose prescribed to point A, the median HR-CTV V100% was 98.4% and the median D90% was 9.1 Gy. In 6 out of 60 insertions (10%), D90% was less than the prescription dose. The HR-CTV volume was smaller for implants where the V100% was greater than 95% (mean = 21.77 cc, n=49), compared to those that did not (mean = 28.3cc, n=11), with a P-value Conclusion: In our underserved patient population, prescribing to point A resulted in inadequate coverage of the HR-CTV, especially in larger tumors. Continued widespread implementation of CT-based treatment planning with HR-CTV may result in improved patient outcomes by allowing for assurance of proper applicator placement, improved and consistent coverage of the tumor volume, and delineation of OARs for volume-based dose calculations.

MSRO27-03 Identifying Prognostic Factors for Locally Advanced Cervical Cancer Patients Treated with Interstitial Implantation via Hybrid Intracavitary and Interstitial Brachytherapy

Monday, Nov. 27 1:50PM - 2:00PM Room: S103CD

Participants
Amanda Rivera, Bronx, NY (*Presenter*) Nothing to Disclose
Keyur Mehta, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

Nitin Ohri, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Ravindra Yaparpalvi, MS, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Hsiang-Chi Kuo, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Shalom Kalnicki, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): For patients with locally advanced cervical cancer, a hybrid intracavitary and interstitial tandem and ovoids applicator can be used to deliver curative brachytherapy (BT) doses to large tumors after external irradiation. Here we examine clinical and radiographic predictors of treatment efficacy in a cohort of patients treated with this approach.Materials/Methods: We reviewed an institutional database of patients with locally advanced cervical cancer who were treated with external beam radiotherapy (EBRT) and hybrid intracavitary/interstitial BT from 2010-2016. Clinical factors, including disease stage and radiotherapy course duration were recorded. Primary tumor volumes were delineated on pre-treatment PET using a commercial semi-automatic gradient-based contouring algorithm, and maximum SUV (SUVmax), metabolic tumor volume (MTV), and total glycolytic activity (TGA) values were obtained. Clinical outcomes of interest included overall survival (OS), freedom from local progression (FFLP), and progression-free survival (PFS). Survival rates were calculated using the Kaplan-Meier method, and comparisons between subgroups were made using logrank testing. Cox proportional hazards modeling was utilized to assess predictors of treatment failure.Results: Forty-six patients were treated with an EBRT dose of 45-54 Gy and a BT dose of 28-30 Gy was administered over 4-5 fractions with concurrent platinum based chemotherapy. The FIGO stage distribution was IB (5), IIB (19), IIIA (1) and IIIB (21). Forty-one patients had pre-treatment PET scans available for analysis. Median SUVmax was 14.4 (IQR 10.0-19.3), median MTV was 41 cc (IQR 26-77), and median TGA was 343 cc (IQR 154-705). With a median follow-up of 16.8 months for surviving patients, 8 local failures, 16 distant failures, and 9 deaths were observed. Among all patients, high MTV was correlated with a prolonged RT course (p=0.025). Prolonged treatment duration was associated with inferior overall survival (HR=1.04 per day, 95% CI 1.01-1.07, p=0.020). Among patients whose RT courses were completed within 10 weeks, two-year rates of OS, FFLP, and PFS were 92%, 85%, and 63%, respectively. In this subgroup, clinical stage and imaging metrics were not statistically significantly associated with any clinical outcome.Conclusion: In this review, we found that prolonged treatment course was associated with inferior clinical outcomes in patients treated with multimodality therapy including hybrid intracavitary and interstitial BT. Among patients with acceptable course duration, excellent outcomes were achieved regardless of cervical tumor disease burden indicated by PET metrics. A novel association was found between disease burden and treatment duration which warrants further study.

MSRO27-04 Patterns of Care in High Risk Early Stage (FIGO Stage IB Grade 3) Endometrioid Adenocarcinoma: A SEER Database Analysis

Monday, Nov. 27 2:00PM - 2:10PM Room: S103CD

Participants
Dane R. Cohen, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jennifer C. Lee, MD, San Antonio, TX (*Presenter*) Nothing to Disclose
Tony Y. Eng, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Calvin B. Rock, BS, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

cohendr@uthscsa.edu

ABSTRACT

Purpose/Objective(s): Over the past two decades we have seen a shift in the management of endometrial cancer, with a general trend towards de-escalation of radiation in those with early stage disease and more systemic therapy in those with locally advanced tumors and higher risk histologies. Patients with high risk early stage endometrioid adenocarcinoma, specifically FIGO Stage IB Grade 3 (IBG3) tumors, are at a high enough risk of regional recurrence to warrant pelvic radiation but may not derive as much benefit from systemic treatments. We have noted a growing trend towards the use of chemotherapy in these patients. The purpose of this study is to identify trends in the use of external beam radiation therapy (EBRT), vaginal brachytherapy (VBT), and chemotherapy for adjuvant treatment of FIGO Stage IB Grade 3 (IBG3) endometrioid adenocarcinoma in the United States.Materials/Methods: Using the Surveillance, Epidemiology, and End Results (SEER) database, we identified 1383 patients with IBG3 endometrioid adenocarcinoma of the uterine corpus treated between 2004 and 2013. Patients were grouped based on the radiation treatment they received. Patients received either no radiation, EBRT alone, VBT alone, both, or other (Results: For patients with Stage IBG3 endometrioid adenocarcinoma who have undergone definitive surgery, there has been a steady increase in the use of VBT alone from 9.2% of patients in 2004 to 36.4% in 2013 (an increase of 27.2%). Over this same period of time there has been a decrease in the use of either EBRT alone (32.8% to 14.4%; a decrease of 18.4%) or in combination with VBT (18.3% to 14.4%; a decrease of 3.9%). Overall, there has been a decline in any use of EBRT (51.2% to 28.8%; a decrease of 22.4%). When stratifying patients by age > 70 or age > 50 this trend persists (25.1% and 27.3% increase in VBT alone, respectively). Conclusion: This population-based analysis reveals a marked decline in the use of EBRT in patients with IBG3 endometrioid adenocarcinoma. While the SEER database does not include chemotherapy data, we hypothesize that this decline is due at least in part to the increasing use of chemotherapy. To date there have been no randomized trials showing a clear benefit to chemotherapy over EBRT in these patients. Furthermore, recent clinical trials have grouped these tumors with either higher stage disease or higher risk histologies when in fact the natural history may be very different. Our findings highlight a concerning trend towards undertreatment of regional disease in a population of patients with a high enough risk to warrant pelvic radiation. Additional work is currently under way to test this hypothesis with the National Cancer Database (NCDB) which captures chemotherapy data.

MSRO27-05 Multi-institution Health Care Review of Uterine Papillary Serous Carcinoma

Monday, Nov. 27 2:10PM - 2:20PM Room: S103CD

Participants
Janna Z. Andrews, MD, Lake Success, NY (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Uterine papillary serous carcinoma (UPSC) represents less the 15% of endometrial cancers and is recognized as an aggressive tumor with poor prognosis. 50% of patient with Stage I UPSC will have extrauterine disease. UPSC contribute to roughly 50% of endometrial cancer related mortality. While surgery is the cornerstone of treatment for UPSC, the optimal adjuvant treatments of USPC remains controversial given the lack of randomized trials. This retrospective study presents the patterns of

failure based on various treatment approaches from a multi-institutional database.Materials/Methods: Tumor registry data from 2010-2015 identified 119 patients (pts) with UPSC treated at three different institutions within the health care system. Treatment was highly variable with 52 (46%) patients treated with surgery, chemotherapy, and radiation, 21 (17%) treated with surgery alone, 20 (17%) treated with chemotherapy and surgery, 8 (6%) treated with surgery and radiation, 8 (6%) received no treatment, 7 (6%) treated with chemotherapy alone, 3 (2%) treated with radiation alone, and 2 (1%) received only chemotherapy and radiation. There was treatment heterogeneity was across all stages of disease. Survival was analyzed by Kaplan Meier.Results: With a median follow up of 18 months, 88 pts (74%) were alive with 70 (58%) disease free with an overall. Disease free recurrence rates for patients were 13 (62%) treated with surgery alone, 10 (55%) in patients treated with chemotherapy and surgery, 6(75%) in patients treated with radiation and surgery, and 42(80)% of patients treated with trimodality therapy. Stage IA had the highest local control and overall survival rates at 18 months, 82% and 87%, the majority of the patients received trimodality therapy. Stage III patients had a local control rate was 42% and 54% overall survival rates at 18 months. Trimodality therapy was given to the majority of these patients, 16(51%). 11(68%) were alive at 18 months. NED status was achieved by 80% of the chemotherapy and surgery arm and the trimodality arm. Overall survival was higher in the trimodality arm, 73% compared to 60% in the surgery chemotherapy arm.Conclusion: This large retrospective multi-institutional review of UPSC demonstrates a significant amount of heterogeneity in the treatment for UPSC. Given the lack of level I data for UPSC, it is not surprising that treatments are highly variable. The literature cites a 5 year overall survival rate of 59% for Stage III patients with trimodality treatment. Our initial review of overall survival is comparable but longer follow up is necessary. Potentially institutional variability may also play a role in poor outcomes. While no optimal treatment approach is identified from this data, we will present a treatment algorithm that can be used when assessing pts with UPSC and which can be used to inform future clinical trials.

MSRO27-06 Gynecologic Sarcomas: A Ten Year Demographics, Disease, Treatment and Outcome Analysis from a Large Tertiary Level Teaching Hospital

Monday, Nov. 27 2:20PM - 2:30PM Room: S103CD

Participants
Gaurav Bhattacharya, Ottawa, ON (*Presenter*) Nothing to Disclose
Matthew` Tsang, MSc, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Samy El-Sayed, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Ghufran A. Aljawi, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

gbhattacharya@toh.ca

ABSTRACT

Purpose/Objective(s): Gynecologic sarcomas, a group of rare tumors of the female reproductive tract, carry a relatively poor prognosis. This study identifies patient, disease and treatment characteristics across a prolonged time period and ascertains clinical outcomes at our major cancer referral center.Materials/Methods: Patients with gynecologic sarcomas in a ten year span from January 1, 2005 to January 1, 2015 were tabulated from a larger pool of 968 soft tissue tumors, with follow up data to ensure at least two years of post-treatment data collection. This was done via analysis of Electronic Medical Records, paper charts and contact with peripheral medical centers and family practitioners' offices, especially for patients lost to follow up at the center. The inclusion criterion was age = 18 years and histological diagnosis from the intermediate and malignant sections of the 2002 World Health Classification of tumors. Carcinosarcomas (formerly known as Malignant Mixed Mullerian Tumors) and collision tumors (defined as two histologic tumor types originating in the same anatomic site) were also included in this analysis. The exclusion criterion was inadequate histological diagnosis. A literature review was also conducted to identify current outcomes trends. Overall survival was analyzed using Kaplan-Meier methodology.Results: One hundred and twelve patients meeting selection criteria were identified. Mean age at diagnosis was 65 years (Standard Deviation/SD: 12) with a median follow up of 30 months. The most common presenting symptoms were vaginal bleeding (50%) and mass ± pain (12%). Only 4 of the patients had no apparent clinical symptoms. Disease site was overwhelmingly of the uterine corpus (86%). The most common histologies were Carcinosarcoma (56%) and Leiomyosarcoma (37%). Mean tumor size was 10 cm (SD: 7) with a mean pre-treatment Hemoglobin value of 11.7 g/dl (SD: 2.1).A majority (88%) received treatment with curative intent. Radiation (49% of all patients) and chemotherapy were provided largely in an adjuvant setting. The most common fractionation regimen was 45 Gy in 25 fractions. From a surgical perspective, most patients were treated with a total abdominal hysterectomy with bilateral salpingoophorectomy. Bilateral lymphadenectomy was conducted in 31% of such surgeries and at least 18% had positive margins.Stage distribution by incidence was: Stage I 40%, Stage II 12%, Stage III 21% and Stage IV 24%. Forty percent of patients had a recurrence with 62% of patients still alive at time of latest follow up. Thirteen patients had a component of local disease progression or recurrence. Overall survival estimates at three and five years were 81% and 45% respectively. Conclusion: The creation of a gynecologic sarcoma database grants an array of details to establish a foundation for further assessment of clinical outcomes. Further research is required on the potential for both locoregional and systemic control improvement with likely benefit from studying outcomes stratified by histology.

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PS20

Monday Plenary Session

Monday, Nov. 27 1:30PM - 2:45PM Room: Arie Crown Theater

OT

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credit: .75

Participants
Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

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Sub-Events

PS20A **Presentation of the Alexander R. Margulis Award for Scientific Excellence**

PS20B **Presentation of Honorary Membership**

Participants
Hassen A. Gharbi, MD, PhD, Tunis, Tunisia (*Recipient*) Nothing to Disclose
Renato A. Mendonca, MD, PhD, Sao Paulo, Brazil (*Recipient*) Nothing to Disclose
Katrine Riklund, MD, PhD, Umea, Sweden (*Recipient*) Nothing to Disclose

For information about this presentation, contact:

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PS20C **Dedication of the New Horizons Lecture to the Memory of Sir Peter Mansfield (1933-2017)**

PS20D **New Horizons Lecture: A New Light: The Birth, and Rebirth, of Imaging**

Participants
Daniel Sodickson, MD, PhD, New York, NY (*Presenter*) Royalties, General Electric Company License agreement, General Electric Company Royalties, Bruker Corporation License agreement, Bruker Corporation Research collaboration, Siemens AG
Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

Abstract

We humans create imaging modalities to extend our vision. We build telescopes to see into the furthest reaches of our universe; microscopes to reveal worlds too small for the naked eye. In the realm of biomedical imaging, we develop tools to pierce the veil of the skin, the skull, or whatever else impedes our view, in order to see what lies beneath. In the process, we aim to understand ourselves better, and, to the extent possible, to liberate ourselves from disease. What begins as an extension of our eyes inevitably results in an expansion of our minds. The history of imaging is rich, characterized by remarkable patterns of discovery and invention, and its future is most certainly bright. That said, it is timely to re-examine both the history and the future of imaging in a world that is changing ever faster around us. Artificially-generated images are the products of technology (the interaction of a probe with a body of interest), and they are rich vehicles for information (maps of the structure and function of bodies, and fingerprints of the interaction of those bodies with their surroundings). Meanwhile, both technology and information are currently in the midst of a sea-change. This lecture will consider the history of biomedical imaging, and will explore its evolving role in our rapidly changing world. After a quick review of the birth of biomedical imaging, in optics, a series of noteworthy rebirths will be surveyed, from X-rays to tomographic imaging modalities. Selected transformative innovations will serve as focal points, using the field of magnetic resonance imaging as a source of illustrative examples. We will then attempt to sketch the changing face of biomedical imaging. We are, in fact, witnessing a rebirth of imaging in our time - a remarkable creative flux spanning traditionally distinct imaging modalities and spatiotemporal scales. A renaissance of technological and methodological developments is circumventing previous limits on imaging speed, spatial resolution, information content, and, ultimately, value. Taken together, these developments are catalyzing a fundamental shift from traditional series of snapshots to a new paradigm of streaming information. Multidimensional, multiparametric image acquisitions are, increasingly, becoming the norm, and a new mathematics of image reconstruction is enabling increasingly robust extraction of multifaceted information from these acquisitions. A revolution in physical modeling, meanwhile, is changing the way we interpret image information, and the way we connect organ-level maps to underlying cellular architecture and molecular composition. At the same time, not only is the latest generation of artificial intelligence entering, with much recent fanfare, into the business of image interpretation, but it also holds the much less commonly appreciated potential to change the way we design imaging devices in the future. Recent implementations of AI for image reconstruction, for example, have begun to resemble the neural processing of complex, continuous sensory data streams. Indeed, what began as emulation of the human eye is, more and more, emulating the workings of the human brain. One might say that we are finally recapitulating, in our technology, what evolution already settled upon long ago for our physiology. Some have worried that today's juggernauts of change - the Big Tech companies and their AI divisions, for example - are poised to roll over the likes of radiologists and medical physicists. Let us not forget, though, that we too are a force for change, a juggernaut of extended vision and expanded mind. If we embrace emerging paradigms of technology and information, and put them to good use, we will continue to see what was once invisible. If we stay true to our rich history of invention, we are bound to see things in a new light.

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SPPH21

Basic Physics Lecture for the RT: Standardizing Image Quality in Digital Radiography

Monday, Nov. 27 1:30PM - 2:45PM Room: S402AB

PH

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Scott J. Emerson, MS, Royal Oak, MI (*Moderator*) Nothing to Disclose
Alisa Walz-Flannigan, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the diagnostic need for standardization of radiographic image quality. 2) Refresh or expand familiarity with the basics of radiographic image acquisition and processing that influence image quality. Develop an intuitive grasp of these concepts through image examples. 3) Gain strategies for standardizing and optimizing image quality: desirable information to collect and analyze, the need for feedback processes, and tools for implementation. 4) Build confidence in troubleshooting techniques for addressing image quality issues.

ABSTRACT

The flexibility of digital radiography (DR) can be both a strength and a challenge in creating consistently high-quality images with optimized exposures. Often, the setting of acquisition techniques and image processing is an art form practiced by individual technologists. While image variation can be constrained through tight communication between radiologist and technologist, this is made more difficult with larger and distributed health systems that may have multiple radiologists viewing a site's images. In addition, modern DR systems have complexities that vary by vendor and may confound a technologist that trained with film, or hasn't been given the tools to appreciate a particular system's idiosyncrasies. While vendors are beginning to provide better acquisition feedback such as with exposure index, there is still a wide-range in availability of DR analytics and how they are used. Starting with the need for image quality standardization, this course delves into the interplay between technique, processing and image quality in DR. Through presentation of image problem examples and their resolution, technologists will be provided with tools to better understand how DR works and how to troubleshoot image problems. Through example of practice analysis and quality feedback strategies, participants are provided with ideas to build their own program for image quality standardization and optimization.

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SPPH22

Physics Symposium: Proton

Monday, Nov. 27 1:30PM - 5:45PM Room: S503AB

PH RO

AMA PRA Category 1 Credits ™: 4.00
ARRT Category A+ Credits: 4.50

FDA Discussions may include off-label uses.

Participants
Indra J. Das, PhD, New York, NY (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

indra.das@nyumc.org

ABSTRACT

This is a moderated session on proton beam therapy distributed among 10 speakers (Radiation oncologists as well as Physicists). It covers breadth of proton beam, history, advances, production, clinical application, treatment planning, pencil beam scanning, Biology, imaging, motion management and neutron beam. This session is a followup of the AAPM summer school on proton beam that took place in June 2015 in Colorado Spring, Co, culminating to the publication of the book 'Principles and Practice of Proton Beam Therapy' edited by IJ Das and H Paganetti.

Active Handout:Indra J. Das

http://abstract.rsna.org/uploads/2017/17001455/Active SPPH22.pdf

Sub-Events

SPPH22A Introduction: History & Advances in Proton Therapy

Participants
Indra J. Das, PhD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

indra.das@nyumc.org

LEARNING OBJECTIVES

1) History of proton beam therapy. 2) Development of seminal events. 3) New innovations from scattered beam to pencil beam scanning. 4) Future of proton beam therapy.

ABSTRACT

Introduction to proton beam therapy from the beginning of 1905 till today is presented in terms of seminal work by William H Bragg on the stopping powers and range of alpha particles, introduction of proton beam as hydrogen nucleus by Ernest Rutherford, introduction of cyclotron by Ernest Lawrence at Berkley and hint of clinical use by Robert Wilson that spanned the proton work to Harvard Cyclotron in 1954 for patient care. The first hospital based clinical proton machine was built at Loma Linda in 1990 followed by conversion of Indiana university cyclotron facility (IUCF) for clinical use in 1999 which was named as Midwest Proton Research Institute (MPRI) that treated over 2000 patients till it was closed in 2014. Currently over 35 centers are treating patients with various types of machines. Modern machines have sophisticated beam delivery system coupled with advanced imaging and 360 deg gantry angles for patient care. Advances in pencil beam scanning, cone beam CT (CBCT) and advanced optimization in treatment planning has propelled proton beam to a new height. Clinical outcomes are being analyzed to provide meaningful debate in the cost and growth of proton therapy which will be presented.

Active Handout:Indra J. Das

http://abstract.rsna.org/uploads/2017/17001456/Active SPPH22A.pdf

SPPH22B Proton Therapy: Promises, Principles, and Proof

Participants
Nancy P. Mendenhall, MD, Gainesville, FL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the basic principles of radiation therapy that govern treatment planning and radiation therapy outcomes, e.g., the factors affecting the therapeutic ratio. 2) To understand the promise of proton therapy for increasing the therapeutic ratio. 3) To understand the current level of clinical evidence regarding proton therapy efficacy, safety, and comparative effectiveness.

SPPH22C Miniaturization Technology and Proton Machines

Participants

Vladimir Derenchuk, MSc, Knoxville, TN (*Presenter*) Director, ProNova Solutions, LLC; Spouse, Employee, ProNova Solutions, LLC

For information about this presentation, contact:

laddie.derenchuk@pronovasolutions.com

LEARNING OBJECTIVES

1) Become familiar with the latest techniques used to reduce the size and cost of proton therapy systems while maintaining state of the art delivery techniques.

ABSTRACT

Miniaturizing innovations in the design of accelerators and gantries include the use of superconducting magnets, combined function magnets and novel methods of range modulation. A description of the innovations currently in use and additional innovations being developed will be discussed.

URL

http://provisionhealthcare.com/proton-therapy/proton-therapy-system/

SPPH22D Advances in TPS and Optimization

Participants
Tony Lomax, Switzerland, Switzerland (*Presenter*) Research Grant, Varian Medical Systems, Inc

LEARNING OBJECTIVES

1) Understand the concepts for treatment planning of Pencil Beam Scanned (PBS) proton therapy. 2) Understand the advantages and limitations of PBS proton therapy. 3) Understand the importance of anatomical changes and adaptive radiotherapy.

SPPH22E Pencil Beam Scanning

Participants
Ronald X. Zhu, PhD, Houston, TX (*Presenter*) Nothing to Disclose

SPPH22F Administrative Hurdles of Setting Up Proton Beam

Participants
Anita Mahajan, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) What is different about proton therapy in contrast to x-ray based therapy facilities. 2) Basic personnel requirements of proton therapy. 3) Patient populations who could benefit the most from proton therapy. 4) Current status of proton therapy in the US and the world and approaches that have been taken to finance and manage them.

ABSTRACT

Proton therapy is a radiotherapy modality that has great promise especially since technology has advanced and lower cost and smaller facilities are now feasible. The similarities and differences between xray and proton therapy will be discusses and the essential personnel to develop and run a safe and efficient program will be discussed. Patient populations that coudl benefit from proton therapy will be described. Some of the financial hurdles, special expertise, technical infrastructure and collaborations that are needed to develop a robust, efficient and safe proton facility will be described. Various approaches to the funding and structuring these programs from established programs in the United States and elsewhere will be discussed.

SPPH22G Proton Therapy for Ocular Cancers

Participants
Alexei V. Trofimov, PhD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

atrofimov@mgh.harvard.edu

LEARNING OBJECTIVES

1) Review types of ocular cancers, and treatment options. 2) Learn about the development and current status of proton therapy for ocular tumors.

ABSTRACT

Nearly 1 in 5 of overall proton therapy patients to date worldwide were treated for ocular tumors. The techniques for treating ocular targets with proton beam were first developed in 1970s. The dose distributions are advantageous for maintaining visual function in a large proportion of cases. Charged particle therapy proved to be quite successful in achieving local tumor control in uveal melanomas, while preserving the eye globe.

SPPH22H Proton Imaging: Advances, Promises and Peril

Participants
Katia Parodi, Garching b. Munich, Germany (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Katia.Parodi@lmu.de

LEARNING OBJECTIVES

1) Understand the issue of range uncertainties in clinical practice of proton beam therapy. 2) Understand the different possible

1) Understand the issue of range uncertainties in clinical practice of proton beam therapy. 2) Understand the different possible implementations of in vivo range verification before, during and after treatment. 3) Understand the merits, challenges and performances of the different proposed in vivo range verification approaches. 4) Understand the prospects of in vivo range/dose verification and the potential clinical impact.

ABSTRACT

Despite all recent technological advances in beam delivery and imaging, full clinical exploitation of the favorable ballistic properties of proton beams is still hampered by the yet unsolved problem of range uncertainties. To this end, several approaches are being extensively investigated to tackle this issue at the stage of treatment planning or treatment delivery. This presentation will review the broad range of proposed verification techniques, critically discussing the main ongoing developments and initial clinical experience with focus on the challenges as well as the prospects of novel imaging for in vivo range (and potentially even dose) verification in proton therapy.

SPPH22I Motion Management in Particle Therapy

Participants
Shinichiro Mori, Chiba, Japan (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mori.shinichiro@qst.go.jp

SPPH22J Neutrons in Proton Beam

Participants
Chee-Wai Cheng, PHD, Cleveland, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

chee-wai.cheng@uhhospitals.org

LEARNING OBJECTIVES

1) Neutron production in proton therapy. 2) Performance characteristics of a neutron specific flat panel detector. 3) Potential application of the neutron panel for real time proton therapy imaging.

ABSTRACT

A neutron imaging flat panel detector (FPD) from PerkinElmer is explored for its potential real time imaging application in proton therapy. Neutrons are produced by impinging a proton beam from a Mevion S250 unit on a brass plug (water equivalent thickness 30cm) and a solid water phantom (9cm thick). The FPD response characteristics to proton dose and dose rate and its imaging performance characteristics such as MTF and contrast resolution are characterized. A Leeds and a Las Vegas phnatom are used to determine the MTF and the contrast resolution of the FPD. The results are compared with those obtained with 6 MV x rays. The detector characteristics increases linearly with MU and MU/min. The MTF and the contrast resolution are comparable to those of the MV FPD from the Elekta machines. Images of a keyset obtained wtih neutron FPD produced in a solid water phantom illustrates the potential application of neutron imaging in proton therapy.

URL

SPSP21

Imagen Cardiovascular: Un Enfoque Práctico de la Cabeza a los Pies: Sesión del Colegio Interamericano de Radiología (CIR) en Espanol / Vascular Imaging: A Practical Approach from Head to Toe: Session of the Interamerican College of Radiology (CIR) in Spanish

Monday, Nov. 27 1:30PM - 4:30PM Room: E451A

CA CT NR VA

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.50

Participants
Pablo R. Ros, MD, PhD, Cleveland, OH (*Moderator*) Nothing to Disclose
Jose L. Criales, MD, Mexico City, Mexico (*Moderator*) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (*Moderator*) Royalties, Reed Elsevier

LEARNING OBJECTIVES

1) Discutir conceptos actualizados en enfermedades e intervenciones cardiovasculares. 2) Revisar hallazgos importantes en enfermedades vasculares y cardiacas, categorizadas por órganos y sistemas. 3) Entender el papel de las diferentes modalidades de imagen en el diagnostico de la enfermedad cardiovascular. 1) Discuss current concepts in vascular diseases and interventions. 2) Review key imaging findings in various diseases of the cardiovascular system, divdided by organs. 3) Understand the role of different imaging modalities in the evaluation of diseases of the heart and vessels.

Sub-Events

SPSP21A Bienvenida / Welcome

Participants
Pablo R. Ros, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose

SPSP21B Pasado, Presente y Futuro de la Terapia Neuroendovascular / Neuroendovascular Therapy: Past, Present and Future

Participants
Marco A. Zenteno, MD, Tlalpan, Mexico (*Presenter*) Nothing to Disclose

SPSP21C Síndrome Aòrtico Agudo en 2017 / Acute Aortic Syndrome: A 2017 Update

Participants
Cristobal A. Ramos Sr, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

cramosg@alemana.cl

LEARNING OBJECTIVES

1) Understand general concepts about epidemiology and risk factors for acute aortic syndroms and the role of diagnostic imaging in their prevention. 2) Recognise the most common clinical presentations of acute aortic syndroms. 3) Differenciate main pathologycal forms of acute aortic syndrom: classic dissection, intramural hematoma and penetrating atheroesclerotic ulcer. 4) Use correctly the Stanford classification system. 5) Provide critical information to physicians of aortic syndrom patients including acute presentations and chronic forms follow up, surgical, endovascular and hybrid procedures, complications and expected postprocedure findings.

SPSP21D Angio TC de las Arterias Coronarias: Lo Escencial / Coronary Artery CT: The Essentials

Participants
Eric T. Kimura-Hayama, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

erickimura@ctcardiomexico.com

LEARNING OBJECTIVES

1. Conocer los fundamentos técnicos, de adquisición, anatómicos e interpretación de la angioTC coronaria

ABSTRACT

La angioTC computada de arterias coronarias es un método no invasivo cada vez más empleado en la evaluación de pacientes con sospecha de enfermedad arterial coronaria. Las técnicas de adquisición de las imágenes son un elemento fundamental que garantiza la adecuada interpretación de las imágenes. En general se acepta existen 3 modalidades de adquisición, todas ellas con gatillo cardiaco: prospectivo (step and shoot), retrospctivo (helicoidal) y high pitch. Desde el punto de vista anatómico, se emplea un modelo de 17 segmentos coronarios, y los criterios de interpretación siguen lineamientos recientemente actualizados y que incluyen las características y localización de la lesión coronaria (tipo de placa, longitud, signos de vulnerabilidad, etc), así como de manera más reciente la categoría CAD-RADS de la misma. A lo largo del desarrollo del método ha existido una mejora significativa en los

aspectos tecnológicos, los cuales han permitido una disminución de la dosis de radiación que el/la paciente recibe, sin embargo el principal valor diagnóstico del método prevalece sin cambios, en particular su alto valor predictivo negativo. La dirección futura del método se encamina a conocer las implicaciones funcionales de una lesión aterosclerosa, ya sea a través de la medición del flujo de reserva fraccional coronario y del análisis perfusorio miocárdico.

SPSP21E Preguntas / Q & A

SPSP21F Presentación del CIR / CIR Update

Participants
Miguel A. Pinochet Tejos, MD, Vitacura, Chile (*Presenter*) Nothing to Disclose

SPSP21G Vasculitis y Enfermedades Sistémicas con Componente Vascular y Cardiaco / Vasculitides and Systemic Diseases with Vascular and Cardiac Involvement

Participants
Antonio Luna, MD, Jaen, Spain (*Presenter*) Consultant, Bracco Group; Speaker, General Electric Company; Speaker, Toshiba Medical Systems Corporation

LEARNING OBJECTIVES

1) Revisar el papel de las técnicas de imagen en el diagnóstico y valoración de actividad de las vasculitis y otras enfermedades sistémicas con afectación cardiovascular / Review the role of imaging in the diagnostic work-up and determination of activity of vasculitides or other systemic diseases involving the cardiovascular system. 2) Determinar la técnica de imagen más adecuada de acuerdo al escenario clínico y tipo de vasculitis / Analyze the most apropiase imaging technique according to the clínical scenario and type of vasculitides.

SPSP21H Enfermedad Arterial Periférica: Evaluación Antes y Despues de Terapia Endovascular / Peripheral Artery Disease: Evaluation before and after Endovascular Therapy

Participants
Thiago Vasconcelos Paulo Neto, MD, Buenos Aires, Argentina (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the peripheral arterial pathology. 2) Recognize the main radiological methods for evaluation and follow-up. 3) Interpret the study methods. 4) Recognize the main complications after treatment.

ABSTRACT

Peripheral arterial disease (PAD) is a result of multiple risk factors in people with predisposition to develop vascular damage. The epidemiological transition and Westernized lifestyle resulted in an increased prevalence of sedentary lifestyle, a diet rich in saturated fats and carbohydrates, tobacco, hypertension, obesity, diabetes and dyslipidemia, leading to an increase in noncommunicable diseases , specifically diseases of the circulatory system, in the last 100 years. Radiology and surgical techniques have evolved to promote a better quality of life for these patients. It is up to our professionals to choose the most effective diagnostic method to provide better treatment results.

SPSP21I Vena Cava Superior: Lo Común y lo Infrecente / Superior Vena Cava: Common and Uncommon Conditions

Participants
Carlos S. Restrepo, MD, San Antonio, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the basic embryology and development of the superior vena cava and most common anatomic variants. 2) Prescribe the imaging protocols and techniques for appropriate visualization of the superior vena cava. 3) Recognize the imaging findings associated with most common pathologies and abnormalities of the superior vena cava. 4) Identify some uncommon congenital and acquired abnormalities that may be source of diagnostic error and confusion.

ABSTRACT

The superior vena cava is a critical vascular thoracic structure, which plays a fundamental role in the homeostasis of the cardiovascular system. It can be affected by numerous congenital and acquired pathologic conditions from indolent and inconsequential anomalies and anatomic variants to more aggressive benign and malignant disorders with poor patient outcome. In this presentation the basic imaging protocols for optimal visualization of the SVC will be reviewed, as well as the basic embryology and most common anatomic variants. Some important congenital abnormalities as well as the most relevant associated conditions will be illustrated. Primary malignancies of the SVC are far less common than intracaval extension of malignant tumors arising in the lung or mediastinum. The pathophysiology, clinical and imaging manifestation of SVC syndrome with be discussed in detail, including benign and malignant, primary and secondary pathologies. Finally, traumatic injuries and iatrogenic complications with SVC involvement will be reviewed.

SPSP21J Preguntas / Q & A

SPSP21K Clausura / Closing

Participants

Pablo R. Ros, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (*Presenter*) Royalties, Reed Elsevier
Jose L. Criales, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discutir conceptos actualizados en enfermedades e intervenciones cardiovasculares. 2) Revisar hallazgos importantes en enfermedades vasculares y cardiacas, categorizadas por organos y sistemas. 3) Entender el papel de las diferentes modalidades de imagen en el diagnostico de la enfermedad cardiovascular. 1) Discuss current concepts in vascular diseases and interventions. 2) Review key imaging findings in various diseases of the cardiovascular system, divided by organs. 3) Understand the role of different imaging modalities in the evaluation of diseases of the heart and vessels.

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VSIO21

Interventional Oncology Series: HCC and Cholangiocarcinoma

Monday, Nov. 27 1:30PM - 5:30PM Room: S406B

GI IR

AMA PRA Category 1 Credits ™: 3.75
ARRT Category A+ Credits: 4.25

FDA Discussions may include off-label uses.

Participants
Anne M. Covey, MD, New York, NY (*Moderator*) Advisory Board, Accurate Medical

Sub-Events

VSIO21-01 Systemic Treatment: Molecular Targeted Agents or Immune Checkpoint Inhibitors

Monday, Nov. 27 1:30PM - 1:50PM Room: S406B

Participants
Ghassan K. Abou-Alfa, MD, New York, NY (*Presenter*) Research Grant, Amgen Inc; Research Grant, AstraZeneca PLC; Research Grant, Agios Pharmaceuticals, Inc; Research Grant, Bayer AG; Research Grant, Bristol-Myers Squibb Company; Research Grant, CASI Pharmaceuticals Inc; Research Grant, Chugai Pharmaceuticals, Ltd; Research Grant, Exelixis, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Polaris Group; Research Grant, Vicus Therapeutics, LLC; Consultant, Aduro BioTech, Inc; Consultant, Agios Pharmaceuticals, Inc; Consultant, ASLAN Pharmaceuticals Limited; Consultant, Blueprint Medicines Corporation; Consultant, Astellas Group; Consultant, Onxeo SA; Consultant, Boston Scientific Corporation; Consultant, Bristol-Myers Squibb Company; Consultant, CASI Pharmaceuticals Inc; Consultant, Delcath Systems, Inc; Consultant, Eisai Co, Ltd; Consultant, Celgene Corporation; Consultant, Halozyme Therapeutics, Inc; Consultant, Iosen; Consultant, Eli Lilly and Company; Consultant, Gilead Sciences, Inc; Consultant, IntegraGen SA; Consultant, Johnson & Johnson; Consultant, Merck & Co, Inc; Consultant, AstraZeneca PLC; Consultant, Merrimack Pharmaceuticals, Inc; Consultant, NewB Innovation Ltd; Consultant, Momenta Pharmaceuticals, Inc; Consultant, NewLink Genetics Corporation; Consultant, Novartis AG; Consultant, Onxeo SA; Consultant, AbbVie Inc; Consultant, F. Hoffmann-La Roche Ltd; Consultant, sanofi-aventis Group; Consultant, SERVIER; Consultant, Silenseed Ltd; Consultant, SillaJen, Inc; Consultant, Sirtex Medical Ltd; Consultant, Vaxxim AG; Consultant, Vicus Therapeutics, LLC; Consultant, Westhaven

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LEARNING OBJECTIVES

1) Recognize the two disease state, the cancer itself and the generally associated cirrhosis of hepatocellular carcinoma (HCC). 2) Recognize the current standards of care used for advanced and metastatic HCC. 3) Learn about the current clinical trials combining local plus systemic therapy for locally advanced and metastatic HCC.

VSIO21-02 Tremelimumab Combined with Subtotal Locoregional Therapy Induces Systemic Tumor Response in Patients with Unresectable Multifocal Hepatocellular Carcinoma

Monday, Nov. 27 1:50PM - 2:00PM Room: S406B

Awards
Student Travel Stipend Award

Participants
Angela W. Chen, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Elliot B. Levy, MD, Rockville, CT (*Abstract Co-Author*) Nothing to Disclose
Venkatesh Krishnasamy, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Tim Greten, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Austin Duffy, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Victoria L. Anderson, MS, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
David Kleiner, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To determine imaging and clinical responses of hepatocellular carcinoma (HCC) lesions to immune checkpoint inhibition combined with locoregional therapies

METHOD AND MATERIALS

A retrospective CT imaging review was conducted for 12 consecutive, prospectively-enrolled patients with unresectable multifocal hepatocellular carcinoma (HCC; mean age 65±7, BCLC: C, ECOG 0/1; post-sorafenib) treated with Tremelimumab (AstraZeneca, Cambridge, Great Britain) anti-CTLA-4 checkpoint inhibition immunotherapy followed by cryoablation (n=4), microwave (MWA) (n=2), radiofrequency ablation (RFA) (n=3), or transarterial chemoembolization (TACE)(n=3). Ablation or TACE was subtotal, with intent to debulk and/or augment immunotherapy. Tumor response was determined with mRECIST and correlated with serum Alpha-fetoprotein (AFP) level using Spearman's test.

RESULTS

All 12 patients with between 1-4 (8 patients with 1; 2 patients with 2, and 2 patients with 4) index tumors having underwent locoregional therapy and a median of 7 (mean: 7.9) distant, untreated tumors (n=95 total) were evaluated. Changes in tumor size were monitored for 142±45 days (range: 67-195 days). 58%, 74%, 73% and 67% of index tumors and 65%, 74%, 72%, and 80% of distant tumors achieved disease control at 2, 4, 6, and 8 months follow-up, respectively, as defined by CR + PR + SD. AFP measured during the same follow-up period correlated with size reduction of distant tumors (rs=0.24, p=0.00029), but not index tumors (rs=-0.01, p=0.91).

CONCLUSION

The combined immune-modulation and subtotal locoregional therapy may improve disease control, via induction of systemic responses in serum AFP that correlates with distant HCC. Disease control occurs despite an initial increase in index tumor size following locoregional therapy.

CLINICAL RELEVANCE/APPLICATION

Tremelimumab combined with locoregional therapies demonstrated efficacy both clinically and radiologically.

VSIO21-03 Interventional Treatment: Percutaneous Approach or Transarterial Therapy

Monday, Nov. 27 2:00PM - 2:20PM Room: S406B

Participants
Anne M. Covey, MD, New York, NY (*Presenter*) Advisory Board, Accurate Medical

LEARNING OBJECTIVES

1) To understand advantages and limitations of percutaneous ablation techniques and transarterial therapies, including chemoembolization and radioembolization, in the treatment of hepatocellular and cholangiocellular carcinoma. 2) The describe current role of percutaneous techniques and transarterial interventions in the management of liver cancer patients. 3) To discuss recent data comparing and combining different interventional treatment options in the treatment of these diseases.

VSIO21-04 Feasibility and Outcomes of Percutaneous Thermal Ablation of Hepatocellular Carcinoma in a Transplanted Allograft

Monday, Nov. 27 2:20PM - 2:30PM Room: S406B

Participants
Brian T. Welch, MD, Rochester, MN (*Presenter*) Nothing to Disclose
John J. Schmitz, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To examine the safety, feasibility, and oncologic control following percutaneous image-guided thermal ablation of hepatocellular carcinoma (HCC) in a transplanted allograft.

METHOD AND MATERIALS

Retrospective review was performed to identify patients who underwent liver transplantation for HCC and subsequently underwent percutaneous hepatic thermal ablation for recurrent HCC within the allograft between January 1st, 2000-September 1st, 2016. Eleven patients with hepatic allograft HCC underwent twelve percutaneous thermal ablation procedures to treat 16 lesions. Patient, procedural characteristics and local oncologic efficacy were reviewed. Complications were characterized via the Common Terminology for Clinically Adverse Events nomenclature [CTCAE] v4.03).

RESULTS

Eleven transplant recipients underwent treatment of 16 HCC tumors in their allografts during 12 ablation sessions. Mean follow-up time was 29 months (range 2-96 months). Local oncologic control was achieved in 10 of 11 tumors (91%) with imaging follow up. One patient (8%) developed a major complication with hepatic abscess.

CONCLUSION

Thermal ablation of recurrent HCC in transplanted allografts can be accomplished safely with acceptable rates of local control. Due to the high number of patients deemed surgically unresectable, the morbidity of surgical resection, the side effects of targeted therapies, and significant mortality associated with recurrences in the, patients may benefit from percutaneous thermal ablative treatments. Further study is needed to assess the role of thermal ablation in allograft HCC recurrences as primary therapy or in a multimodality approach with emerging systemic therapies.

CLINICAL RELEVANCE/APPLICATION

Expand the role of thermal ablation into a new patient cohort with transplanted allografts.

VSIO21-05 Embolization: How to Optimize Patient Selection and Treatment Strategy

Monday, Nov. 27 2:30PM - 2:50PM Room: S406B

Participants
Karen T. Brown, MD, New York, NY (*Presenter*) Nothing to Disclose

VSIO21-06 Dual-Energy Quarter-Millimeter Photon-Counting CT to Assess Radiopaque Microsphere Distribution Following Embolization

Monday, Nov. 27 3:00PM - 3:10PM Room: S406B

Participants
Amir Pourmorteza, PhD, Atlanta, GA (*Presenter*) Nothing to Disclose
William F. Pritchard JR, MD,PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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Ivane Bakhutashvili, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Elliot B. Levy, MD, Rockville, CT (*Abstract Co-Author*) Nothing to Disclose
Rolf Symons, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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David A. Bluemke, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Research agreement, Siemens AG; Research support, Siemens AG; Research agreement, Carestream Health, Inc; Research support, Carestream Health, Inc

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PURPOSE

Single-energy 0.25mm scans are possible with conventional energy-integrating detector (EID) CT systems using an ultrahigh resolution (UHR) comb; the UHR comb blocks photons from hitting half of the detector surface and is thus highly dose-inefficient. There are currently no CT scanners capable of dual-energy imaging at 0.25mm resolution. Unlike EIDs, photon-counting detectors (PCD) do not rely on scintillating crystals, which require optical insulation, and can thus be made at much smaller pixel sizes. Here we investigate the feasibility and dose-efficiency of dual-energy quarter-millimeter PCD CT in imaging radiopaque drug-eluting microspheres.

METHOD AND MATERIALS

We used a prototype whole-body PCD CT scanner. The PCD pixels consist of 4x4 subpixels, each with counters that can detect photons above 2 energy thresholds. The subpixels are binned to create logical detector pixels: 4x4 binning results in standard resolution (SR: 0.5mm at isocenter), and 2x2 binning results in ultrahigh resolution (UHR: 0.25mm at isocenter). Iodinated radiopaque (70-150μm) LUMI beads were used to embolize hepatic arteries of swine. Explanted liver samples were placed inside an anthropomorphic phantom and scanned in SR and UHR modes at 140 kVp, 300 mAs, 25/75 keV thresholds. Images were reconstructed with filtered backprojection and linear convolution kernels (D50 for SR, S80 for UHR). Spatial resolution was measured in the line pair section of the Catphan CT phantom. Image noise was measured as SD of a large ROIs within a uniform region. Iodine concentration was estimated from the dual-energy scans using a vendor-supplied software.

RESULTS

UHR spatial resolution was 19 LP/cm for UHR compared to 9 LP/cm for SR. There was no statistically significant difference in iodine concentration values measured in UHR and SR. Hepatic arterial branches showed more distal visualization with UHR mode compared to SR (Figure). The image noise was 24% higher in UHR (0.25x0.25x0.5mm voxel size) compared to SR (0.5x0.5x0.5mm).

CONCLUSION

PCD CT can produce dual-energy UHR 0.25mm images of distal hepatic arterial branches for determination of iodine concentration and better visualization of bead distribution and thus its relationship to target tissue.

CLINICAL RELEVANCE/APPLICATION

Embolization of distal arterial branches can be visualized with photon-counting CT with 2-fold greater resolution than conventional CT, leading to better assessment of bead distribution.

VSIO21-07 Y90 Radioembolization: Available Data and Levels of Evidence

Monday, Nov. 27 3:10PM - 3:30PM Room: S406B

Participants
Riad Salem, MD, MBA, Chicago, IL (*Presenter*) Research Consultant, BTG International Ltd Research Grant, BTG International Ltd

VSIO21-08 Safety of Y-90 Resin Microspheres Radioembolization Using Full Strength Contrast Material

Monday, Nov. 27 3:30PM - 3:40PM Room: S406B

Participants
Ieva Kurilova, MD, New York, NY (*Presenter*) Nothing to Disclose

Franz E. Boas, MD,PhD, New York, NY (*Abstract Co-Author*) Co-founder, Claripacs, LLC; In-kind support, Bayer AG; Investor, Labdoor; Investor, Qventus; Investor, CloudMedx; Investor, Notable Labs
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Etay Ziv, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Lynn A. Brody, MD, New York, NY (*Abstract Co-Author*) Stockholder, Sirtex Medical Ltd
Constantinos T. Sofocleous, MD, PhD, New York, NY (*Abstract Co-Author*) Consultant, General Electric Company; Consultant, Johnson & Johnson;
Mithat Gonen, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Regina G. Beets-Tan, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

This study was conducted to assess the safety of 90Y resin microspheres administration using non-diluted contrast material (100% Omnipaque 300).

METHOD AND MATERIALS

After IRB waiver, we reviewed all colorectal cancer liver metastases patients treated with 90Y resin microspheres radioembolization from 2009 to 2017. Beginning in April 2013, experienced operators started using full strength contrast material instead of the standard sandwich infusion technique for 90Y resin administration. Occurrence of myelosuppression (leukopenia, neutropenia, erythrocitopenia or/and thrombocytopenia), incidence of stasis, reflux and non-target delivery, laboratory toxicities, side effects and complications within 6 months after radioembolization were evaluated. The results were compared between the non-diluted contrast group (group A) and the standard sandwich infusion technique group (group B).

RESULTS

90Y delivery with contrast was recorded in 28 (34%) group A patients and in 54 (66%) group B patients with the standard sandwich technique. There was no statistically significant difference between the groups regarding blood count values at the baseline, nor at any time point during at least 6 months follow - up. Stasis occurred in 9 (17%) of infusions in group A versus 30 (32%) in group B, p=0.038, resulting in 63% lower incidence of stasis in the group A. The mean percentage of 90Y dose administered was 92% in group A (95% CI, 88 - 96%) versus 84% in group B (95% CI, 78 - 88%), p=0.014. In 2 (4%) of infusions in group A patients had reflux with non-target radioembolization, compared to 5 (5%) in the group B. After the procedure incidence of laboratory toxicities between group A and B was 3 (12%) and 8 (17%), respectively (p=0.73). Incidence of grade 1-2 toxicities between group A and B was 11 (42%) and 23 (48%), respectively (p=0.8). Incidence of grade 3-4 toxicities between the groups was 2 (8%) and 5 (10%) (p=1).

CONCLUSION

Direct contrast delivery of 90Y resin microspheres is safe without evidence of catheter occlusion or myelosuppression. This method allows real-time monitoring reducing the incidence of stasis and inadequate radiation dose delivery to the tumor.

CLINICAL RELEVANCE/APPLICATION

We provide data on the safety profile of 90Y resin microspheres administration using full strength contrast material providing continuous real-time infusion monitoring and decreasing stasis and reflux.

VSIO21-09 Lipiodol as an Imaging Biomarker of Tumor Response after Transarterial Chemoembolization Therapy in Patients with Primary and Metastatic Liver Cancer: Preliminary Results

Monday, Nov. 27 3:40PM - 3:50PM Room: S406B

Participants
Milena A. Miszczuk, New Haven, CT (*Presenter*) Nothing to Disclose
Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV
Vinayak Thakur, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Nariman Nezami, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Fabian Laage-Gaupp, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Michal E. Kulon, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Johanna M. van Breugel, MSc, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ming De Lin, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Jean-Francois H. Geschwind, MD, Westport, CT (*Abstract Co-Author*) Consultant, Koninklijke Philips NV; Consultant, Terumo Corporation; Consultant, Bayer AG; Consultant, Boston Scientific Corporation; Consultant, BTG International Ltd; Consultant, Bristol-Myers Squibb Company; Consultant, Johnson & Johnson; Consultant, Guerbet SA; Consultant, Merck & Co, Inc; Research Grant, Boston Scientific Corporation; Research Grant, BTG International Ltd; Research Grant, Guerbet SA; Research Grant, Koninklijke Philips NV; Research Grant, PreScience Labs, LLC; Founder and CEO, PreScience Labs, LLC

PURPOSE

To establish the role of Lipiodol as an imaging biomarker of tumor response.

METHOD AND MATERIALS

39 patients with HCC (n=22) or metastatic disease (n=17) were included in this prospective, single arm, phase II clinical trial.Patients were treated with conventional transarterial chemoembolization (cTACE). Imaging was performed at baseline (BL, MRI/CT), 24h post-TACE (CT), and at 1, 3 and 6 months post-TACE (MRI/CT).Data analysis included Lipiodol deposition on BL and follow-up and tumor response assessment using WHO, RECIST, mRECIST, EASL, and qEASL guidelines. Baseline tumor enhancement was compared in responders and non-responders for each response assessment guideline separately.Furthermore, extratumoral, intrahepatic Lipiodol deposition was analyzed over time using native CTs.Statistical analysis included linear regression and student's t-tests.

RESULTS

Responders presented higher tumor enhancement at 1 (WHO, RECIST, EASL, all p<0.05), 3 (WHO, mRECIST, EASL, qEASL, all

Responders presented higher tumor enhancement at 1 (WHO, RECIST, EASL, all p<0.05), 3 (WHO, mRECIST, EASL, qEASL, all p<0.05) and 6 months follow-up (RECIST, p=0.037). Furthermore, a small overall tumor area and high Lipiodol deposition were predictive of response 1 and 3 months post-TACE when applying the qEASL guidelines.Tumor enhancement on BL showed a weak correlation with Lipiodol deposition (24h CT; R2=0.106).Extratumoral Lipiodol washout was substantially higher compared to intratumoral washout.

CONCLUSION

BL tumor enhancement showed a weak positive trend in predicting Lipiodol deposition after cTACE. High tumor enhancement at BL and Lipiodol deposition on initial follow-up (24h) were predictive of response to therapy up until 6 months and 3 months post-TACE, respectively. Patients with small enhancing tumors have a higher chance of response to treatment. In conclusion, Lipiodol can be used as an imaging biomarker of tumor response in patients treated with cTACE.

CLINICAL RELEVANCE/APPLICATION

Lipiodol can be used as an imaging biomarker of tumor response in patients treated with conventional transarterial chemoembolization.

VSIO21-10 Panel Discussion: Current Concepts in the Management of Intermediate-advanced HCC

Monday, Nov. 27 3:50PM - 4:10PM Room: S406B

Participants
Ghassan K. Abou-Alfa, MD, New York, NY (*Presenter*) Research Grant, Amgen Inc; Research Grant, AstraZeneca PLC; Research Grant, Agios Pharmaceuticals, Inc; Research Grant, Bayer AG; Research Grant, Bristol-Myers Squibb Company; Research Grant, CASI Pharmaceuticals Inc; Research Grant, Chugai Pharmaceuticals, Ltd; Research Grant, Exelixis, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Polaris Group; Research Grant, Vicus Therapeutics, LLC; Consultant, Aduro BioTech, Inc; Consultant, Agios Pharmaceuticals, Inc; Consultant, ASLAN Pharmaceuticals Limited; Consultant, Blueprint Medicines Corporation; Consultant, Astellas Group; Consultant, Onxeo SA; Consultant, Boston Scientific Corporation; Consultant, Bristol-Myers Squibb Company; Consultant, CASI Pharmaceuticals Inc; Consultant, Delcath Systems, Inc; Consultant, Eisai Co, Ltd; Consultant, Celgene Corporation; Consultant, Halozyme Therapeutics, Inc; Consultant, Iosen; Consultant, Eli Lilly and Company; Consultant, Gilead Sciences, Inc; Consultant, IntegraGen SA; Consultant, Johnson & Johnson; Consultant, Merck & Co, Inc; Consultant, AstraZeneca PLC; Consultant, Merrimack Pharmaceuticals, Inc; Consultant, NewB Innovation Ltd; Consultant, Momenta Pharmaceuticals, Inc; Consultant, NewLink Genetics Corporation; Consultant, Novartis AG; Consultant, Onxeo SA; Consultant, AbbVie Inc; Consultant, F. Hoffmann-La Roche Ltd; Consultant, sanofi-aventis Group; Consultant, SERVIER; Consultant, Silenseed Ltd; Consultant, SillaJen, Inc; Consultant, Sirtex Medical Ltd; Consultant, Vaxxim AG; Consultant, Vicus Therapeutics, LLC; Consultant, Westhaven
Riad Salem, MD, MBA, Chicago, IL (*Presenter*) Research Consultant, BTG International Ltd Research Grant, BTG International Ltd
Karen T. Brown, MD, New York, NY (*Presenter*) Nothing to Disclose
Anne M. Covey, MD, New York, NY (*Presenter*) Advisory Board, Accurate Medical

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LEARNING OBJECTIVES

1) Recognize the two disease state, the cancer itself and the generally associated cirrhosis of hepatocellular carcinoma (HCC). 2) Recognize the current standards of care used for advanced and metastatic HCC. 3) Learn about the current clinical trials combining local plus systemic therapy for locally advanced and metastatic HCC.

VSIO21-11 Image-guided Ablation Technologies in the Treatment of HCC

Monday, Nov. 27 4:20PM - 4:40PM Room: S406B

Participants
Govindarajan Narayanan, MD, Miami, FL (*Presenter*) Consultant, BTG International Ltd; Consultant, AngioDynamics, Inc; Consultant, Johnson & Johnson;

VSIO21-12 Tumor Burden Assessment in Patients with Intrahepatic Cholangiocarcinoma prior to TACE: Determining the Predictive Value of 3D Tumor Analysis for Overall Survival

Monday, Nov. 27 4:40PM - 4:50PM Room: S406B

Participants
Irvin Rexha, New Haven, CT (*Presenter*) Nothing to Disclose
Nariman Nezami, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Fabian Laage-Gaupp, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the role of 3D tumor burden and enhancement assessment techniques on enhancement based MRI concerning the overall survival (OS) of patients with intrahepatic cholangiocarcinoma (iCCA) before conventional transarterial chemoembolization (cTACE).

METHOD AND MATERIALS

This retrospective study included 73 patients with intrahepatic cholangiocarcinoma, who were treated with cTACE between 2001 and 2015. 1D (overall tumor diameter and enhancing tumor diameter) and 2D (maximum tumor cross-sectional area and enhancing tumor area) measurements were conducted using baseline MRI. Additionally, 3D quantitative tumor analysis was done by assessing enhancing tumor volume (ETV [cm3]), enhancing tumor burden (ETB [%], ratio between ETV [cm3] and total liver volume [cm3]) and total tumor volume (TTV [cm3]). Patients were divided into two groups of high or low tumor burden (HTB and LTB, respectively) by calculating the receiver operating characteristic curve. The statistical analysis was composed of concordances, uni- and multivariate cox proportional hazard ratios (HR) and Kaplan-Meier plots.

RESULTS

Enhancement based measurements achieved good seperation of survival curves with p <= 0.05. For enhancing tumor diameter the MOS was 1.78 times higher in the LTB group when compared to the group of HTB (17.18 vs. 9.63 months, respectively) with p=0.003. Enhancing tumor area achieved a MOS for the LTB group which was 1.79 times higher than in the HTB group with p=0.03 (17.12 vs. 9.56 months, respectively). ETV [cm3] achieved a MOS which was 1.51 times higher in the LTB group (14.46 vs. 9.56 months, respectively) with p=0.01. When using TTV [cm3], the MOS for LTB was 1.89 times higher when compared to the HTB group with p=0.03 (15.41 vs. 8.15 months, respectively). Multivariate analysis showed an HR of 0.46 (95% CI 0.27 - 0.78, p=0.004) and 0.56 (95% CI 0.33 - 0.96, p=0.04) for enhancing tumor diameter and enhancing tumor area, respectively. For ETV and TTV, HR was 0.52 (95% CI 0.30 - 0.91, p=0.02) and 0.58 (95% 0.34 - 0.98, p=0.04).

CONCLUSION

Tumor assessment techniques which focus on volumetric assessment techniques of the enhancing and total tumor volume reliably predict the survival in patients with iCCA.

CLINICAL RELEVANCE/APPLICATION

Using the prognostic factors ETV [cm3] and TTV [cm3] can allow for more personalized treatment decisions and patient staging and may help identify pateints with iCCA that are most suitable for cTACE.

VSIO21-13 Interventional Oncology Treatment of Cholangiocarcinoma

Monday, Nov. 27 4:50PM - 5:10PM Room: S406B

Participants
William S. Rilling, MD, Milwaukee, WI (*Presenter*) Research support, B. Braun Melsungen AG Research support, Sirtex Medical Ltd Research support, Siemens AG Consultant, B. Braun Melsungen AG Consultant, Cook Group Incorporated Consultant, Terumo Corporation Advisory Board, Terumo Corporation

VSIO21-14 3D Quantitative Imaging and Machine Learning in Liver Cancer: From Trial to Practice

Monday, Nov. 27 5:10PM - 5:30PM Room: S406B

Participants
Julius Chapiro, MD, New Haven, CT (*Presenter*) Research Grant, Koninklijke Philips NV

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LEARNING OBJECTIVES

1) Understand the basic principles and standards of HCC assessment. 2) Learn the application of tumor response methodologies and their role as efficacy biomarkers in loco-regional tumor therapy. 3) Understand the role of emerging 3D quantitative imaging techniques, machine learning and radiomics in IO.

ABSTRACT

This talk will provide a full update on response assessment to image-guided tumor therapies in interventional oncology. Novel intra-procedural imaging biomarkers as well as techniques for the assessment of tumor response (mRECIST, RECIST, qEASL) will be discussed. This talk will further provide the rationale for machine learning and deep learning techniques for the assessment of liver cancer.

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RCA24

Radiology Search and Analytics Software Tools for Clinical and Practice Quality Optimization (Hands-on)

Monday, Nov. 27 2:30PM - 4:00PM Room: S401AB

IN

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

Participants
Safwan Halabi, MD, Stanford, CA (*Moderator*) Nothing to Disclose
Safwan Halabi, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Matthew P. Lungren, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Become familiar with available search and analytics tools that can be used to promote clinical and practice quality optimization. 2) Apply common search and analytics techniques to extract meaningful clinical and practice data. 3) Understand the tools and resources needed to develop your practice's search and analytics strategy for performance improvement.

Active Handout:Safwan Halabi

http://abstract.rsna.org/uploads/2017/17002579/Active RCA24.pdf

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RCB24

Teaching Congenital Heart Disease with 3D Printed Models: Double Outlet Right Ventricle (Hands-on)

Monday, Nov. 27 2:30PM - 4:00PM Room: S401CD

CA IN

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

FDA Discussions may include off-label uses.

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
Taylor Chung, MD, Oakland, CA (*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
Andreas Giannopoulos, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

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

ABSTRACT

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

Honored Educators

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

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RCC24

PACS 2018: A Reconstruction

Monday, Nov. 27 2:30PM - 4:00PM Room: S501ABC

IN

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

Participants
Donald Dennison, Waterloo, ON (*Moderator*) Nothing to Disclose
Charlene Tomaselli, MBA, Baltimore, MD (*Presenter*) Nothing to Disclose
Robert Coleman, BS, Portland, ME (*Presenter*) Nothing to Disclose
Donald Dennison, Waterloo, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the basic concepts and variations of a Deconstructed PACS solution. 2) Understand the key success factors when integrating the various solution components. 3) Understanding when an organization is not advised to pursue a Deconstructed PACS solution architecture. 4) Understand the clinical and business drivers that lead organizations to deconstruct their PACS. 5) Understanding the impact of a deconstructed PACS on Radiologists and the imaging informatics IT team. 6) Using a deconstructed PACS to support system consolidation and expansion. 7) Understand the functions of an enterprise imaging platform, and how those functions map to the components of a "Deconstructed PACS". 8) Appreciate both the risks and potential rewards of implementing a Deconstructed PACS solution for enterprise imaging. 9) Identify important areas of focus when selecting systems and vendors needed to reconstruct a working PACS environment. 10) Map a transition strategy from an existing "traditional" PACS approach to a solution comprised of integrated components from different vendors. 11) Identify strategies to address the key challenges associated with a Deconstructed PACS model.

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MSRO24

BOOST: Head and Neck-Case-based Review (An Interactive Session)

Monday, Nov. 27 3:00PM - 4:15PM Room: S402AB

HN NR OI RO

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Suresh K. Mukherji, MD, Northville, MI (*Presenter*) Nothing to Disclose
Sung Kim, MD, New Brunswick, NJ (*Presenter*) Nothing to Disclose
Chad Zender, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Francis P. Worden, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Expose to audience to the experience of a multidisciplinary tumor board. 2) Discuss specific imaging findings that directly afftect staging, treatment and management. 3) Review the optimum modalities to detect cartilage invasion and perineural spread.

ABSTRACT

The intent of this session is to expose to audience to the experience of a multidisciplinary tumor board. Specific cases will be presented that will discuss specific imaging findings that directly afftect staging, treatment and management. The session will also review the optimum modalities to detect important imaging findings such as cartilage invasion and perineural spread.

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MSRO28

BOOST: Gynecologic-Case-based Review (An Interactive Session)

Monday, Nov. 27 3:00PM - 4:15PM Room: S103CD

GU OI RO

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Susanna I. Lee, MD, PhD, Boston, MA (*Moderator*) Editor, Wolters Kluwer nv
Aoife Kilcoyne, MBBCh, Boston, MA (*Presenter*) Nothing to Disclose
Akila N. Viswanathan, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Marcela G. Del Carmen, MD, Boston, MA (*Presenter*) Nothing to Disclose
Bradley Quade, MD,PhD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the role of the multidisciplinary team in diagnosis and treatment as outlined by a radiologist, radiation oncologist, surgeon and pathologist. 2) Analyze and avoid potential pitfalls in the diagnosis and management of gynecologic cancers. 3) Facilitate a multimodality approach to treatment planning.

ABSTRACT

Multidisciplinary discussion of 5 gynecologic oncology cases including experts from pathology, radiology, gynecologic oncology and radiation oncology.

Active Handout:Susanna I. Lee

http://abstract.rsna.org/uploads/2017/17001727/Active MSRO28.pdf

Active Handout:Aoife Kilcoyne

http://abstract.rsna.org/uploads/2017/17001727/Active MSRO28.pdf

SSE01

Breast Imaging (Ultrasound Screening)

Monday, Nov. 27 3:00PM - 4:00PM Room: Arie Crown Theater

BR US

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

Participants
Wendie A. Berg, MD, PhD, Pittsburgh, PA (*Moderator*) Nothing to Disclose
Stamatia V. Destounis, MD, Scottsville, NY (*Moderator*) Hologic, Inc. Scientific Advisory Board

Sub-Events

SSE01-01 Ultrasound Screening After Digital Mammography versus Digital Breast Tomosynthesis

Monday, Nov. 27 3:00PM - 3:10PM Room: Arie Crown Theater

Participants
Elizabeth H. Dibble, MD, Providence, RI (*Presenter*) Nothing to Disclose
Tisha M. Singer, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Nneka Jimoh, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Grayson L. Baird, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Ana P. Lourenco, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare the yield of dense breast ultrasound (US) screening following digital mammography (DM) versus digital breast tomosynthesis (DBT).

METHOD AND MATERIALS

IRB-approved, HIPAA compliant retrospective search of radiology databases at two tertiary breast imaging centers and an office practice staffed by the same fellowship-trained breast radiologists to identify screening US examinations from 10/1/14-9/30/16. Prior DM vs. DBT, demographic information, abnormalities on screening US, and pathology results were recorded. Additional breast cancers detected with US after DM vs. DBT and additional benign lesions requiring biopsy or follow-up were calculated. Because the time between DM or DBT and US varied, time between exams was estimated using Kaplan-Meier analysis. Differences between DM and DBT were compared using Chi Square and Fisher's Exact Tests.

RESULTS

3187 screening breast US exams were performed (3025 (94.9%) initial screening US exam; mean age 54.4, range 18.2-90.1); 1434 after DM and 1672 after DBT. 81 did not have a prior mammogram available. There were 201(14.0%) BI-RADS 3 results after DM and 177 (10.6%) after DBT (p=0.004). 119 biopsies or aspirations had results available. Of the 44 biopsies or aspirations after DM, 7 (16%) were malignant and 37 (84%) were benign; of the 75 biopsies or aspirations after DBT, 9 (12%) were malignant and 66 (88%) were benign (p=0.546). The additional cancer detection rate by US after DM was 5/1434 or 3.5 per 1000 women screened and after DBT was 5/1672 or 3 per 1000 women screened (p=0.810). Figure 1 summarizes US screening results. The median time between cancer detection with US after DM vs. DBT was not statistically significantly different (p=0.999).

CONCLUSION

No significant difference was observed in additional cancer detection rate with screening US following DM vs. DBT. The BI-RADS 3 rate of screening US was significantly lower following DBT.

CLINICAL RELEVANCE/APPLICATION

Knowing that the cancer yield of screening US is similar for prior DBT vs. DM may help inform clinical practice, as questions abound about whether DBT is sufficient supplemental screening for women with dense breast tissue.

SSE01-02 A Prospective Study of Automated Breast Ultrasound (ABUS) in a DBT Based Screening Practice of Women with Dense Breasts

Monday, Nov. 27 3:10PM - 3:20PM Room: Arie Crown Theater

Participants
Denise M. Chough, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
David Gur, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Grace Y. Rathfon, MD, Monroeville, PA (*Abstract Co-Author*) Nothing to Disclose
Amy H. Lu, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Terri-Ann Gizienski, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Christiane M. Hakim, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Marie A. Ganott, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Wendie A. Berg, MD, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess prospectively the informativeness and reporting consistency of ABUS as supplemental imaging of women with dense breast tissue as determined from prior mammograms.

METHOD AND MATERIALS

We are currently performing a prospective, fully balanced, IRB approved trial in which women with dense breasts undergo DBT plus ABUS screening. Two of six specifically trained, participating radiologists independently and sequentially first interpret DBT, or ABUS, alone and then interpret the other modality. The primary interpreting radiologist receives the second interpreting radiologist's opinion only when there is a disagreement and determines the final clinical management recommendation. We report all screening recommendations and diagnostic outcomes on the first 467 examinations performed prior to January 31, 2017 and for which all diagnostic workups, if any, are complete.

RESULTS

Of 934 initial independent interpretations (467X2), the initial recall recommendations rates were 64 (6.9%) and 102 (10.9%) on DBT alone and ABUS alone, respectively. Disagreement rates between the two readers for the same modality (double readings) were higher ($p < 0.05$) for ABUS (68 disagreements) than DBT (48 disagreement). After reviewing second opinions, when applicable, by the primary reader, 29 initial recommendations/decisions were changed (11 from "negative" or "benign" to "recall" and 18 from "recall" to "negative" or "benign). Only 31% of actually recalled patients were initially recalled by both modalities, suggesting that DBT and ABUS tend to frequently depict different "suspicious" abnormalities. Of the 15 biopsies performed to date, 3 were initially recalled by DBT alone, 7 by ABUS alone, and 5 by both. Three cancers were found, two initially recalled by both DBT and ABUS and one was recalled by ABUS only.

CONCLUSION

ABUS, perhaps with double reading only of examinations initially rated as BIRDS 0, may prove efficacious as a supplement to DBT and possibly as a primary screening modality of women with dense breasts.

CLINICAL RELEVANCE/APPLICATION

ABUS with double readings of initially suspected examinations should be investigated both as a potential supplement to DBT as well as a possible primary screening modality of women with dense breasts.

SSE01-03 Accuracy and Outcomes of Screening Breast Ultrasound in Women with a Personal History of Early-Stage Breast Cancer

Monday, Nov. 27 3:20PM - 3:30PM Room: Arie Crown Theater

Participants
Soo-Yeon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Nariya Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Bo Ra Kwon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Ui Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sooyeon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Su Hyun Lee, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Min Chang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Research Grant, General Electric Company
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the performances of breast ultrasonographic (US) screening in women with a personal history of breast cancer (PHBC) by comparison with those in women without personal history of breast cancer (non-PHBC).

METHOD AND MATERIALS

Between January 2013 and December 2013, 12747 consecutive screening whole breast US examinations were identified. Among them, women with early-stage breast cancer (stage 0, I or II) were eligible. Non-PHBC women who underwent incident screens at least 9 months ago and had negative mammography and at least 1-year follow-up were matched 1:1 to PHBC women according to breast density and age. Screening performance measures were calculated and compared between the two groups by using generalized estimation equation or chi-square test. Characteristics of screen-detected and interval cancers were described.

RESULTS

There were 3435 exams in 3226 PHBC women (mean age, 52.3; range, 24-83 years) and 3291 exams in 3226 matched women without PHBC (mean age, 52.2; range, 25-84 years) (603 fatty, 2623 dense women for each group). Fourteen cancers (10 screen-detected, 4 interval cancers) were observed in PHBC women and 13 cancers (12 screen-detected, 1 interval cancer) in non-PHBC women. Performances of PHBC vs non-PHBC women were similar in the following outcomes; cancer detection rate of 2.9 per 1000 vs 3.6 per 1000 (P=.60), interval cancer rate of 1.2 per 1000 vs 0.3 per 1000 (P=.23), sensitivity of 71.4% (10/14) vs 92.3% (12/13) (P=.33), positive predictive value for biopsy performed(PPV3) of 10.9% (4/37) vs 21.1% (12/57) (P=.20). Specificity and abnormal interpretation rate of PHBC were better than those of non-PHBC as follows; 93.2% (3176/3421) vs 89.6% (2917/3278) (P<.001) and 7.4% (255/3435) vs 11.2% (373/3291) (P<.001). In addition, 70% (7/10) of screen-detected cancers and 50% (2/4) of interval cancers in PHBC women were stage I or II, while all observed cancers (100%, 13/13) were stage I or II in non-PHBC women (64.3% [9/14] vs. 100% [13/13], P=.04).

CONCLUSION

US screening in PHBC women detects early second breast cancers with higher specificity, however, has more advanced stage observed cancers, relative to those in non-PHBC women.

CLINICAL RELEVANCE/APPLICATION

Supplemental breast US screening in addition to mammography is recommendable for breast cancer survivors, although more advanced stage cancers are observed than those in non-PHBC women.

SSE01-04 Background Echotexture on Breast Ultrasound: Impact on Diagnostic Performance of Supplemental Screening in Women with Negative Mammography

Monday, Nov. 27 3:30PM - 3:40PM Room: Arie Crown Theater

Participants
Su Hyun Lee, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ann Yi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Soo-Yeon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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PURPOSE

To evaluate the effect of background echotexture on the diagnostic performance of screening ultrasound (US) in women with negative mammography.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board and the requirement for written informed consent was waived. Between January 2012 and December 2014, 10277 women who underwent screening US after negative mammography and had a report on background echotexture were identified. Bilateral whole breast US were performed with a handheld device by experienced radiologists. Background echotexture was prospectively assessed according to the BI-RADS classification. The abnormal interpretation rate, cancer detection rate, and positive predictive value of screening US were compared between groups with homogeneous and heterogeneous background echotextures using a chi-square test.

RESULTS

Of 10277 women, 7206 (mean age, 53.6 yrs) showed homogeneous background echotexture and 3071 (mean age, 48.5 yrs; P<.001) showed heterogeneous background echotexture. Abnormal interpretation rate was significantly higher in group with heterogeneous background echotexture than those with homogeneous background echotexture (20.0% [613/3071] vs 8.1% [582/7206]; P<.001). Eleven cancers (4 DCIS and 7 invasive) were detected in group with homogeneous background echotexture (cancer detection rate, 1.5 per 1000 exams) and 9 cancers (1 DCIS and 8 invasive) were detected in group with heterogeneous background echotexture (cancer detection rate, 2.9 per 1000 exams; P=.147). Positive predictive value for biopsy performed (PPV3) was 9.5% (10/105) in group with homogeneous background echotexture and 5.0% (5/100) in group with heterogeneous background echotexture (P=.286). There were 3 known false-negative screening US in our study population, all performed in women with heterogeneous background echotexture.

CONCLUSION

Heterogeneous background echotexture on breast US was associated with higher abnormal interpretation rate in supplemental screening. Higher cancer detection rate and lower PPV3 were noted in screening US with heterogeneous background echotexture although the difference was not statistically significant.

CLINICAL RELEVANCE/APPLICATION

Background echotexture can affect the diagnostic performance of screening US. Care should be taken when interpreting screening US in women with heterogeneous background echotexture.

SSE01-05 Diagnostic Performance of Automated Breast Ultrasound in Breast Cancer Screening: Independent Evaluation of Coronal View and Transverse View

Monday, Nov. 27 3:40PM - 3:50PM Room: Arie Crown Theater

Participants
Megumi Nakajima, MD, Obihiro-Shi, Japan (*Presenter*) Nothing to Disclose
Kiyoshi Namba, MD, Obihiro, Japan (*Abstract Co-Author*) Medical Advisor, QView Medical, Inc; Medical Advisor, Volpara Health Technologies Limited; Educator, General Electric Company

PURPOSE

Automated Breast Ultrasound (ABUS) has been proven to find more invasive breast cancers when used as adjunct to mammography (MG) in screening. ABUS is characterized by coronal view (CV) and transverse view (TV). ABUS reading is directed to go through both views to elicit the result. Despite CV is innovative and potential invention of diagnostic ultrasound, no independent scientific evaluation has ever been pursued. Purpose of this study is to pursue diagnostic performance and efficiency of CV and TV independently. The way of reading whole breast data of ABUS is different from hand-held ultrasound (HHUS), and we have investigated the efficient way. The CV is unique view of ABUS which we are not used to reading and the TV is similar to HHUS which we are used to. We think detecting by CV and evaluating by TV is safe and short time way in breast cancer screening. So we studied about the safety of detecting breast cancers by CV by comparing with TV. This prospective study is the first trial to evaluate the diagnostic performance of ABUS in comparison between CVand TV.

METHOD AND MATERIALS

Two separate image data sets (a total of 200 breasts, 100 CVs & 100 TVs) were blindly prepared. Each set contained unilateral breast images 32 nomal, 38 benign, and 30 malignant cases. All readers completed ABUS Mandatory Program in advance.Three breast cancer specialists (A,B,C) of different degrees of experience with ABUS (A: >2y ABUS, B: 50 ABUS, C: HHUS only) read CV

and TV independently. Two sets were read separately, whithin one hour per day, with no clinical imformation. Subjects: ABUS (Oct.2014 - Jan.2017). 24-81 y.o.(median: 552.0, average: 53.2). A total of 30 cancers were DCIS (4), IDC (22), mucinous carcinoma (2), ILC (2), and findings of them were non-mass (4) and masses (26). Average tumor size was 13.8mm (6.1mm-23.2mm). BI-RADS (ACR) categories were used for evaluation.The sensitivity, specificity and reading time were assessed.

RESULTS

1. Sensitivity was 80.0% and 75.6% (CV vs TV, *P*=0.0179). 2. Specificity was 81.9% and 80.5% (CV vs TV, *P*=0.423). 3. The average reading time of CV and TV were 136 seconds/case and 166 seconds/case respectively.

CONCLUSION

Diagnostic performance of CV was superior to TV, and reading time was shorter in CV. CV was suggested to be useful in screening setting.

CLINICAL RELEVANCE/APPLICATION

Future appropriate application of CV interpretention has a potential to improve values of ABUS in breast cancer screening.

SSE01-06 Recall Rates for Technologist-Performed Screening Ultrasound Compared to DBTs and Influence of Double Reading

Monday, Nov. 27 3:50PM - 4:00PM Room: Arie Crown Theater

Participants
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Andriy I. Bandos, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess recall rate after technologist-performed handheld screening ultrasound (US) read in batch mode compared to recall rate using tomosynthesis with synthetic 2D reconstructions (DBTs) in women with dense breasts.

METHOD AND MATERIALS

Across three practices, from 12/1/15 through 1/31/17, 3021 women, with at least heterogeneously dense breasts by prior mammography or on baseline, aged 40-75 years, were enrolled in an IRB-approved HIPAA-compliant protocol to have technologist-performed handheld US with standard documentation after clinically performed DBTs. Two breast-imaging specialist radiologists reviewed images from each modality in batch mode, initially blinded to the other modality results, with one observer interpreting US first and one DBTs first. After reviewing both modalities together, observers were asked if they would still recall the patient. Reader 1 considered the input of reader 2 for final participant management.

RESULTS

Median participant age was 54.5 years. Across 6042 readings (3021x2), recall rate from either observer on DBTs was 496 (8.2%) and from US 576 (9.5%, p= 0.009); after reviewing both modalities, recall was recommended in 821 (13.6%) of interpretations. This represents an increase in recalls of 325/6042 (5.4%) compared to DBTs alone. Recall rates varied significantly by site, ranging from 2.5% to 14.5% (p<0.0001) for ultrasound and from 3.2% to 10.4% (p<0.0001) for DBTs. Only 42 US recalls were for immediate additional evaluation (BI-RADS 0) before a final assessment could be rendered. There were 376 reader disagreements regarding participant recall: 172 based on US only; 210 on DBTs only; and 25 on both. After reader integration, 18 participants were changed to US recall, 32 to DBTs recall, and 9 to both; 2 were changed to no recall on US, 19 to no recall on DBTs, and 32 to no recall on either modality, for a net change of 6 additional recalls.

CONCLUSION

Adding technologist-performed handheld US to screening DBTs increased recall rate by 5.4%. Observers gave a final assessment for 6000/6042 (99.3%) interpretations of technologist-performed handheld US using a standardized screening protocol. Double reading had a neutral effect on recall rate.

CLINICAL RELEVANCE/APPLICATION

It is feasible to implement technologist-performed screening US with batch interpretation, though recall rates for additional testing varied by site.

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103rd Scientific Assembly and Annual Meeting
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McCormick Place, Chicago
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SSE02

Breast Imaging (MRI Response to Neoadjuvant Treatment)

Monday, Nov. 27 3:00PM - 4:00PM Room: E450A

BR MR

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

Participants
Elizabeth A. Morris, MD, New York, NY (*Moderator*) Nothing to Disclose
Constance D. Lehman, MD, PhD, Boston, MA (*Moderator*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company

Sub-Events

SSE02-01 Phenotypic Biomarkers of Intra-Tumor Heterogeneity in Breast DCE-MRI Can Augment Tumor Volume Measures in Predicting Survival after Neoadjuvant Chemotherapy for Locally Advanced Breast Cancer: Results from the ACRIN 6657/I-SPY-1 Trial

Monday, Nov. 27 3:00PM - 3:10PM Room: E450A

Participants
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PURPOSE

Breast cancer is biologically heterogeneous. Image-based assessment may alleviate pathologic sampling limitations to allow for more comprehensive assessment of tumor heterogeneity. We investigate tumor heterogeneity metrics derived from DCE-MRI as biomarkers to augment early prediction of long-term survival after neoadjuvant chemotherapy for locally advanced breast cancer.

METHOD AND MATERIALS

The ACRIN 6657/ISPY-1 trial cohort was accessed from NCI's Cancer Imaging Archive and DCE-MRI images were retrospectively analyzed for 106 women who had complete clinical and imaging data with tumor segmentations. Age, race, hormone receptor status (ER/PR/Her2), and functional tumor volume (FTV) were available. Four kinetic features (signal enhancement ratio, peak enhancement, wash-in/wash-out slope) were computed voxel-wise from DCE-MRIs acquired at the first post-treatment visit. Spatio-temporal heterogeneity was quantified for each feature using multi-resolution wavelets and principal component analysis was applied on the wavelet decomposition feature vectors to reduce dimensionality. Time-to-event analysis was performed using the Cox proportional hazards model and prediction of recurrence-free survival (33 events) was estimated with the c-statistic. A baseline model with FTV, age, race, and receptor status was compared using the likelihood-ratio test (LRT) to a model where tumor heterogeneity measures were added based on their univariate performance and low (<0.25) correlation to FTV.

RESULTS

The baseline model with age, race, receptors, and FTV had a c-statistic=0.70 (p=0.005), where FTV was the only significant predictor (p<0.001). A parsimonious model including FTV plus the top four univariate performing tumor heterogeneity features with low correlation to FTV had a c-statistic=0.77 (pLRT<0.001), where 3 out of 4 included features had independent contribution (p<=0.05). A model including the four heterogeneity features, but without FTV, had a c-statistic=0.71 (p=0.007), indicating similar performance to FTV.

CONCLUSION

Our preliminary data suggests that early prediction of survival after breast neoadjuvant chemotherapy can be improved when DCE-MRI measures of tumor heterogeneity are added to tumor volume measures.

CLINICAL RELEVANCE/APPLICATION

Tumor heterogeneity analysis via imaging may improve prediction of therapeutic efficacy, allowing for early treatment modification to avoid futile therapy while achieving precision cancer treatment.

SSE02-02 Patterns, Predictive Factors of Locoregional Recurrence in Breast Cancer Patients Undergone Breast-Conserving Surgery After Tumor Down-staging by Neoadjuvant Chemotherapy

Monday, Nov. 27 3:10PM - 3:20PM Room: E450A

Participants
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PURPOSE

We evaluated patterns and predictive factors of locoregional recurrence (LRR) in patients undergone BCS after tumor down-staging through NAC by comparison with those of pre-planned BCS group.

METHOD AND MATERIALS

Between October 2003 and September 2015, 688 consecutive breast cancer patients who had undergone BCS after NAC were identified. Patients with incomplete clinicopathologic information (n=27), bilateral breast cancer (n=6), or unavailable preoperative breast MRI (n=3) were excluded. Finally, 652 women (mean age, 45.4 years; range, 22-78 years) composed of 551 down-staged BCS and 101 pre-planned BCS patients were included. Rate and site of LRR were compared between the two groups using Fisher's exact test. MR imaging features (non-mass enhancement, rim enhancement, and peritumoral edema) and clinicopathologic features (age, stage, histologic grade, lymphovascular invasion, margin status, tumor subtype, radiotherapy, endocrine therapy) were analyzed to identify independent predictors associated with LRR by using multivariable regression analysis. Median follow-up was 64.1 months.

RESULTS

LRRs were diagnosed in 50 patients (9.8% [72.0% local and 28.0% regional]). No difference was found in the rate of LRR between the down-staged and pre-planned BCS groups (9.8% [54/552] vs. 9.9% [10/101], P=.975). LRR was more frequently found at the original tumor bed in down-staged BCS group than in pre-planned BCS group (50.9% [27/53] vs. 10% [1/10]; P=.016). In multivariable regression analysis, younger age <= 40 years (OR = 2.180, 95% CI = 1.157 to 4.108, P=.016), pathologic stage of 3 (OR = 6.297, 95% CI =2.614 to 15.170, P=<.001), and absence of radiotherapy (OR = 5.222, 95% CI =1.832 to 14.880, P=.002) remained an independent predictor of LRR. In addition, there was a tendency that patients with non-mass enhancement on preoperative MRI experience LRR (OR = 2.119, 95% CI = 0.976 to 4.597, P=.058).

CONCLUSION

Non-mass enhancement on preoperative MRI tends to be associated with LRR which frequently occurs in the original tumor bed in breast cancer patients undergone BCS after down-staging by NAC.

CLINICAL RELEVANCE/APPLICATION

Although BCS after tumor down-staging by NAC is oncologically safe, careful postoperative surveillance is needed for the original tumor bed, when non-mass enhancement was present on initial MRI.

SSE02-03 Comparison of Pathologic Response Evaluation Systems after Neoadjuvant Chemotherapy in Breast Cancers: Correlation with Breast MRI Computer-Aided Detection

Monday, Nov. 27 3:20PM - 3:30PM Room: E450A

Participants
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PURPOSE

Several pathologic methods are used to assess the tumor response of breast cancer after neoadjuvant chemotherapy (NAC) to predict clinical outcome. The purpose of the study was to investigate the tumor response after NAC using dynamic contrast-enhanced (DCE) magnetic resonance (MR) imaging parameters assessed with a commercially available computer-aided system and analyzed their correlation with pathologic response assessment systems.

METHOD AND MATERIALS

Our institutional review board approved this retrospective study. Between January and December 2015, 223 consecutive patients who had DCE MR imaging before and after completion of NAC prior to definitive surgery were included. The reduction rate of maximum diameter, volume, peak enhancement, and persistent, plateau, and washout-enhancing components were measured with a computer-aided system on DCE MR images and correlated with the Miller-Payne grading system, residual breast cancer burden (RCB) classes and RCB index.

RESULTS

The reduction rate was 65.5 ± 34.5 for maximum diameter, 84.4 ± 46.6 for volume, 56.8 ± 48.1 for peak enhancement, -31.0 ± 426.1 for persistent component, -7.8 ± 756.9 for plateau component, and 42.8 ± 225.9 for washout component. All six MR imaging parameters showed the best correlation with the Miller-Payne grading system (r = 0.472 to 0.722, P < 0.001), followed by RCB class (r = -0.580 to -0.412, P < 0.001) and RCB index (r = -0565 to -0.413, P < 0.001). Comparing with Miller-Payne grading system, the reduction rate of volume (r = 0.722, P < 0.001) showed the strongest correlation followed by maximum diameter (r = 0.687, P < 0.001), peak enhancement (r = 0.638, P < 0.001), plateau component (r = 0.562, P < 0.001), washout component (r =

0.548, P < 0.001), and persistent component (r = 0.472, P < 0.001).

CONCLUSION

Miller-Payne grading system showed the best correlation with the changes of DCE MR imaging parameters measured automatically by a commercially available computer-aided system, and the reduction rate of tumor volume measured on MR imaging showed the strongest correlation with the pathologic tumor response.

CLINICAL RELEVANCE/APPLICATION

The reduction rate of tumor volume measured on MR imaging showed the strongest correlation with the Miller-Payne grading system and could be applied to predict pathologic response.

SSE02-04 DCE-MRI Texture Features of Locally Advanced Breast Cancer: Correlation with Tumor Biomarkers, Post-Treatment Imaging and Pathologic Complete Response

Monday, Nov. 27 3:30PM - 3:40PM Room: E450A

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PURPOSE

Computer-extracted texture analysis of locally advanced breast cancers (LABC) on pre-treatment dynamic contrast MR imaging (DCE-MRI) may predict radiomic classification of tumors and pathologic response. The purpose of this study was to evaluate tumor and peritumoral texture features associated with tumor type, pathologic complete response (pCR), and post-treatment imaging volume.

METHOD AND MATERIALS

In this institutional review board-approved study, 44 women with LABC underwent breast DCE-MRI on a 3.0T magnet prior to and after neoadjuvant chemotherapy. In-house segmentation software was used to draw whole lesion 3D regions of interest on pre- and post-treatment imaging and automatically select a peritumoral enhancement ring. Computer-generated texture features for whole lesion and peritumoral enhancement were extracted from fat-suppressed first post-contrast T1-weighted (T1W) and corresponding subtraction (sub) pre-treatment images using three spatial scales (SS) at ~1 mm/4 mm/8 mm resolution. Texture features were correlated with tumor biomarkers, post-treatment imaging % volume change, and pCR, using Kruskal-Wallis, Mann-Whitney and Spearman rank tests.

RESULTS

Cancers were 29.5% (13/44) estrogen receptor/progesterone receptor positive, (ER/PR+), 15.9% (7/44) triple negative breast cancer (TBNC) and 54.5% (24/44) human epidermal growth factor receptor 2-overexpressed (HER2+). 43% (19/44) achieved pCR. For all lesions, lesion entropy on SS-8 mm sub images correlated with pCR (p=0.039). Peritumoral enhancement mean on T1W images correlated with ki-67 (R=0.391, p=0.024); peritumoral enhancement entropy (R=0.433, p=0.006) and skew (R=0.0372, p=0.02) correlated with volume change after chemotherapy. Peritumoral enhancement entropy on T1W (p=0.018) and sub images (p=0.042) correlated with tumor markers, as did whole lesion sub mean (p=0.004), skew (p=0.003), kurtosis (p= 0.003) and entropy (p=0.049). For HER2+ cancers, peritumoral and whole lesion features did not predict pathologic or imaging response, but correlated to ki-67 (R=0.662, p=0.003; R=0.604, p=0.008).

CONCLUSION

Whole lesion and peritumoral texture features on pre-treatment DCE-MRI may predict tumor biomarkers and response to neoadjuvant chemotherapy in LABC.

CLINICAL RELEVANCE/APPLICATION

Pre-treatment DCE-MRI texture features may predict tumor aggressiveness and response to neoadjuvant chemotherapy in locally advanced breast cancer, allowing for targeted treatment.

SSE02-05 Texture Entropy Features at 1 Centimeter Outside HER2+ Breast Cancer Lesions Predict Response-Associated Molecular Subtypes on DCE-MRI

Monday, Nov. 27 3:40PM - 3:50PM Room: E450A

Awards
Trainee Research Prize - Medical Student

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PURPOSE

Radiomics (computerized imaging feature extraction) has been successful in the prediction of breast cancer biology and outcomes, but has thus far focused within the lesion or bulk parenchyma. In this work, we evaluate whether radiomic features relating to heterogeneity patterns extracted from outside the tumor are predictive of the molecular sub-subtypes (enriched and non-enriched) of HER2+ breast cancers identified by PAM50 profiling. We hypothesize that the HER2-Enriched (HER2E) subtype, associated with high treatment response, may be distinguishable by radiomic analysis of the peritumoral region on DCE-MRI.

METHOD AND MATERIALS

42 1.5 or 3 T pre-treatment DCE-MRI scans of HER2+ patients with PAM50-identified molecular subtype (19 HER2E, 23 non-HER2E) were retrospectively analyzed. Radiomic features (Co-occurrence of Local Anisotropic Gradient Orientations (CoLIAGe), Laws, Haralick, and Gabor) were computed intratumorally and within 3 mm annular peritumoral rings out to a 15 mm radius . The top 5 HER2E-associated features within each region were identified by Wilcoxon feature selection and used to train a diagonal linear discriminant analysis classifier in a 3-fold cross-validation setting. The feature most commonly selected across all bins was identified and used to predict HER2E alone in each region.

RESULTS

The set of top intratumoral features, consisting of Gabor, Haralick, and Laws features, predicted HER2E with an area under the receiver operating characteristic curve (AUC) of .77 +/- .03. Within the 6-9 mm and 9-12 mm bins, top feature sets consisted solely of CoLIAGe features and predicted HER2E with AUCs of .82 +/- .03 and .83 +/- .02, respectively. Statistics of the single most commonly selected feature only (CoLIAGe Difference Average) predicted HER2E most effectively within the 9-12 mm bin (AUC = .77 +/- .02), but performed poorly intratumorally (AUC = .51 +/- .07).

CONCLUSION

Texture features extracted 6-12 mm beyond the lesion were found to distinguish HER2+ sub-subtypes more strongly than features within the tumor. Elevated disorder of intensity gradient orientations detected by CoLIAGe features in the peritumoral region better identified HER2E compared to texture features from within the tumor.

CLINICAL RELEVANCE/APPLICATION

Imaging features from the peritumoral region may help enable non-invasive sub-subtyping of breast cancer patients and provide new insights into tumor biology that are as yet poorly understood.

SSE02-06 Performance of Late Enhancement and Apparent Diffusion Coefficient Ratio Detected on Magnetic Resonance Imaging to Predict Pathologic Response after Neoadjuvant Systemic Therapy in Various Breast Cancer Subtypes

Monday, Nov. 27 3:50PM - 4:00PM Room: E450A

Participants
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PURPOSE

To assess the performance of MR late enhancement (LE) and apparent diffusion coefficient (ADC) ratio to predict pathologic response (PR) after neoadjuvant systemic therapy (NST) in breast cancer subtypes.

METHOD AND MATERIALS

This was a prospective study with waiver of informed consent. From January 2015 to December 2016, 83 women (mean age, 58) with breast cancer undergoing NST were enrolled. Eight lesions (10%) were immunohistochemically HER2+, 12(14%) triple negative, 10(12%) luminal A-like, 43(52%) luminal B-like and 10(12%) luminal B-like/HER2+. Breast MRI was performed before and after NST. On MRI, absence or presence of LE in the posttreatment exam and ADC ratio (ADC postreatment/ADC pretreatment) of the lesion were assessed. Pathologic complete response (pCR) was defined as no residual ductal carcinoma in situ or invasive disease in the breast. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and global accuracy of LE were calculated. Receiver operating characteristic (ROC) curves evaluated the predictive performance of univariate and multivariate models for PR.

RESULTS

PCR was reported in 16% (13/83) of cases. Absence of LE was observed in 19% (16/83). Overall, assessment of LE after NST had a 87% sensitivity, 54% specificity, 91% PPV, 44% NPV and 82% accuracy to predict PR. The breakdown by subtypes showed no pCR in luminal A-like or luminal B-like/HER2+. Luminal B-like subgroup achieved pCR in 9% (4/43). Triple-negative cancers showed pCR in 33% (4/12) and LE predicted PR with 100% sensitivity, 20% specificity, 73% PPV, 100% NPV and 75% accuracy. Finally, the HER2+

subgroup responded the most, achieving pCR in 63% (5/8) with LE predicting PR with 67% sensitivity, 80% specificity, 67% PPV, 80% NPV and 75% accuracy. Mean ADC ratio in the pCR subgroup was significantly higher than that in the non-pCR subgroup (p= 0.003). A multivariate model including LE and ADC ratio predicted PR with an 85% accuracy (95% CI: 72%-97%).

CONCLUSION

Late enhancement and ADC ratio are independent predicting factors for pathologic response after NST in breast cancer.

CLINICAL RELEVANCE/APPLICATION

These results pose the possibility of omitting locorregional surgery in highly-selected groups of patients with HER2+ breast cancer who achieve pCR after NST demonstrated by absence of LE and high ADC ratio on MR imaging. Vacuum-assisted biopsy would be needed previously to confirm the predicted pCR.

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November 26 to December 1
McCormick Place, Chicago
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SSE03

Cardiac (Myocardial Ischemia and Viability: MRI)

Monday, Nov. 27 3:00PM - 4:00PM Room: S502AB

CA MR

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

FDA Discussions may include off-label uses.

Participants
J. Paul Finn, MD, Los Angeles, CA (*Moderator*) Speakers Bureau, Bayer AG; ; ;
Arthur E. Stillman, MD, PhD, Atlanta, GA (*Moderator*) Nothing to Disclose

Sub-Events

SSE03-01 First Human Application of a Prototype Non-Binary Myocardial Infarct Quantification Technique Accounting for Partial Volume Averaging: Technical Feasibility and Inter-Reader Assessment

Monday, Nov. 27 3:00PM - 3:10PM Room: S502AB

Participants
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PURPOSE

Binary threshold-based myocardial infarct (MI) quantification techniques ignore partial volume averaging, yielding substantial mischaracterization of MI. This study aimed to assess the technical feasibility of MI quantification using a prototype non-binary algorithm - percent infarct mapping (PIM) - in patients with suspected MI.

METHOD AND MATERIALS

Patients (n=171, 64±14y) referred for 1.5T cardiac MR were prospectively enrolled in this IRB-approved study. MRI protocol included late gadolinium enhancement (LGE) acquisition (in-plane 1.2×1.2mm2, echo/repetition time [TE/TR] 3.9/8.4ms; flip 25°), and post-contrast T1 mapping (MOLLI scheme 4(1)3(1)2; in-plane 1.56×1.56mm2; TE/TR 2.6/1.1ms; flip 35°). MI percentage (MI%) was quantified by two readers based on LGE images using manual delineation and binary approaches (2-5 standard deviations [SD] and full-width at half-maximum [FWHM] thresholds), as well as based on T1 and LGE images applying the previously described PIM algorithm (PIMT1 and PIMLGE, respectively) using an in-house developed application integrated into the Research Mass Software. Mann-Whitney and Bland-Altman (BA) tests were used for data analysis.

RESULTS

MI was observed in 89 (52%) patients and in 185 short-axis slices. MI% with binary 2, 3, 4, 5 SDs and FWHM techniques was 15.7±6.6, 13.4±6.8, 11.6±5.9, 10.9±5.5, and 10.1±5.9%, respectively. The 5SD and FWHM techniques showed the best agreement with manual MI delineation (9.9±6.1%, BA bias 1.3% and 1.2%, respectively). 2SD and 3SD algorithms, however, significantly overestimated manual MI% (P=0.0054 and P=0.0197, respectively). PIMLGE measured significantly lower MI% (7.9±4.8%) compared to manual measurements (P=0.0011). PIMLGE, however, showed the best agreement with the PIMT1 reference (7.6±4.9%, P=0.1084, BA bias 0.4%). Inter-reader agreement was high using all the algorithms (BA bias range 0.1-1.3%).

CONCLUSION

The human application of PIMLGE technique for MI quantification is feasible. As expected, PIMLGE provides significantly smaller MI% than any thresholding technique due to its ability to account for voxel-wise MI content. Additionally, it has excellent agreement with the T1-based, validated reference.

CLINICAL RELEVANCE/APPLICATION

PIMLGE is able to visualize and quantify the heterogeneity of MI providing further advantages in multiple clinical scenarios such as localizing post-MI arrhythmia foci and assessing potential myocardial salvage.

SSE03-02 Rest and Stress T1-Mapping and T1 Reactivity in Patients with and Without Coronary Artery Disease

Monday, Nov. 27 3:10PM - 3:20PM Room: S502AB

Participants
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PURPOSE

To demonstrate the possibilities of T1 mapping in rest and stress as a novel gadolinium-free method for tissue characterization discriminating normal and diseased myocardium in a patient group with or without coronary artery disease (CAD).

METHOD AND MATERIALS

We prospectively included patients who underwent stress perfusion as part of clinical work up due to suspicion of CAD. Conventional stress perfusion imaging and late gadolinium enhancement (LGE) were performed to identify perfusion defects and to discriminate ischemic and infarcted myocardium. The patients were divided into three groups, an ischemic group, an infarct group and a control group without perfusion defects. A Modified Look-Locker Inversion Recovery (MOLLI) based T1-mapping sequence was performed at both rest and in stress using a 1.5T MR system. A pixel-wise T1 map of the myocardium was acquired in short-axis view with inline motion correction. A single-shot steady-state free-precession readout was used to generate the images. The T1 maps were analyzed on commercial software. Short-axis T1 maps were manually contoured using conservative septal sampling , and specific sampling in ischemic or infarcted regions of interest (ROI) based on perfusion images and LGE images.

RESULTS

We included a total of 64 patients, 10 patients with ischemic myocardium, 15 patients with infarcted myocardium and 39 control patients. Heart rate increased in all three groups with the use of adenosine, but in the infarcted group the heart increased significantly less during stress compared to the control group. Pre-contrast native T1-values were significantly higher in infarcted myocardium in rest and stress (median 1044(IQR 985-1076) and 1053(IQR 989-1088)) compared to ischemic myocardium (median 961(IQR 939-988) and 958(IQR 945-988)). T1 reactivity was significantly lower in ischemic and infarcted myocardium (median 0.00 (IQR -0.18-0.16) and 0.41(IQR 0.09-0.86))compared to normal remote myocardium (median 3.54(IQR 1.48-5.78) and 3.21(IQR 1.95-4.79)).

CONCLUSION

In conclusion T1-mapping in rest and stress is able to distinguish between normal, normal remote, ischemic and infarcted myocardium using native T1 and T1 reactivity.

CLINICAL RELEVANCE/APPLICATION

Native T1 and T1 reactivity holds potential as a biomarker for tissue characterization in MR without the use of gadolinium.

SSE03-03 T1 Map-based Quantitative Inversion Time Prescription for Late Gadolinium Enhancement Outperforms Look-Locker-based Subjective Inversion Time Estimation

Monday, Nov. 27 3:20PM - 3:30PM Room: S502AB

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PURPOSE

Look-Locker (LL)-based subjective estimation of the inversion time (TI) ("TI-scout") for late gadolinium enhancement (LGE) imaging has multiple limitations. Our aim was to develop and test a T1 map-based synthetic inversion recovery (SyIR) technique allowing for the quantitative calculation of the optimal TI (TI0).

METHOD AND MATERIALS

Patients (n=78; 61±17y) referred for 1.5T cardiac MR were prospectively enrolled in this IRB approved study. LL TI-scout (in-plane 2.08×2.08mm2; echo/repetition time [TE/TR] 1.1/2.5ms; flip 50°; TI range 90-600ms) and T1-map (MOLLI scheme 4(1)3(1)2; in-plane 1.56×1.56mm2; TE/TR 1.1/2.6ms; flip 35°) were acquired at 12-min post-contrast in a random order. SyIR images were calculated from T1 maps in a TI range of 200-400ms. Two groups (Gr) were defined: GrLL (n=40; T1 map followed by LL, LL used for TI0 prescription for LGE) and GrT1 (n=38; LL followed by T1 map, T1-based SyIR used for TI0 prescription). Image quality

(quality of nulling, ability to differentiate enhanced myocardium from blood, and enhanced from normal) was rated (3-point Likert scale) and objectively measured. Groups were compared using the Kruskal-Wallis and Mann-Whitney tests.

RESULTS

LGE was observed in 45 (56.9%) subjects. TI0 was significantly shorter based on LL compared to T1-based SyIR (GrLL: 242±47ms vs. 286±56ms, P=0.0198; GrT1: 244±29ms vs. 285±32ms, P<0.0001). A significant difference was observed between LL-based TI0 and the actual TI applied for the LGE scan (242±47ms vs. 279±54ms, P=0.0009) due to the need to account for LL correction ("fudge factor"). This difference was not shown between SyIR TI0 and the actual TI used. LGE images based on SyIR TI0 had better image quality ratings compared to LL TI0-based LGE images for the quality of nulling (2.3 [2.0-2.6] vs. 1.8 [1.4-2.2], P=0.0027). There was no difference in the other subjective measures. Myocardial/background signal ratio was lower in GrT1 compared to the GrLL (1.2±0.4 vs. 2.4±1.1, P=0.0079).

CONCLUSION

T1-based SyIR imaging provides objective, quantitative, and real-time prescription of TI0 for LGE imaging; eliminating the need for LL correction and the substantial operator dependence of the acquisition ("fudge factor").

CLINICAL RELEVANCE/APPLICATION

The T1-based SyIR technique provides improved quality of myocardial signal nulling for LGE, retrospective TI0 selection, higher TI resolution, no need for LL correction or TI0 adjustment, and less operator dependence.

SSE03-04 Stress Perfusion CMR: Improved Correlation with Invasive Fractional Flow Reserve after Correction for Perfusion Changes in Remote Myocardium

Monday, Nov. 27 3:30PM - 3:40PM Room: S502AB

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PURPOSE

This study was undertaken, considering fractional flow reserve (FFR) as the reference: (i) to evaluate a predictive model of flow reserve using adenosine cardiac magnetic resonance (CMR) time-signal intensity measurements collected in the area distal to a focal coronary artery stenosis (CAS) and (ii) to assess the incremental value of correcting this model by including similar measurements in remote areas.

METHOD AND MATERIALS

This retrospective study was approved by the hospital ethics committee. Forty-six patients (mean age 61±9 years; 33 males) who underwent both adenosine first-pass CMR and FFR in the work-up for a focal CAS (n=49) were included after written informed consent. Areas-at-risk (RISK) and remote adenosine/rest time-signal intensity parameters were evaluated. Boosting models were elaborated to predict the FFR value from (i)the whole (extended) and (ii)RISK-only parameters. The relationship between the predictions and FFR value was described with Bland-Altman and summarized with intra-class correlation(ICC). Diagnostic accuracies of the models predicting FFR<=0.80 were calculated.

RESULTS

The average FFR value was 0.84±0.09 (0.60-0.98 range), 15(31%) were <=0.80. Decreasing FFR was associated with opposite effects on myocardial time-signal intensity responses downstream of the CAS or remotely. Compared to the RISK-only models, the extended models exhibited higher correlations with the FFR value (0.73;95%CI,0.57-0.84 versus 0.25;95%CI,0.03-0.50) and diagnostic accuracy to predict FFR<=0.80 CAS [44/49 (90%; 95%CI,78-98) vs 36/49 (73%;95%CI,55-88)].

CONCLUSION

When evaluating the functional significance of a CAS using adenosine first-pass CMR, considering time-signal intensity measurements in remote areas allows a better correlation with invasive FFR and improved diagnostic accuracy for FFR<=0.80.

CLINICAL RELEVANCE/APPLICATION

To improve the clinical relevance of evaluating coronary stenoses by using adenosine first-pass CMR, each perfusion-related parameter should be corrected by its value in remote segments.

SSE03-05 Assessment of Left-Ventricular-Wall Motion Disorders after Myocardial Infarction Using Compressed Sensing Real-Time Cine Imaging

Monday, Nov. 27 3:40PM - 3:50PM Room: S502AB

Participants
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PURPOSE

To evaluate the reliability of a compressed sensing (CS) real-time prototype cine sequence (Sparse 2D cine, Siemens Healthineers) for the detection of left ventricle (LV) wall motion disorders after myocardial infarction (MI) in clinical practice.

METHOD AND MATERIALS

Thirty consecutive adult patients (20 males, 10 females; mean age = 64.5 ± 13.4 years) referred for either initial work-up or follow-up by cardiac magnetic resonance (CMR) in the clinical context of MI were prospectively included. Each patient underwent the same CMR protocol: (a) the reference segmented multi-breath-hold steady-state free precession cine sequence including short-axis stack, one four-chamber slice, one two-chamber slice (Group 1) and (b) a CS real-time single-breath-hold sequence (Group 2) providing the same slice number, position and thickness. In both groups, wall motion disorders were independently and blindly assessed by two radiologists, based on the American Heart Association LV segmentation. Paired Wilcoxon signed-rank test was used to analyze the statistical difference. ROC study was performed to assess the differential diagnosis performance.

RESULTS

All patients presented at least one segmental wall motion abnormalities in Group 1 and in Group 2. In Group 1, among 510 segments analyzed, 278 (54.5%) had motion disorder described as hypokinesia (n= 147; 28.6%), akinesia (n= 124; 24.3%) or dyskinesia (n= 7; 1.4%). There was no significant difference regarding wall motion disorder description in Group 2 compared to Group 1 (p = 1.0) with a 98.92% sensitivity (95%CI [96.9-99.8]) and a 99.14% specificity (95%CI [96.9-99.9]). Area under the curve was 0.992 (95%CI [0.980-0.998]; p < 0.0001).

CONCLUSION

The single-breath-hold Compressed Sensing real-time cine imaging technique is a reliable sequence to assess wall motion abnormalities by CMR in the context of myocardial infarction.

CLINICAL RELEVANCE/APPLICATION

As patients suffering from MI may present shortness of breath, use of CS cine imaging can significantly reduce acquisition time without compromising detection accuracy of LV-wall motion disorders.

SSE03-06 Development of Cardiac Remodeling in Patients with Acute Myocardial Infarction Studied by Cardiac MRI (CMR)

Monday, Nov. 27 3:50PM - 4:00PM Room: S502AB

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PURPOSE

Left ventricular (LV) remodeling after acute myocardial infarction (AMI) is defined as an increase of left ventricular end-diastolic volume index (LVEDVi) >=15% within the first months after AMI. The purpose of this study was to analyze the exact course of LVEDVi and its relation to infarct size and LV ejection fraction.

METHOD AND MATERIALS

We performed CMR in 84 consecutive patients (mean age 56 years) with reperfused first AMIs to assess LV volumes, myocardial mass and function. Infarct size was obtained by late gadolinium enhancement (LGE) CMR. Patients underwent the baseline CMR 7 ±4 days after AMI. Follow-up scans were performed after 6.5 ±1.5 weeks, 3.5 ±0.6 months and 6.7 ±1.4 months. An increased LVEDVi was defined as >97 mL/m2 in males and >90 mL/m2 in females.

RESULTS

Two distinct different types of LV remodeling were observed. Twenty-one of 84 patients (25%) showed a classic remodeling with normal LVEDVi at baseline (76 ±13 mL/m2), which significantly increased to 89 ±19 mL/m2 at 7 week (P<0.05) and than remained stable. Thirteen patients (16%) showed early remodeling with an increased LVEDVi of 112 ±14 mL/m2 at baseline and no further change of LVEDVi during follow-up. Infarct size of patients with early remodeling (22 ±7 %LV) and classic remodeling (19 ± 9 %LV) were larger compared to patients without remodeling 12 ±9 %LV, (P<0.01). At baseline, patients with early remodeling had a significantly lower ejection fraction (EF) with 42 ±9 % compared to patients with classic (55 ±13%, P<0.01) and to patients with no remodeling (57 ±10 %, P<0.01). Patients with early remodeling had no recovery of EF during follow-up (45 ±5 %, P=ns).

CONCLUSION

Besides classic remodeling, 16% of our patients showed early remodeling, which is characterized by immediate LV dilatation after AMI and initially severely reduced EF with no recovery during follow-up.

CLINICAL RELEVANCE/APPLICATION

Patients with early remodeling may represent a subgroup of patients at higher risk for heart failure and sudden cardiac death, requiring more intensive treatment to prevent these events.

SSE04

Cardiac (Coronary Artery Disease: General I)

Monday, Nov. 27 3:00PM - 4:00PM Room: S504AB

CA CT MR

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

SSE04-01 Improving the Degree and Uniformity of Enhancement in Coronary CT Angiography with a New Bolus Tracking Method Enabled by Free Breathing

Monday, Nov. 27 3:00PM - 3:10PM Room: S504AB

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PURPOSE

To demonstrate the improved degree and uniformity of enhancement in coronary CT angiography (CCTA) on a 16cm wide-coverage CT with a new bolus tracking method enabled by free breathing, in comparison with the conventional method with breath holding.

RESULTS

The mean enhancement in vessels in Group A (412.7±55.3HU) was higher than in Group B (337.6±72.7HU) ($P<0.05$). The fluctuation rate for the enhancement was lower in the free breathing group in AS (13.4%), RCA (16.4%), LAD (19.5%) and LCX (16.7%) than in the breath holding group (21.5%, 20.8%, 21.5% and 26.2%, respectively) (all $P<0.05$). There was no significant difference in image quality score, SD, SNR, CNR between the two groups.

CONCLUSION

A new bolus tracking method enabled by free-breathing in CCTA on 16cm wide-coverage CT system increases the enhancement degree and uniformity in coronary arteries, compared with the conventional triggering method.

CLINICAL RELEVANCE/APPLICATION

Free-breathing CCTA can increase the enhanement effect of coronary artery, provide us a consistency enhancement effect image, and improved the overall image quality.

SSE04-02 The Effect of the Motion Correction Algorithm on the Image Quality of Coronary CT Angiography with Fast kVp Switching Single Source Dual-Energy CT at the Reconstructed Various Cardiac Phases

Monday, Nov. 27 3:10PM - 3:20PM Room: S504AB

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PURPOSE

To investigate the effect of the motion correction algorithm (SnapShot Freeze: SSF; GE Healthcare) on the image quality at various cardiac phases in coronary CT angiography (CCTA) with fast kVp switching single source dual-energy CT (ssDECT).

METHOD AND MATERIALS

Twenty five patients with heart rate below 65 bpm (42 - 65 bpm) who underwent CCTA using ECG-gated axial step-and-shoot with dual-energy scan mode on a 64-row ssDECT (Revolution GSI; GE Healthcare) were included. For the CCTA scan, we used the scan parameter as follows; tube voltage: 80/140 kVp fast switching, rotation time: 0.35 s/rot, and tube current was determined 375 mA or 600 mA or 640 mA based on patient BMI (CTDIvol was 36.7 ± 8.3 mGy). Cardiac axial images were reconstructed with and without SSF at the cardiac phases of 60% to 90% with 5% interval. Two readers graded the image quality of the 4 major coronary arteries (right coronary artery: RCA, left main trunk: LMT, left arterial descending artery: LAD, and left circumflex: LCX) reconstructed with and without SSF 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) with consensus and score above 3 was defined as diagnostic acceptable vessel. Average scores of the per-vessel and the per-segment in each cardiac phase were compared between reconstruction with and without SSF by using Wilcoxon signed rank test.

RESULTS

In all cardiac phase, average scores of SSF were higher than that of without SSF in the all vessels and the all segments (with SSF: 3.6±0.9, without SSF: 3.2±0.9, P<0.01). Without SSF, cardiac phases that coronary vessel was diagnostic acceptable were from 65% to 80% in RCA, 60% to 85% in LMT, 60% to 85% in LAD, 65% to 80% in LCX. With SSF, those cardiac phases were 60% to 80% in RCA, 60% to 90% in LMT, 60% to 85% in LAD, 60% to 85% in LCX. Diagnostic acceptable cardiac phase for all vessels was 65% to 80% without SSF, and 60% to 85% with SSF.

CONCLUSION

SSF controlled the motion artifact and improved image quality of CCTA with fast kVp switching ssDECT. In addition, SSF extended the diagnosable range of reconstructed cardiac phases.

CLINICAL RELEVANCE/APPLICATION

Motion correction algorithm (SSF) in coronary CT angiography with fast kVp switching dual-energy CT was useful to reduce the motion artifacts and extend diagnostic acceptable cardiac phase.

SSE04-03 Single-Phase Coronary Artery CT Angiography Extracted From Stress Dynamic Myocardial CT Perfusion on a Third-Generation Dual-Source CT: Validation by Coronary Angiography

Monday, Nov. 27 3:20PM - 3:30PM Room: S504AB

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PURPOSE

To investigate the image quality (IQ) and diagnostic performance of single-phase coronary CT angiography (SP-CCTA) images extracted from stress dynamic myocardial CT perfusion (CTP) scans using third-generation dual-source CT (DSCT).

METHOD AND MATERIALS

The institutional review board approved the study and written informed consent was obtained from all patients. Consecutive symptomatic patients who met appropriateness criteria for cardiac CT were prospectively recruited and scanned with adenosine triphosphate-stress dynamic myocardial CTP and routine CCTA protocol using third-generation DSCT. Images from the phase of the CTP scan with the best enhancement of the coronary arteries were selected as the SP-CCTA. Baseline characteristics and IQ results were assessed. Coronary angiography (CAG) was used as a reference standard, the diagnostic accuracy for stenosis >=50% detection was compared with SP-CCTA and routine CCTA.

RESULTS

51 patients successfully underwent the combined ATP-stress dynamic myocardial CTP and CCTA examination, among which 34 patients underwent CAG. The mean heart rate during stress CTP was much higher than that during CCTA (85.0±12.7 and 67.9±10.0 bpm, p<0.001). The qualitative IQ scores of SP-CCTA were similar to that of routine CCTA (p>0.05). On a per-vessel basis, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the curve results of SP-CCTA and routine CCTA for diagnosis of stenosis >=50% exhibit no significant difference (SP-CCTA: 95.0%, 86.0%, 84.4%, 95.6%, 0.841; routine CCTA: 92.1%, 88.5%, 85.4%, 93.9%, 0.829; all P>0.05). The mean effective radiation dose (ED) of CTP and routine CCTA plus CTP were 3.92±1.72mSv and 5.98±2.01mSv (P<0.05), respectively.

CONCLUSION

With third-generation DSCT, the IQ and diagnostic value of SP-CCTA was equivalent to routine CCTA. It is potentially feasible to replace a separate routine CCTA acquisition with SP-CCTA images extracted from stress dynamic myocardial CTP.

CLINICAL RELEVANCE/APPLICATION

The single-phase CCTA derived from CTP with the third-generation dual-source CT is able to replace the routine CCTA scan and create highest possibilities for "one-stop" cardiac CT examination, which allowing patients in need of myocardial blood flow assessment to benefit from it.

SSE04-04 Participants

3D Fusion of Coronary CT Angiography and CT Myocardial Perfusion Imaging: One-Stop-Shop Assessment of Morphology and Function

Monday, Nov. 27 3:30PM - 3:40PM Room: S504AB

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PURPOSE

To develop a software tool for 3D fusion imaging of CT coronary angiography (CTCA) and CT myocardial perfusion imaging (CTPerf), intuitively visualizing relevant coronary artery stenoses and corresponding myocardial perfusion deficits for diagnostics of coronary artery disease (CAD).

METHOD AND MATERIALS

12 patients underwent CTCA and CTPerf after heart transplant in this prospective study (mean age 56±12 years, range 32-76 years, all males, scan date 08/2015-03/2016). CT image quality was rated. Coronary diameter stenoses >50% were documented for CTCA. Adenosine stress-induced perfusion deficits were noted for CTPerf. A software tool was implemented to allow for 3D fusion imaging of both datasets. Coronary arteries and heart contours were segmented in a fully automatic fashion using centerline or model-based region growing algorithms, respectively. To overcome registration mismatch due to different heart phases of CTCA/CTPerf image acquisition, myocardial perfusion values were mathematically projected on the CTCA left ventricle. 3 resulting datasets (i.e., coronary tree, heart contour, and perfusion values) were fused for 3D multiparametric volume rendering. Either endocardial, transmural, or epicardial average perfusion values could be visualized. 3D fusion was compared to CTCA/CTPerf side-by-side analysis and results from catheter CA.

RESULTS

CT image quality was rated as good-excellent (mean score 3.6±0.5, scale 1-4). In 5/12 patients (41%), manual heart phase adjustment used for automatic segmentation was required. Subsequent 3D fusion imaging was successfully feasible in all cases (12/12, 100%). 2/12 patients (17%) showed stress-induced perfusion deficits. Ischemic regions could be intuitively correlated to culprit coronary lesions in both cases (2/2, 100%). Results from 3D multiparametric volume rendering approved coronary assignment of side-by-side analysis and were in full correspondence with findings from catheter CA.

CONCLUSION

A software framework for 3D CTCA/CTPerf fusion imaging was developed, advancing a CT one-stop-shop multiparametric CAD diagnostic procedure for patients being not able to undergo CMR perfusion imaging due to MRI contraindications.

CLINICAL RELEVANCE/APPLICATION

For diagnostics of CAD, assessment of coronary artery stenosis and myocardial ischemia are equally important. 3D fusion of CTCA and CTPerf eases the assignment of anatomical to functional information.

SSE04-05 Single Breath-Hold Whole-Heart Unenhanced Coronary MRA Using Multi-Shot Gradient Echo EPI with 3T MRI: Comparison with Free-Breathing TFE Coronary MRA in Healthy Volunteers

Monday, Nov. 27 3:40PM - 3:50PM Room: S504AB

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PURPOSE

The single breath-hold technique for coronary magnetic resonance angiography (MRA) can shorten the total scan time and reduce the influence of respiratory motion. However, unenhanced whole heart coronary MRA at 3T MRI is still challenging because of increased B0 inhomogeneity compared with 1.5T MRI. Here we investigated the feasibility of single breath-hold unenhanced coronary MRA using multi-shot gradient echo planar imaging (MSG-EPI) with a 3T-scanner.

METHOD AND MATERIALS

14 volunteers underwent single breath-hold coronary MRA with MSG-EPI and free-breathing turbo field echo (TFE) coronary MRA at 3T. The acquisition time, signal to noise ratio (SNR), and the contrast of the sequences were compared using paired t-tests. Readers evaluated the image contrast, noise, sharpness, artifacts, and overall image quality.

RESULTS

The acquisition time was 88.1% shorter for MSG-EPI than TFE (24.7 ± 2.5 vs 206.4 ± 23.1 sec, $p < 0.01$). The SNR was significantly higher on MSG-EPI than TFE scans ($p < 0.01$). There was no significant difference in contrast between MSG-EPI and

TFE scans (1.8 ± 0.3 vs 1.9 ± 0.3, p = 0.24). There was no significant difference in image contrast, image sharpness, and overall image quality between the two scanning techniques. The scores for image noise and artifacts were significantly higher on MSG-EPI than TFE scans ($p < 0.05$).

CONCLUSION

The single breath-hold MSG-EPI sequence is a promising technique for shortening the scan time and preserving the image quality of unenhanced whole-heart coronary MRA with 3T MRI.

CLINICAL RELEVANCE/APPLICATION

The MSG-EPI sequence with a 3T MRI scan provides adequate quality for single breath-hold unenhanced coronary MRA, compared with the conventional TFE sequence.

SSE04-06 Effects of Coronary Stents on Phase Contrast Flow Measurements in Cardiovascular MRI: Phantom Study

Monday, Nov. 27 3:50PM - 4:00PM Room: S504AB

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PURPOSE

The evaluation of restenosis after coronary stent implantation is important for management after treatment. Assessing coronary flow reserve using phase contrast MRI has potential for the noninvasive detection of coronary artery stenosis, including in-stent restenosis. However, in patients with stents, metallic compounds often evoke image artifacts, such as phase alterations and image distortions of the magnetic field. The purpose of this study was to evaluate influences according to various types of stents (different material and cell design) on phase contrast measurements in a phantom study.

METHOD AND MATERIALS

Three stents (MULTI-LINK VISION, Nobori, and Ultimaster) from varying material and cell designs were placed in a flow phantom. Phase contrast measurements were acquired with a 1.5 T MR scanner using conventional gradient-echo sequences proximal and distal to the stent at a predefined distance (every 3mm from the stent's distal edge). Scan parameters were as follows: temporal resolution 47ms, TE 4.2ms, TR 7.0 ms, slice thickness 5mm, flip angle 30 degrees, and in-plane resolution 1.7x3.0mm. In each stent, results (peak velocity and average flow per second) were compared to measurements with a reference flow at the proximal level without any stents.

RESULTS

Flow results distal to the stent differed significantly from the reference flow (25.8cm/sec and 7.02ml/sec) acquired at the proximal level of the stent according to the stent type. The maximum flow miscalculation of peak velocity and average flow per second was -10.95cm/sec and +3.52ml/sec for MULTI-LINK VISION, -23.84cm/sec and -5.86ml/sec for Nobiri, and+2.00cm/sec and -0.35ml/sec for Ultimaster. For MULTI-LINK VISION and Ultimaster, flow values measured approximately 3mm distal to the level of the stent agreed with the reference flow. For Nobiri, flow values measured approximately 12mm were effective.

CONCLUSION

Tested coronary stents led to a significant deviation of measured flow rates compared to a reference. A distance effective to avoid this influence should be adjusted according to the stent type.

CLINICAL RELEVANCE/APPLICATION

For flow measurements of the coronary artery after stent implantation, a distance effective to avoid the deviation of measured flow due to a stent should be adjusted according to the stent type.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
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SSE05

Chest (Emphysema and Airways)

Monday, Nov. 27 3:00PM - 4:00PM Room: S404CD

BQ CH CT

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

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Sub-Events

SSE05-01 A Thin Walled Small Lumen CT-Based Airway Phenotype Identified within the SPIROMICS Cohort

Monday, Nov. 27 3:00PM - 3:10PM Room: S404CD

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PURPOSE

We have sought to understand the role of reconstructed computed tomographic (CT) field of view (DFOV) on airway wall thickness within the NIH sponsored subpopulations and intermediate outcome measures in COPD study (SPIROMICS). In doing so, we have identified a subphenotype with thin walled small lumen (TWSL) central airways. We explored the clinical and demographic differences between the TWSL and non-TWSL groups.

METHOD AND MATERIALS

2937 baseline full inspiratory (TLC) and expiratory (RV) CT data sets were evaluated within the full SPIROMICS cohort of smokers with and without COPD and non-smokers. A scatter plot of wall thickness vs. DFOV was plotted for the trachea and right mainstem bronchus (RMB). Two distinct clusters were identified at each location. A linear discriminator algorithm was used to calculate the line separating two clusters. 426 TWSL vs. non-TWSL clinical and demographic comparisons were made via t-tests using conservative Bonferroni correction to keep significance level at $p < .05$. The same method was used to compare CT density-histogram-based measurements.

RESULTS

The line separating TWSL vs. non-TWSL is: WT (mm) = 6.24e-03 DFOV (mm) + 7.77e-02. Subjects below the line at the trachea or the RMB are termed: TWSL. 118 (4%) of subjects were TWSL at the trachea. An additional 932 ((118+932)/2937=35%) were TWSL at RMB. Amongst the 426 clinical and demographic comparisons between RMB-TWSL vs non-TWSL, 103 were significant. The lumen area between TLC and RV was more stable in the TWSL group. The TWSL group is female dominant (P=1.66E-15), six minute walk distance is less (P=4.43E-12) BMI is greater. (P=1.52E-41). Other differentiators include: History of asthma, FEV1, BODE Index, and MRC-defined shortness of breath, all of which are greater in TWSL. The TWSL group had significantly more dense lung regions (>-650HU) and less CT-defined emphysema (<-950Hu) compared with the non-TWSL group.

CONCLUSION

TWSL subjects within the smoking population differentiate from non-TWSL both demographically as well as clinically. The TWSL group have significant airway pathology-associated symptoms coupled with less emphysema and a greater portion of dense lung.

CLINICAL RELEVANCE/APPLICATION

A thin walled and small lumen (TWSL) airway phenotype has been identified which, in a smoking population, is distinct in terms of

demographics, clinical pathophysiology and CT-density characteristics.

SSE05-02 Predictors of Treatment Response in COPD Patients at 1-Year Follow-Up: Value of Advanced CT Quantification

Monday, Nov. 27 3:10PM - 3:20PM Room: S404CD

Awards
Student Travel Stipend Award

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PURPOSE

To investigate predictive factors of treatment response in COPD patients at 1-year follow-up using advanced quantitative CT analyses.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board with waiver of informed consent. 258 patients (240 men and 18 women; mean age, 66.0 years ± 8.0) were selected from Korean Obstructive Lung Disease (KOLD) cohort, who underwent baseline chest CT, initial and 1-year follow-up pulmonary function test (PFT) during treatment. Patients received combined inhalation of long-acting beta-agonist and corticosteroid. From volumetric CT data, emphysema index, airway trapping index (ATI), and small airway parameter (AWT-Pi10) using both full-width-half-maximum (FWHM) and integral-based half-band (IBHB) methods were obtained. ATI measurements were acquired by using thresholds of -856HU on expiratory CT (ATI_-856) and by using co-registration (ATI_emphysema, ATI_hyperinflated, ATI_normal, respectively). The clinically meaningful treatment response was defined as an absolute increase of at least 0.225L on follow-up PFT. Multiple logistic regression analysis was performed to identify predictive factors of treatment response

RESULTS

Treatment responders were 41 patients (15.9%). The mean increase in FEV1 was 0.38 ± 0.17 L. Univariate analysis showed that age, initial 6-minite walk distance (6MWD), initial DLCO, emphysema index, ATI_emphysema and Pi10_IBHB were significantly different between patients with and without treatment response (P= 0.008. 0.001, 0.002, 0.004, 0.001 and <0.001, respectively). Multivariate analysis revealed that 6MWD and Pi10_IBHB were independent variables predictive of FEV1 increase (P= 0.001 and <0.001, respectively). The adjusted odds ratio was 1.008 (95% CI, 1.003-1.012) and 5.439 (95% CI, 2.069-14.301) respectively. Receiving operating characteristic curve showed that area under the curve of these two variables was 0.715.

CONCLUSION

Accurate measurement of Pi10 by IBHB methods may help predict treatment outcome of COPD at 1-year follow-up.

CLINICAL RELEVANCE/APPLICATION

Application of advanced CT quantification with acute measure of small airway dimension has been shown to accurately evaluate treatment outcome of COPD; thus, it can be considered to be used in routine clinical practice.

SSE05-03 Inspiratory/Expiratory Xenon-Enhanced Area-Detector CT (ADCT): Utility for Regional Ventilation, Pulmonary Functional Loss and Clinical Stage Evaluations of in Smokers

Monday, Nov. 27 3:20PM - 3:30PM Room: S404CD

Participants
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PURPOSE

To evaluate the utility of xenon (Xe) ventilation assessment on inspiratory/expiratory Xe-enhanced area-detector CT (ADCT) for regional ventilation, pulmonary functional loss and clinical stage evaluations in smokers.

METHOD AND MATERIALS

Forty consecutive smokers prospectively underwent inspiratory/expiratory xenon-enhanced ADCT examinations as well as pulmonary function tests. Then, all smokers were classified by GOLD classification based pulmonary function test results. Each CT data was transferred to our proprietary software to generate Xe wash-in (WI), wash-in/wash-out (=WI/WO) ratio and ventilation (=[WI-WO]/WI) ratio maps between inspiratory/expiratory CT scans by pixel-by-pixel analyses. According to the previous study, each pixel within the lung was divided into three lesion groups as follows: normal lung, functional small airway disease (fSAD) and emphysema. To determine regional ventilation differences, each Xe ventilation index was compared three groups by Tukey's HSD test. To evaluate the capability for pulmonary function loss assessment, step-wise regression analyses were performed among all Xe ventilation indexes and pulmonary function test results such as %FEV1 and FEV1/FVC%. Finally, discrimination analysis was performed to determine the concordance capability for GOLD stage classification was also determined.

RESULTS

WI and ventilation ratio had significant difference among three lesion groups ($p<0.05$) and WI/WO ratio of emphysema had significant difference with that of others ($p<0.05$). %FEV1 ($r2=0.71$, $p<0.05$) and FEV1/FVC% ($r2=0.71$, $p<0.05$) were significantly affected by ventilation ratio as 1st step and WI as 2nd step. With all Xe ventilation indexes, the concordance capability for GOLD classification was determined as 87.5 (35/40) %.

CONCLUSION

Xenon ventilation assessment on inspiratory/expiratory xenon-enhanced ADCT was useful for regional ventilation, pulmonary functional loss and clinical stage evaluations in smokers.

CLINICAL RELEVANCE/APPLICATION

Xenon ventilation assessment on inspiratory/expiratory xenon-enhanced ADCT was useful for regional ventilation, pulmonary functional loss and clinical stage evaluations in smokers.

SSE05-04 Visual Emphysema Pattern Using the Fleischner Society Classification System Is Independently Associated with Mortality in Cigarette Smokers

Monday, Nov. 27 3:30PM - 3:40PM Room: S404CD

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PURPOSE

Visual categorization of pattern of emphysema on CT has been shown to correlate with symptomatic impairment. However, the relationship between pattern of emphysema and mortality has not previously been evaluated.

METHOD AND MATERIALS

Of the first 4000 subjects consecutively enrolled in the COPDGene study, 3171 had availability of both visual CT scores and survival information. Trained research analysts performed visual classification of parenchymal emphysema, paraseptal emphysema, and airway wall thickening, on baseline volumetric CT scans of these subjects using the Fleischner Society classification system. Each scan was independently evaluated by two analysts; discordances between analysts were adjudicated by a thoracic radiologist. Severity of emphysema was evaluated quantitatively using % low attenuation < -950 HU (LAA-950). Median duration of follow-up was 6.9 years (range 30 days to 8.5 years). Regression analysis of the relationship between imaging patterns and survival was based on the Cox proportional hazards model, with adjustment for age, race, gender, height, weight, pack-years of cigarette smoking, current smoking status, educational level, and LAA-950, and (in a second model) FEV1.

RESULTS

Observer agreement for presence and pattern of parenchymal emphysema was good to excellent. There were 519 deaths in the group. Compared with subjects who did not have visible emphysema, mortality was significantly greater in those with all grades of CLE (except for trace), with adjusted hazard ratios of 1.8 for mild centrilobular emphysema, 2.5 for moderate centrilobular emphysema, 4.8 for confluent emphysema, and 3.8 for advanced destructive emphysema. This increased mortality persisted after further adjustment for LAA-950 and FEV1, except for those with advanced destructive emphysema.

CONCLUSION

The presence and pattern of parenchymal emphysema according to the Fleischner Society grading system is associated with significantly increased mortality risk, independent of the quantitative severity of disease measured by LAA-950.

CLINICAL RELEVANCE/APPLICATION

Visual evaluation of emphysema pattern is an important novel marker of mortality risk.

SSE05-05 Reconstructed Field of View Affects CT-based Pulmonary Airway Wall Metrics and Must be Accounted for in Assessments of Male-Female Differences

Monday, Nov. 27 3:40PM - 3:50PM Room: S404CD

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PURPOSE

It is well-established that gender has a significant effect on airway wall thickness. Males tend to have thicker airway walls than their female counterpart. However, in analyzing the role of reconstructed computed tomographic (CT) display field of view (DFOV) on airway wall thickness within the NIH sponsored subpopulations and intermediate outcome measures in COPD study (SPIROMICS) we have identified that this gender effect is confounded with the thickening of airway wall metrics with increased DFOV.

METHOD AND MATERIALS

2818 baseline full inspiratory CT data sets were evaluated within SPIROMICS (smokers and nonsmokers with a full range of COPD status, 40-80 years, 46% Females). Airway wall thickness is selected as the response variable. A generalized Additive Model(GAM) is adopted for the analysis which, compared to the commonly used multi-variate regression, is more robust and flexible in modeling nonlinear relationships between the response variable and its predictors. Two models with DFOV and without DFOV are implemented to see the confounding effect on gender differences. Moreover, Age, Race, BMI, Weight, Height, Scan site, and GOLD status are also considered as confounders in the model.

RESULTS

A total of 22 spatially matched airway segments are analyzed across all subjects. The table depicts the percentage decrease of airway wall thickness for females using males as the baseline before and after adjustment for DFOV. Gender effect is reduced for all segments after adjusting for DFOV, even though the effect varies across different airways, on average adjustment for DFOV reduces the effect of gender by 49.8%. In the case of tracheal wall thickness, the adjusted R2 is increased from 62% to 76% which implies that adding DFOV as a confounder leads to a better model fit.

CONCLUSION

Although females have thinner airway walls, the effect is halved when the measurement are corrected for DFOV.

CLINICAL RELEVANCE/APPLICATION

DFOV of CT reconstructions must be taken into account when assessing population differences in airway wall thickness and when assigning clinical meaning to measures of airway wall thickness.

SSE05-06 Distribution and Change of Parametric Response Map in Patients with Chronic Obstructive Pulmonary Disease: Cross-Sectional and Longitudinal Aspects

Monday, Nov. 27 3:50PM - 4:00PM Room: S404CD

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PURPOSE

To evaluate distribution and change of emphysema and regional air trapping by parametric response mapping (PRM) in chronic obstructive pulmonary disease (COPD) patients according to cross-sectional and longitudinal aspects .

METHOD AND MATERIALS

Inspiration and expiration CT scans from 224 subjects (mean age, 65.3 years; M : F = 214 : 10) in COPD cohorts were acquired at baseline and 3 years from the baseline. PRM was performed in all CT scans and classified lung parenchyma as normal (PRMNormal), emphysematous (PRMEmph), and functional small airway disease (PRMfSAD) using the co-registration method of inspiration and expiration CTs and two thresholds (-950 HU and -856 HU). Calculation of the center of distribution that is the median value for both axes and principal eigenvector of the data determined by the principal component analysis were obtained in each patient. After obtaining the center of distribution on CT at baseline and 3years, we indicated disease progression as a vector from the centroid at baseline to the centroid at 3 years per patient.

RESULTS

The distribution of GOLD stages at baseline were stage I in 31 patients, stage II in 121 patients, stage III in 63 patients, and stage IV in 9 patients. At 3 years follow-up, there were stage I in 36 patients, stage II in 116 patients, stage III in 52 patients, and stage IV in 7 patients. On based on pulmonary function tests, 147 patients (65.6%) showed stable GOLD stage while there were aggravation in 26 patients (11.6%) and improvement 38 patients (17.0%), respectively. Principal eigenvectors at baseline and 3 years from the baseline showed the tendency that fSAD was a transitional phase from normal parenchyma to emphysema. The vectors from the centroid at baseline to the centroid at 3 years per patient also demonstrated that functional small airway disease precedes emphysema.

CONCLUSION

PRM of chest CT in COPD patients appears to be a valuable tool in understanding disease progression and evaluating disease status.

CLINICAL RELEVANCE/APPLICATION

Cross-sectional and longitudinal analyses of COPD patients with parametric response map may provide supporting evidences that functional small airway disease precedes emphysema.

SSE06

Emergency Radiology (Chest and Forensic Radiology)

Monday, Nov. 27 3:00PM - 4:00PM Room: N228

CH CT ER

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

SSE06-01 Clinical Postmortem Computed Tomography Can Demonstrate the Cause of Death or Guide the Autopsy

Monday, Nov. 27 3:00PM - 3:10PM Room: N228

Participants
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PURPOSE

To investigate the potential of postmortem CT (pmCT) to improve the clinical diagnosis of cause of death.

METHOD AND MATERIALS

86 cadavers underwent whole-body pmCT before conventional autopsy. Radiologists and pathologists were blinded to each other's results and compiled their own reports. Differences in the number of correctly identified clinical diagnoses, prior and post pmCT, as to the cause of death, type of pathology and anatomical system involved, were investigated by McNemar tests, with autopsy as the reference standard.

RESULTS

Using pmCT, the number of correctly identified causes of death, type of pathology and anatomical system involved increased from 53% to 64% (p=0.05), from 65% to 83% (p=0.001) and from 65% to 84% (p=0.001) respectively. The subgroup of cardiovascular causes of death showed almost the lowest sensitivity (54%) for cause of death after pmCT, but the most significant increase in sensitivity for anatomical system, from 62% to 82% (p=0.02) using pmCT.

CONCLUSION

Postmortem CT significantly improves clincial diagnosis as to the cause of death. If the exact cause of death is uncertain after pmCT, radiologists can indicate a particular region of interest, directing pathologists, which in turn may be able to reduce the invasiveness of a conventional autopsy.

CLINICAL RELEVANCE/APPLICATION

Due to decreasing autopsy rates, determination of cause of death relies heavily on clinical assessment. Postmortem CT significantly improves clinical diagnosis as to the cause of death. Used as a pre-autopsy screening, it may be able to reduce the invasiveness, or eliminate entirely, a conventional autopsy.

SSE06-02 Role of CT in the Personal Identification of Cadavers in Mass Disaster: Our Experience in Shipwrecked Migrants

Monday, Nov. 27 3:10PM - 3:20PM Room: N228

Awards
Student Travel Stipend Award

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PURPOSE

To show the enormous contribution of CT in personal identification of migrants in the deadliest Mediterranean shipwreck occurred in April 2015, when a boat with about 700 migrants hoping to reach Sicily drowned off Libyan waters.

METHOD AND MATERIALS

In July 2016, 149 body bags of cadavers of the about 700 migrants were scanned through an 8-channels mobile CT placed next to the tents where coroners, antropologists and police forces were performing forensic studies. One of the main efforts of the team was the personal identification of the migrants; the radiological tools for personal identification have been studied and assessed mixing the different figures' expertise.

RESULTS

The radiological CT tools that proved to be useful for personal identification were:- age estimation: evaluation of bone growth plates (clavicle, scapula, humerus, radium, ulna, pelvic bones, femur, tibia and fibula) and of dental growth (mainly the third molar)- sex determination: evaluation of residual genitalia and of pelvic bones (morphology and angles)- stature estimation through the measurement of long limb bones lenght as the distance between the highest point of the caput femoris and the lowest point of the medial condyle were measured-pre-existing pathological conditions (i.e. fractures, bone diseases)- dental profile assessment-personal belongings (i.e. wallet, razors)Thus, a radiological template to be used in this kind of mass disaster has been created.

CONCLUSION

CT provides an important contribution in personal identification of cadavers in mass disaster and the knowledge of its strenghts and limits in this field is mandatory when approaching to it.

CLINICAL RELEVANCE/APPLICATION

Presentation of the strenghts and limits of CT for personal identification in mass disaster showing its usefulness as added tool to anthropological and autoptic assessment for age estimation and sex determination.

SSE06-03 Thoraco-Abdominal Injuries of Manual and Load-Distributing Band Cardiopulmonary Resuscitation on Postmortem Computed Tomography

Monday, Nov. 27 3:20PM - 3:30PM Room: N228

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PURPOSE

To compare thoraco-abdominal post-resuscitation injuries between manual and load-distributing band (LDB) cardiopulmonary resuscitation (CPR) on postmortem Computed Tomography (CT).

METHOD AND MATERIALS

Patients with a thorax-abdomen postmortem CT, performed between July 2012 and December 2016, were classified into three groups: 1) deaths with LDB CPR, 2) deaths with manual CPR and 3) death without CPR. Patients with recent trauma, incomplete thorax-abdomen scanning procedures or below eighteen years of age were excluded. The scans were retrospectively reviewed for anterolateral and posterior rib fractures, sternal and vertebral fractures, pneumothorax, pleural fluid, hemothorax, epigastric effusion, abdominal free air and peri-organic abdominal fluid or hemorrhages. Chi-square and Mann-Whitney U tests were used to test for significant differences between the LDB and manual CPR group, and between the resuscitated and the non-resuscitated group.

RESULTS

The LDB group (n=38) showed more often (63% vs. 21%, p=0.001) a posterior rib fracture than the manual CPR group (n=29). Compared to the non-resuscitated group (n=58), the resuscitated group showed more often an anterolateral (88% vs. 9%, p<0.001) and posterior (45% vs. 0%, p<0.001) rib fracture, more anterolateral fractured ribs per patient (4 vs. 10, p=0.003), more often a sternal fracture (52% vs. 2%, p<0.001), epigastric effusion (42% vs. 7%, p<0.001) and less pelural fluid (14mm vs. 34mm, p=0.002), if present.

CONCLUSION

In unsuccessful resuscitations, the use of LDB CPR resulted in more posterior rib fractures than manual CPR. CPR in general, either manual or LDB, led to more rib and sternal fractures and more epigastric effusion.

CLINICAL RELEVANCE/APPLICATION

CPR leads to more fractures and organ injury than no CPR. Even more posterior rib fractures are observed when LDB CPR is used instead of manual CPR. Post-CPR injuries are comparable to high-energy trauma. This is important knowledge for caretakers of survivors, leading to more specific treatment and an argument to perform a CT scan in survivors.

SSE06-04 CCTA in Patients with Positive Troponin and Low Clinical Suspicion for ACS: A Useful Diagnostic Option to Exclude Obstructive CAD

Monday, Nov. 27 3:30PM - 3:40PM Room: N228

Awards
Student Travel Stipend Award

Participants
James P. Nugent, BSC, Vancouver, BC (*Presenter*) Nothing to Disclose
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Faisal Khosa, FFR(RCSI), FRCPC, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Traditional algorithms in the management of ACS dictate that patients with a positive troponin should be admitted to hospital and undergo invasive coronary angiography (ICA). A recognized proportion of these patients will have no evidence of coronary artery disease (CAD) on ICA. In this study we report the CCTA findings in a carefully selected subgroup of patients with positive troponin who have low clinical suspicion for ACS.

METHOD AND MATERIALS

IRB approved retrospective analysis of 491 consecutive patients referred for CCTA between 04/04/2015 to 04/02/2017. All scans were performed on a dual source CT scanner in the emergency department of a level I trauma centre. Charts were reviewed for first positive troponin (TnI > 0.045 µg/L, Siemens Dimension Vista Flex® CTNI; Newark, USA) within 24 h prior imaging. 108 patients met inclusion criteria; 14 were excluded due to technical factors or substantial motion artifact. Statistical analysis was performed using Student's t-test with Prism 6 for Mac OS X version 6.0c (La Jolla, USA).

RESULTS

94 patients (55 men, 39 women) with a mean TnI of 2.22 ± 2.82 µg/L underwent CCTA an average of 4.8 ± 3.4 hours after a positive Tn test. Mean age was 54.2 14.6 yrs. CCTA demonstrated complete absence of CAD in 41 patients (44%; 22 M, 19 F). CAD with less than 25% stenosis was observed in 25 patients (27%; 10 M, 15 F). CAD with 25-50% stenosis was observed in 9 patients (10%; 8 M, 1 F). CAD with greater than 50% stenosis was observed in 19 patients (20%; 15 M, 4 F). Patients with greater than 50% stenosis were significantly older than patients with no CAD (47.6 vs. 59.1 yrs, p = 0.0073).

CONCLUSION

CCTA can be successfully used to exclude CAD in a carefully selected subgroup of patients with positive troponin with low clinical suspicion for ACS. In our study 44% of these low risk patients had no CAD and a further 27% of patients had CAD with less than 25% stenosis.

CLINICAL RELEVANCE/APPLICATION

Current management guidelines direct patients with positive troponin toward invasive catheter angiography. CCTA is a non-invasive alternative to image coronary arteries when the clinical picture suggests ACS is unlikely.

SSE06-05 Prognostic Value of CT Pulmonary Angiography (CTPA) Parameters in Acute Pulmonary Embolism (APE)

Monday, Nov. 27 3:40PM - 3:50PM Room: N228

Participants
Chiara Moroni, MD, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
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Marco Bartolini, MD, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Vittorio Miele, MD, Florence, Italy (*Presenter*) Nothing to Disclose

PURPOSE

To correlate CTPA parameters with prognostic stratification of patients with APE

METHOD AND MATERIALS

We retrospectively evaluated 140 outpatients with symptomatic APE diagnosed with CTPA. Death or clinical deterioration at 30 days were the primary endpoint. CTPA were evaluated by two blinded readers for: quantitative obstruction of pulmonary arteries (using Qanadli score), right ventricle diameter/left ventricle diameter ratio (RVD/LVD) and diameters of pulmonary trunk, superior

cava vein, azygos vein and coronary sinus. We applied a multiple logistic regression analysis of CTPA parameters, (using the following measures: >9 mm for coronaric sinus, >10 mm for azigos vein, > 1,1 for RVD/LVD) to evaluate the association with right ventricle disfunction (RVD), measured by echocardiogram, and primary outcome.

RESULTS

20/140 patients (14,3%) experienced death or clinical deterioration. We didn't analyze superior cava vein diameter due to high interobserver variability. Multiple logistic regression analysis demonstrated a significative correlation between RVD/LVD >1,1 (OR 6,1 CI 95%2.1-18.5) and RVD. No association, however, was found between RVD and azygos vein and coronaric sinus diameters. Coronaric sinus diameter >9 mm (O 11,6 CI95% 2,5-52,7) significantly correlates with primary outcome.

CONCLUSION

In APE, RVD/LVD is as good as echocardiogram in predicting RVD. Coronaric sinus diameter correlates with risk of short-term adverse events.

CLINICAL RELEVANCE/APPLICATION

CT angiography parameters is as good as ecocardiogram in predictong right ventricle deterioration anche strongly correlates with short time adverse events.

SSE06-06 Recent Trends in Use of Coronary CT Angiography and Radionuclide Myocardial Perfusion Imaging in Emergency Department Patients with Chest Pain

Monday, Nov. 27 3:50PM - 4:00PM Room: N228

Participants
David C. Levin, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Laurence Parker, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Ethan J. Halpern, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Recent studies by Litt, Hoffmann, Goldstein, and others have shown that in patients presenting to Emergency Departments (EDs) with chest pain, using coronary CT angiography (CCTA) as the initial imaging test leads to shorter ED length of stay, shorter time to diagnosis, higher frequency of discharge from the ED, and lower costs, compared with standard therapy which commonly involves use of radionuclide myocardial perfusion imaging (MPI). There is no difference in outcomes. Our goal was to compare recent trends in use of these 2 imaging modalities in ED patients.

METHOD AND MATERIALS

We analyzed the nationwide Medicare Physician/Supplier Procedure Summary Master Files for 2006-2015. The CPT codes for CCTA and MPI were selected and procedure volumes were tabulated. Medicare's place-of-service codes were used to identify those exams done in EDs. Medicare's specialty codes were also used to determine the number of these exams done by radiologists and cardiologists.

RESULTS

In 2006, a total of 22,342 MPIs were done in Medicare ED patients. Except for a dip in 2010, volume remained relatively stable over the ensuing years and was virtually identical in 2015 (22,338) to its 2006 level. By comparison, in 2006 a total of 126 CCTAs were performed in Medicare ED patients. This number increased steadily in subsequent years and reached 1919 by 2015 (+1423%). The 2015 ratio of use of MPIs to CCTAs in EDs was 11.6 to 1. In 2015, radiologists interpreted 78% of ED MPIs and 83% of ED CCTAs. Cardiologists interpreted 21% of ED MPIs and 16% of ED CCTAs.

CONCLUSION

Volumes of MPIs done in ED patients with chest pain have remained relatively stable in recent years. CCTA volume has increased rapidly, but is still far below that of MPI. This is of concern in view of previous studies showing that CCTA is a more effective and efficient procedure in these ED patients. Radiologists appear to have a stronger presence than cardiologists in ED imaging of patients with suspected coronary artery disease.

CLINICAL RELEVANCE/APPLICATION

CCTA use is increasing rapidly in ED patients with chest pain, but it is still used much less frequently than MPI.

SSE07

Gastrointestinal (Image Biomarkers)

Monday, Nov. 27 3:00PM - 4:00PM Room: E350

BQ GI MR

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

FDA Discussions may include off-label uses.

Participants
Michael S. Gee, MD, PhD, Jamaica Plain, MA (*Moderator*) Nothing to Disclose
Jason A. Pietryga, MD, Riverside, RI (*Moderator*) Nothing to Disclose

Sub-Events

SSE07-01 Baseline Tumor Enhancement and Apparent Diffusion Coefficient in Predicting Short-Term Response to TACE in Breast Metastases to the Liver: A Volumetric Technique

Monday, Nov. 27 3:00PM - 3:10PM Room: E350

Participants
Daniel Fadaei Fouladi, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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Mounes Aliyari Ghasabeh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ankur Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pegah Khoshpouri, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Farnaz Najmi Varzaneh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pallavi Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Nanna Shao, MBBS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

To investigate whether magnetic resonance (MR) obtained volumetric pretreatment enhancement and apparent diffusion coefficient (ADC) and their change after treatment may predict short-term response in patients with liver breast cancer metastases

METHOD AND MATERIALS

In this retrospective, HIPAA compliant study liver MR images of 91 patients with breast liver metastases (2004-2015) who had received hepatic trans-arterial chemoembolization (TACE) were reviewed. Baseline and 2-4 months post-TACE volumetric lesion enhancement in the portal venous phase (PVP) and ADC (b value >500) were calculated using a prototype Siemens Healthcare-developed software (MR Onco-Treat). Percent change in the largest transverse diameter at 2-4 month post-treatment was defined according to Response Evaluation Criteria in Solid Tumors (RECIST), and decrease in size by 30% was considered partial response to therapy. SPSS software (ver. 21) and Mann-Whitney U test were used for statistical analysis.

RESULTS

The median pretreatment ADC value was significantly lower in the group with partial response to treatment as compared to that with stable disease (1240.4 x 10-6 mm2/s vs. 1433.9 x 10-6 mm2/s, p=0.03). Post-TACE percent increase in ADC value and percent decrease in PVP enhancement were significantly more in patients with partial response to treatment compared to those with stable disease (28.5% vs. 0.9%, p<=0.04 and -25.5% vs. -5.0%, p<0.01, respectively). The two groups were comparable as to the baseline enhancement during the PVP (64.5% in those with partial response vs. 85.3% in those with stable disease, p=0.19).

CONCLUSION

Volumetric baseline ADC, as well as post-TACE enhancement and ADC changes were associated with response to treatment in patients with breast cancer metastases to the liver. Accordingly, a lower baseline ADC, more decrease in post-TACE enhancement during the PVP and more increase in post-TACE ADC were indicators of a better response to treatment.

CLINICAL RELEVANCE/APPLICATION

Baseline volumetric ADC could be used to predict prognosis in patients with breast cancer metastasis to the liver.

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 Educator

SSE07-02 Volumetric Functional MRI as New Prognostic Marker to Predict Survival in Unresectable Intrahepatic

Cholangiocarcinoma Undergoing Systemic Chemotherapy: Long Term Single Institution Outcomes

Monday, Nov. 27 3:10PM - 3:20PM Room: E350

Awards
Student Travel Stipend Award

Participants
Ankur Pandey, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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Daniel Fadaei Fouladi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

Value of multi-parametric assessment of volumetric functional MRI in predicting overall survival (OS) of patients with unresectable intrahepatic cholangiocarcinoma (iCCA) treated with systemic chemotherapy.

METHOD AND MATERIALS

72 patients (mean age 65±13 years, 29 males) with unresectable iCCA were included in this retrospective HIPAA compliant, IRB approved study with waived patient consent. All patients received systemic chemotherapy as the only treatment after undergoing baseline CE-MRI with DWI/ADC map. Single largest lesion was assessed using semi-automatic software for RECIST and volume, and volumetric functional parameters including viable tumor volume, percent viable tumor volume (100* viable tumor volume/whole tumor volume), percent viable tumor burden (100* viable tumor volume/whole liver volume), and ADC. These parameters were compared between low (<=10 months) and high (>10 months) OS groups. ROC, Cox regression and Kaplan Meier survival analysis was performed. P<0.05 was considered significant.

RESULTS

RECIST (58.9±40.4 vs 43.9±26.0 mm; P=0.06), tumor volume (142.2±232.4 vs 77.8±93.2 cm3, P=0.18), viable tumor volume (58.3±89.3 vs 55.1±67.2 cm3; P=0.887) and percent viable tumor burden (2.8±4% vs 2.8±3.0%; P=0.975) were not different between low and high OS groups. Baseline ADC was lower (1228.9±207.2 vs 1621.6±412.7 x 10-6 mm2/s; P<0.0001) and percent viable tumor volume was higher (58.5±37.7 vs 81.7±21.3%; P=0.009) in OS >10 months. Baseline ADC cut off 1325 x 10-6 mm2/s could differentiate low from high OS with a sensitivity, specificity and accuracy of 76.9%, 81.8% and 81.4%, respectively, with better OS for ADC <= 1325 x 10-6 mm2/s (log-rank test, P<0.001). Univariate Cox regression analysis revealed association of baseline ADC (HR, 1.003; P<0.0001) and percent viable tumor volume (HR, 0.981; P<0.01) with OS.

CONCLUSION

There is 0.3% increase and 1.9% decrease in the expected mortality risk relative to a unit increase in baseline ADC and percent viable tumor volume, respectively, in iCCA patients receiving systemic chemotherapy. ADC cut off of 1325 x 10-6 mm2/s at baseline showed OS differences with an accuracy of 81% in identifying patients with OS more than 10 months.

CLINICAL RELEVANCE/APPLICATION

Baseline functional MR parameters like volumetric ADC and percent viable tumor can be used to assess mortality risk and predict OS in patients with unresectable iCCA receiving systemic chemotherapy.

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 Educator

SSE07-03 Pre-Surgical Texture Analysis of Rectal Cancer to Distinguish Residual Tumor from Complete Response

Monday, Nov. 27 3:20PM - 3:30PM Room: E350

Participants
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PURPOSE

Non-operative management in patients with complete response is a new trend, but hinge on accurate imaging and clinical assessment. To investigate ability of texture features to differentiate residual tumor from complete response on rectal MRI.

METHOD AND MATERIALS

IRB approved retrospective study of 30 patients, with preoperative rectal MRI. Uniform pre-operative treatment included induction chemotherapy and neoadjuvant chemoradiation, followed by surgery. 3D volume of interest (VOI) was manually delineated from oblique axial T2 images using ITK-SNAP software. Haralick texture features (energy, entropy, correlation, contrast, homogeneity), and Gabor edge images at angles 0, 45, and 90 were computed from within delineated VOIs using in-house developed software. The features were tested for significance by comparing patients with complete vs. partial response on surgical pathology. Additionally, elastic net regression using Least absolute shrinkage and selection operator (LASSO) regression was performed to extract the most relevant features with alpha=0.1. Leave-one-out cross- validation (LOOCV) was performed to extract the best model.

RESULTS

21/30 cases were analyzed (6 excluded due to insufficient 3D coverage, and 3 due to mucin). Preliminary results showed that three texture features (entropy p=0.044, Gabor(0°) p=0.027, and Gabor(45°) p=0.04) showed statistically significant differences between partial and complete tumor response. Elastic net regression identified correlation, entropy, Gabor(0°) and Gabor(45°) to be relevant for distinguishing between complete and partial response. The feature weights were: correlation=0.0017, entropy=0.0027, Gabor(0°) = 0.007, and Gabor(45°) = 0.0037. The mean square error of the regression analysis was (RMSE=0.48). Figure shows post-treatment MRIs of 2 patients, the first with complete response and the second with partial. Table shows the application of texture analysis to MR images in these patients.

CONCLUSION

Combining texture features may predict partial from complete tumor response. Further studies with larger number of cases are important to confirm preliminary results.

CLINICAL RELEVANCE/APPLICATION

Preliminary results indicate that it is potentially feasible to use texture features to assess response. Our results suggest that lesions depicting lower heterogeneity in terms of edges and those depicting higher entropy are associated with complete response.

SSE07-04 Magnetic Resonance Tumor Regression Grade (mrTRG) To Assess Response after Neoadjuvant Chemoradiation Therapy for Locally Advanced Rectal Cancer: Pathologic Characteristics of the Response Assessment System

Monday, Nov. 27 3:30PM - 3:40PM Room: E350

Awards
Trainee Research Prize - Fellow

Participants
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Hyo Jung Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Chemoradiation therapy (CRT) before surgery has become the standard for locally advanced rectal cancer. Imaging methods to assess CRT response have been proposed, of which magnetic resonance tumor regression grade (mrTRG) is most prominent although its pathologic characteristics are not well known yet. This study is to determine the pathologic nature of mrTRG and suggest how to use mrTRG for patient management.

METHOD AND MATERIALS

472 consecutive patients (M:F, 308:164; 62.2±11.8 years) who had newly diagnosed rectal cancer of T3 or N+ stage as assessed with MRI, no distant metastasis or any lesions that were not cleared of metastasis as evaluated with both CT and PET/CT, and no previous (during past 5 years) or concomitant cancers, underwent long-course CRT. We finally analyzed 439 patients after excluding dropouts during CRT (n=19), no post-CRT MRI (n=4), no surgical resection (n=9), and loss of pathology data (n=1). Post-CRT MRI was obtained 4-6 weeks after the finish of CRT. Three experienced abdominal radiologists evaluated CRT response using mrTRG (1 to 5). Pathologic tumor regression was graded using surgical specimen according to complete (1), near complete (2), moderate (3), minimal (4), and no regression (5). We performed a correlative analysis between mrTRG and pathologic TRG and pT stage.

RESULTS

The study cohort consisted of pathologic TRG1 (n=88), 2 (n=113), 3 (n=175), 4 (n=62), and 5 (n=1). mrTRG grades distributed similarly, showing 15% mrTRG1 (n=66), 25.5% mrTRG2 (n=112), 37.1% mrTRG3 (n=163), 21.4% mrTRG4 (n=94), and 0.9% mrTRG5 (n=4). mrTRG1 showed complete and near complete regression in 60.6% and 27.3%, respectively. These were 22.3% and 52.7%, respectively, for mrTRG2. mrTRG3 and 4 had only 26.4% and 14.9%, respectively, rates of combined complete and near complete regression. Pathologic T stages of mrTRG1 were pT0 (ie, complete regression) in 60.6%, pT2 or lower in 89.4%, and pT3/4 without achieving near complete regression in only 3%. When mrTRG1 and 2 are combined, these values were 36.5%, 77.5%, and 7.9%.

CONCLUSION

mrTRG1, possibly combined mrTRG 1 and 2, seems to be reasonable criteria to recommend a local excision instead of a radical surgery while it seems unclear if mrTRG could be a robust tool to find candidates for nonsurgical observation.

CLINICAL RELEVANCE/APPLICATION

mrTRG could be used to guide local excision of rectal cancer after CRT, which should be further proved with oncologic outcome trials.

SSE07-05 Texture Analysis Can Be a Potential Tool to Differentiate Gastrointestinal Stromal Tumors with KIT Exon 11 Mutations, which is an Important Genotype for Imatinib Therapy, on Enhanced CT Images

Monday, Nov. 27 3:40PM - 3:50PM Room: E350

Participants
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PURPOSE

To determine the accuracy of texture analysis to differentiate gastrointestinal stromal tumors (GISTs) with KIT exon 11 mutations on enhanced CT images.

METHOD AND MATERIALS

Ethical approval was obtained for this retrospective analysis, and the requirement for informed consent was waived. This study consisted 69 patients with GISTs, of which 46 patients with KIT exon 11 mutations (yes-exon11-GISTs), and 23 patients without KIT exon 11 mutations (no-exon11-GISTs). Clinical information of the patients were collected and their correlation with GISTs genotypes were analyzed. Enhanced CT images including two sets of single-section were contoured manually by three independent radiologists. Two-dimensional texture analysis were performed for each lesion and the repeatability was assessed. Texture features including histogram parameters, Gray-Level Co-occurrence Matrix Parameters, and Gray-Level Run Length Matrix Parameters, were evaluated. Logistic regression models were built using clinical features and CT texture parameters. Enhanced CT images for each patient were independently reviewed by two radiologists who subjectively graded lesion heterogeneity on a five-point scale, and the correlation between the subjective heterogeneity rating and GISTs genotypes were evaluated.

RESULTS

There were lower lesion heterogeneity in yes-exon11-GISTs. The repeatability of the texture features were very good within and between readers. The texture parameters stdDeviation was included in the logistic regression model in each ROI session. The AUCs of stdDeviation ranged from 0.727±0.063 to 0.750±0.063. The visual subjective heterogeneity rating evaluated by the two radiologists had no significant difference between yes-exon11-GISTs and no-exon11-GISTs.

CONCLUSION

CT texture analysis can be used to differentiate GISTs with exon 11 mutations in KIT gene from those GISTs without KIT exon 11 mutations on enhanced CT images.

CLINICAL RELEVANCE/APPLICATION

The specific mutation in GISTs correlates with clinical response to molecular therapies. The importance of matching the GISTs genotypes with specific therapies, which makes precision medicine for GISTs feasible, have been noticed. Patients with exon 11 mutations of KIT gene are more likely to respond to imatinib than those with other mutations or those who are wild type for KIT and PDGFRA mutations. Our study suggest that CT texture analysis can be used to differentiate yes-exon11-GISTS from no-exon11-GISTs.

SSE07-06 Using Texture Analysis on Perfusion-Weighted Magnetic Resonance Imaging in Assessing Microvascular Invasion of Hepatocellular Carcinoma

Monday, Nov. 27 3:50PM - 4:00PM Room: E350

Participants
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Bin Song, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To prospectively test whether the texture analysis on perfusion-weighted magnetic resonance imaging (PW-MRI) can offer reliable indexes capable of predicting and grading microvascular invasion (MVI) of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

Perfusion-weighted magnetic resonance imaging was performed on 31 HCC patients on a 3.0 Tesla MR scanner. The perfusion data was acquired using a prototype radial stack-of-stars three-dimensional spoiled gradient echo pulse sequence with golden-angle radial sampling schemes over the course of 6.25 minutes. Post-processing of PW-MRI data was performed on an in-housed software O.K.(Omini-Kinetics) to calculate Ktrans, Kep, Ve and the semi-quantitative parameter of area under the curve (AUC) using the Extended Tofts linear model, followed by texture analysis on those parametric maps using the same software. A total of 75 texture features were calculated for each perfusion results. The presence of MVI was histopathologically determined and classified into three groups: A-negative (without MVI), B-mild (had one to five invaded vessels), and C-severe (had more than five invaded vessels). Spearman correlation coefficients were determined between texture parameters and the degree of MVI. Receiver operation characteristic (ROC) analysis of predicting the presence of MVI was performed for identified texture parameters.

RESULTS

The MinLocation of Ktrans (r=0.377, P=0.037), RelativeDeviation of Ve (r=0.371, P=0.04) as well as the MinIntensity (r=-0.366, P=0.043), MinLocation (r=0.377, P=0.037), skewness (r=0.542, P=0.002) and kurtosis (r=0.467, P=0.008) of AUC mapping showed week to moderate correlations with the degree of MVI. The MinLocation, skewness and kurtosis of AUC were significantly different between the groups with and without MVI (P<0.05), with area under the ROC curve of 0.707, 0.859 and 0.734, respectively, in predicting the presence of MVI.

CONCLUSION

A combination of perfusion-weighted magnetic resonance imaging and texture analysis can help predicting and grading microvascular invasion (MVI) of hepatocellular carcinoma (HCC))

CLINICAL RELEVANCE/APPLICATION

Texture analysis on PW-MRI provides additional information regarding distribution and heterogeneity of intratumoral microvasculature, and therefore helps non-invasive evaluation of tumor MVI.

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Explore Invent Transform

SSE08

Gastrointestinal (Elastography)

Monday, Nov. 27 3:00PM - 4:00PM Room: E352

GI MR US

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

Participants
Mitchell E. Tublin, MD, Pittsburgh, PA (*Moderator*) Nothing to Disclose
Sudhakar K. Venkatesh, MD, FRCR, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSE08-01 Hepatic MR Elastography at 3T: Agreement Across Pulse Sequences and Effect of Hepatic Iron

Monday, Nov. 27 3:00PM - 3:10PM Room: E352

Participants
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PURPOSE

To compare 3 prototype hepatic magnetic resonance elastography (MRE) sequences at 3T with the standard clinical implementation gradient echo (GRE) sequence and to determine the effect of hepatic R2* on measurable area of liver stiffness (LS).

METHOD AND MATERIALS

52 patients (28 men, 24 women; mean age 56 years) underwent liver MRE at 3T (MAGNETOM Prisma, Siemens Healthcare) in this IRB-approved, HIPAA-compliant study. Sequences included: GRE (TR/TE 50/22 msec; slice thickness/gap 5/1 mm; matrix 77 x128; phase partial Fourier; flip angle, 250; breath hold, 18 sec), rapid GRE (TR/TE 25/22 msec; slice thickness/gap 5/1 mm; matrix, 84 x 128; flip angle, 150, breath hold, 9 sec), rapid fractional GRE (TR/TE 25/15 msec; slice thickness/gap 5/1 mm; matrix, 84 x 128; flip angle, 150, breath hold, 9 sec), and spin-echo echoplanar imaging (SE-EPI) (TR/TE 1600/49; slice thickness/gap 5/1 mm; matrix, 128 x 128; echo train length, 47; flip angle, 900; breath hold 18 sec). Hepatic R2* values were calculated using a multi-echo Dixon technique (LiverLab, Siemens). Mean LS and measurable area of stiffness (> 95% confidence threshold) were compared. Hepatic R2* was correlated with measurable area of LS and technical success rate.

RESULTS

In 6/52 patients, $\geq$ 1 sequence (5 GRE, 1 GRE and SE-EPI) failed (< 100 mm2 measurable area of LS). Mean LS was not significantly different across the 4 sequences (GRE 2.55 kPa, Rapid GRE 2.66 kPa, Rapid Fractional GRE 2.51 kPa, SE-EPI 2.52 kPa; P = 0.10). There was a significant difference in measurable area of LS (GRE 12389 mm2, Rapid GRE 14053 mm2, Rapid Fractional GRE 17039 mm2, SE-EPI 11212 mm2, P < 0.0001). Hepatic R2* was inversely correlated with measurable LS area for all 4 sequences (P < 0.0004). Mean hepatic R2* was higher among patients in whom $\geq$ 1 pulse sequence failed (mean R2* 100 sec-1 vs 50 sec-1, P = 0.0065).

CONCLUSION

Measured LS was equivalent across 4 hepatic MRE sequences, but there was a significant difference in measurable area of LS, with the largest area achieved with the rapid fractional GRE sequence. Hepatic R2* was significantly correlated with measurable area of LS and was significantly higher among patients with one or more failed sequences.

CLINICAL RELEVANCE/APPLICATION

Modified GRE (reduced TR/TE) or SE-EPI sequences may be useful alternatives for hepatic MRE, especially at 3T, because of less susceptibility to T2* effects associated with liver iron and shorter breath-holds.

SSE08-02 Evaluation of Hepatic Fibrosis by Using Monoexponential, Biexponential, and Stretched Exponential Diffusion-Weighted MR Imaging

Monday, Nov. 27 3:10PM - 3:20PM Room: E352

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PURPOSE

To compare the ability of diffusion parameters acquired from monoexponential, biexponential, and stretched exponential diffusion-weighted imaging (DWI) models for the diagnosis of hepatic fibrosis (HF)

METHOD AND MATERIALS

Ninety five patients who underwent DWI using 9 b-values at 3T and had a pathologic reference standard of HF were included in this study. Liver apparent diffusion coefficient (ADC) obtained from a monoexponential model; true diffusion coefficient (Dt), pseudo-diffusion coefficient (Dp), and perfusion fraction (f) calculated from a biexponential model; distributed diffusion coefficient (DDC) and diffusion heterogeneity index (a) obtained from a stretched exponential model were compared with the pathologic HF stage (F). For the stretched exponential model, parameters were also obtained using a 6 b-value dataset with omitted lower b values (DDC#, a#). Spearman correlation analysis was performed to assess the relationship between HF and DWI parameters. The accuracy of DWI in the determination of HF stage was evaluated with Obuchowski measures. Diagnostic performance in diagnosing significant HF (>= F2) was compared using generalized estimating equation.

RESULTS

All parameters except Dt showed a significant negative correlation with the HF stage ($P < 0.05$). Among these, DDC# showed the strongest negative correlation with the HF stage ($\rho = -0.61$). The diagnostic accuracy for HF staging was highest for DDC# (Obuchowski measures, 0.770 ± 0.03) followed by a# (0.768 ± 0.04), DDC (0.748 ± 0.03), and Dp (0.728 ± 0.04). The accuracy of DDC# (78.9%) for determining significant HF (>= F2) was significantly higher than that of ADC, Dt, and f ($P < 0.05$). Dp showed similar accuracy (74.7%) with DDC# for determining >= F2 ($P > 0.999$), but revealed significantly lower specificity than DDC# (61.4% vs. 93.2%, $P < 0.001$). The diagnostic performance of DDC and a obtained with all b-values were not significantly different from those with 6 b-values (DDC#, a#) ($P > 0.05$).

CONCLUSION

Stretched exponential DWI is a promising method in the staging of HF. DDC showed comparable or better diagnostic performance with Dp even at fewer b-value acquisition.

CLINICAL RELEVANCE/APPLICATION

Stretched exponential DWI is a promising noninvasive method for classifying the severity of hepatic fibrosis, and it has the advantage of reducing scanning time with fewer b-value acquisitions.

SSE08-03 Evaluation of 2-D Ultrasound Shear Wave Elastography, Magnetic Resonance Elastography and Transient Elastography for the Non-Invasive Diagnosis of Advanced Fibrosis in Patients with Nonalcoholic Fatty Liver Disease: Preliminary Results

Monday, Nov. 27 3:20PM - 3:30PM Room: E352

Participants
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PURPOSE

To evaluate the performance of 2D ultrasound shear wave elastrography (2D-SWE), magnetic resonance elastography (MRE) and transient elastography (TE) for the diagnosis of advanced fibrosis in patients with biopsy-proven nonalcoholic fatty liver disease (NAFLD).

METHOD AND MATERIALS

In this IRB-approved, cross-sectional study 35 (21F, 14M) adult subjects (mean age, 50 years) with biopsy-proven NAFLD were prospectively recruited. The patients underwent 2D-SWE, MRE and TE the same day and with a median interval time of 72 days from liver biopsy. 2D-SWE was performed on a GE LOGIQ E9 scanner. MRE was conducted on a 1.5T scanner using a 2D-GRE sequence (GE Healthcare). TE was performed on Fibroscan (Echosens) using the XL probe. The median of measurements in the right hepatic lobe was considered for statistical analysis. Histologic evaluation included the fibrosis stage (F0-4) and the NAFLD activity score (NAS). Receiver operating characteristic (ROC) analysis was used to evaluate the performances of 2D-SWE, MRE and TE in diagnosing advanced fibrosis (F3-F4). Logistic regression analysis was used to assess the effect of BMI and NAS score on the diagnostic performance.

RESULTS

The distribution of fibrosis stage was as follow: F1, n=10; F2, n=13; F3, n=6; F4, n=4. 2D-SWE, MRE and TE detected advanced fibrosis with an area under the ROC (AUROC) respectively of 0.85 (95% confidence interval [CI], 0.72-0.97; P=0.001), 0.95 (95%

CI, 0.88-1.0; P<0.001) and 0.94 (95% CI, 0.86-1.0; P<0.001). The mean ± SD BMI was 34.5 ± 7.3 kg/m2 and the mean ± SD NAS was 4.7±1.4. NAS was significantly associated with changes in AUROC (Odds ratio=3.1; P=0.012).

CONCLUSION

2D-SWE, MRE and TE are highly accurate methods for the non-invasive diagnosis of advanced fibrosis in patients with NAFLD.

CLINICAL RELEVANCE/APPLICATION

Ultrasound and MR-based elastography methods are highly accurate for the detection of advanced fibrosis in patients with NAFLD.

SSE08-04 Correlation of Liver Stiffness Values Measured by Transient Elastography with Histopathologic Grading of Hepatic Fibrosis by Quantitative Morphometric Measurement and Semi-Quantitative Analysis

Monday, Nov. 27 3:30PM - 3:40PM Room: E352

Participants
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PURPOSE

To correlate liver stiffness values measured by transient elastography with two different histopathologic fibrosis grading systems, i.e. quantitative morphometric measurement of the fibrosis area and semi-quantitative analyses using the METAVIR score

METHOD AND MATERIALS

This prospective study was approved by the institutional review board and informed consent was obtained. We finally enrolled 74 subjects who were examined by transient elastography and underwent liver resection for focal hepatic lesions (60 subjects) or donor lobectomy (14 subjects) from March 2015 to January 2016. The time interval between transient elastography and liver resection was less than one month. Histopathologic hepatic fibrosis was graded quantitatively by using morphometry of the fibrosis area and semi-quantitatively by using the METAVIR score. The Spearman correlation coefficient (ρ) was used to examine the correlation between liver stiffness values measured by transient elastography and the two histopathologic fibrosis grading systems. The correlation between the two histopathologic fibrosis grading systems was also analyzed.

RESULTS

Liver stiffness values measured by transient elastography were poorly correlated with quantitiative morphologic analysis of the fibrosis area ($\rho = 0.305$, $P = 0.008$), while they were much better correlated with the METAVIR score ($\rho = 0.729$, $P < 0.001$). The correlation between the two histopathologic fibrosis grading systems was also poor and not significant ($r = 0.265$, $P = 0.265$).

CONCLUSION

Liver stiffness values measured by transient elastography were correlated better with semi-quantitative histopathologic grading than with qualitative morphometric analyses.

CLINICAL RELEVANCE/APPLICATION

This study enhances our understanding of physical properties measured by US elastography on the basis of histopathologic backgrounds.

SSE08-05 Two-Center Experience with Ultrasound Elastography in Cirrhosis: Factors Affecting the Application of SRU Consensus Guidelines

Monday, Nov. 27 3:40PM - 3:50PM Room: E352

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PURPOSE

1) To evaluate if patients with known hepatic cirrhosis have shear wave velocities of >2.2 m/s, the cutoff for advanced fibrosis established by recent SRU guidelines.2) To identify potential patient or technique-related factors that can lower the otherwise expected high stiffness measurements in patients with cirrhosis.

METHOD AND MATERIALS

In this IRB-approved study, we identified 131 patients with known cirrhosis from two large academic centers. Thirty of these patients did not qualify due to lack of sufficient criteria for cirrhosis, 17 were excluded due to high interquartile range/median value

(>0.3), and 2 were considered invalid due to unexpectedly high numbers (>5 m/s). All of the remaining 82 patients underwent Acoustic Radiation Forced Impulse (ARFI) Shear Wave Elastography (SWE) using a Philips EPIQ ultrasound machine. Ten shear wave velocity (SWV) measurements were obtained and the median was considered the final SWV.

RESULTS

Patient age ranged from 28-79 years (mean 58). SWV ranged from 1.17-2.66 m/s. Only 9 (11%) patients met the SRU cutoff of SWV > 2.2 m/s for advanced fibrosis, and 9 (11%) patients demonstrated normal SWV (<1.34 m/s). There was weak correlation (0.3-0.5) between SWV and elevated liver function tests (LFTs) as well as lower platelet counts. However, there was no correlation between SWV and HCV titers, serum fibrosis/inflammation tests, body-mass-index, age, and presence of portal hypertension. All patients with sustained viral response (SVR) and/or Harvoni treatment had SWV <1.8 m/s, but there was no significant difference in SWV between patients with and without SVR.

CONCLUSION

The vast majority (89%) of patients with cirrhosis demonstrate SWV less than the SRU cutoff of 2.2 m/s. Only weak correlation was noted between SWV and LFTs as well as low platelet counts. No other factors demonstrated a significant effect on SWV alone, indicating a multifactorial approach may be more appropriate. Our study suggests that revision of the current SRU cutoff may be necessary in the near future.

CLINICAL RELEVANCE/APPLICATION

The current SRU cutoff of SWV > 2.2 m/s would miss the majority of patients with advanced fibrosis (including cirrhosis) and thus revision of these guidelines may be necessary in the near future.

SSE08-06 Hepatic Sinusoidal Obstruction Syndrome: Diagnostic Value of Ultrasound Shear-Wave Elastography - An Experimental Study in a Rat Model

Monday, Nov. 27 3:50PM - 4:00PM Room: E352

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PURPOSE

To evaluate the diagnostic value of ultrasound shear-wave elastography (SWE) in the assessment of hepatic sinusoidal obstruction syndrome (SOS) in a monocrotaline (MCT)-induced rat SOS model.

METHOD AND MATERIALS

The institutional animal care and use committee approved this study. Twenty rats were randomly divided into four groups with five animals each. Each group of animals were administered phosphate-buffered saline vehicle, or different doses of MCT (90, 160, and 200 mg/kg) by gavage. All rats underwent liver stiffness measurement (LSM) by 2D ultrasound SWE and immediately sacrificed to obtain liver tissue. LSMs were correlated with histologic grades of SOS using Spearman's rank correlation test, and receiver operating characteristic (ROC) curve analysis was performed to determine the accuracy and cutoff values for SOS severity.

RESULTS

According to histologic analysis, 10, 4, and 6 rats were categorized as having none, mild, and moderate/severe SOS, respectively. LSM by ultrasound SWE showed significant correlation with SOS severity (rho = 0.91, P <0.001) with means of 6.2, 10.5, and 12.3 kPa, in none, mild, and moderate/severe SOS, respectively. The area under the ROC curves were 0.98 (none vs. mild or moderate/severe) and 0.93 (none or mild vs. moderate/severe) with optimal cutoffs of LSM of 7.9 and 8.5 kPa, respectively.

CONCLUSION

LSM by ultrasound SWE may be helpful in the diagnosis and severity classification of hepatic SOS.

CLINICAL RELEVANCE/APPLICATION

Hepatic sinusoidal obstruction syndrome (SOS), a drug-induced liver injury, is associated with increased morbidity after major hepatectomy. Therefore, there has been a great need of a noninvasive quantitative test for diagnosis and monitoring of hepatic SOS. This animal study suggests that ultrasound shear wave elastography can be useful in the noninvasive assessment of hepatic SOS while further validation is needed in human subjects.

SSE09

Gastrointestinal (CT Dose)

Monday, Nov. 27 3:00PM - 4:00PM Room: E353B

CT GI SQ

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

Participants
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William P. Shuman, MD, Seattle, WA (*Moderator*) Research Grant, General Electric Company

Sub-Events

SSE09-01 Comparative Study on Optimal Noise Index and Iterative Reconstruction Algorithms According to Patient's Body Weight in Abdomen-Pelvis CT

Monday, Nov. 27 3:00PM - 3:10PM Room: E353B

Participants
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PURPOSE

To figure out optimal noise indices and iterative reconstruction algorithms corresponding to patient's body weight in abdomen-pelvis CT.

METHOD AND MATERIALS

450 patients (40-90kg) who underwent abdomen-pelvis CT with AEC based on three different noise indices (NI) were retrospectively analyzed. We set control group (NI:10.5) and experimental groups (NI:12.81 and 14.8). To find out the relation among body weight, radiation dose, and NI, the patients of each group were stratified into 10 groups according to their body weight (40-90kg, 5kg intervals, 15 patients/group). When assessing image quality, we additionally adapted 30% and 50% adaptive statistical iterative reconstruction (ASIR) algorithms on the CT images of experimental groups to compensate for image quality deterioration. The volume CT dose index (CTDIvol), dose length product (DLP), and quantitatively hepatic noise according to body weight compared with control were assessed using two-way analysis of variance and Bonferroni p-value adjustments.

RESULTS

All values of CTDIvol and DLP had significantly differences in all steps of NI and body weight ($P<0.05$). The higher NI was, the lower radiation dose was in all cases. Due to the slope change of dose-weight graph, patients were divided into three groups which were classified as thin (below 55kg), normal (from 55 to 80kg), and obese (above 80kg). Among three NI, 12.81 was appropriate to thin and normal group, on the other hand, 14.8 was effective to reduce radiation dose for obese group. Usage of 30% and 50% ASIR algorithms can reduce image noise efficiently. Quantitatively hepatic noise in thin group with 30% ASIR and in obese group with 50% ASIR were similar to that in normal with FBP ($P>0.05$).

CONCLUSION

Different noise indices on the basis of body weight should be taken into account in abdomen-pelvis CT. For compensating for low image quality, it is imperative to use iterative reconstruction algorithms.

CLINICAL RELEVANCE/APPLICATION

We recommend that if you want to give an optimal dose to patients, you have to set NI of 12.81 and 14.8 in accordance with body weight. It is beneficial to use 30% ASIR below 55kg and 50% ASIR above 80kg by providing appropriate image quality.

SSE09-02 Effect of Visceral Fat Volume on CTE Image Quality at Full and Reduced Radiation Exposure Using FBP and Iterative Reconstructions

Monday, Nov. 27 3:10PM - 3:20PM Room: E353B

Participants
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PURPOSE

To evaluate the effect of of visceral fat volume on subjective image quality in CT Enterography (CTE) at full and reduced radiation exposure images using standard FBP and iterative reconstructions

METHOD AND MATERIALS

IRB approved, HIPAA compliant, retrospective, single center, cohort study consisting of 74 patients:active terminal ileal(TI) Crohns disease (n=37) and normal (n=37). All patients had CTE on a dual-source CT (100% exposure using both tubes) with filtered back projection(FBP) reconstruction. Primary source (30% exposure) data was extracted and reconstructed with FBP & Sinogram-Affirmed Iterative Reconstruction(SAFIRE) version 3 (strength 3 & 4). Using a 4-point scale for image quality (non-diagnostic, suboptimal, diagnostic, optimal), 7 readers, randomized and blinded to the exposure and reconstruction method, subjectively evaluated image quality for assessment of active TI Crohns disease. Visceral fat volume was calculated from the full exposure image sets using semi-automated software. Pearson's correlation coefficient was used to characterize the linear relationship between the number of readers indicating poor image quality and visceral fat volume.

RESULTS

There was a statistically significant association between low visceral fat volume and the number of readers indicating poor image quality. In 47 patients with < 2000 cc visceral fat volume, the majority (>3) of readers scored poor image quality for 2% of full exposure FBP, 23% of reduced exposure FBP, 17% of SAFIRE 3 and 40% of SAFIRE 4 images. In 27 patients with >= 2000 cm3 visceral fat volume, the majority (3) of readers scored poor image quality for 0% of full exposure FBP, 7% of reduced exposure FBP, 0% for SAFIRE 3 and 4% for SAFIRE 4 images. Pearson correlation coefficient (95% CI); -0.3(-0.5,-0.08) for full-exposure FBP, -0.29(-0.49,-0.07) for reduced-exposure FBP, -0.29(-0.48,-0.06) for SAFIRE 3 and -0.47(-0.63,-0.27) for SAFIRE 4

CONCLUSION

Low visceral fat volume is statistically significantly associated with poor subjective image quality in full exposure FBP and reduced exposure FBP and SAFIRE (3 and 4) CTE studies.

CLINICAL RELEVANCE/APPLICATION

Negative association between low visceral fat volume and image quality should be considered when designing reduced exposure protocols for CTE.

SSE09-03 A New Iterative Reconstruction CT Technique of Forward Projected Model-based IR Solution (FIRST): Evaluation of Image Quality, Radiation Dose Reduction, and Reconstruction Time at Upper Abdominal CT using an Anthropomorphic Phantom Model

Monday, Nov. 27 3:20PM - 3:30PM Room: E353B

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PURPOSE

Iterative reconstruction (IR) techniques can be used to improve the quality of low-dose CT images. Recently, a full iterative reconstruction method, Forward projected model-based IR SoluTion (FIRST) has become available. The purpose of our study was to evaluate the radiation dose reduction, image quality, and reconstruction time of upper abdominal CT images using FIRST in comparison with those of AIDR 3D (adaptive iterative dose reduction 3D) and FBP (filtered back projection) by using an anthropomorphic phantom.

METHOD AND MATERIALS

An anthropomorphic phantom of upper abdomen was scanned with a 320-slice CT scanner (Aquilion ONE/GENESIS; Toshiba). Five different tube currents were employed at 120 kVp: 25, 50, 100, 150 and 200 mAs. Scans for 20-cm scan length were performed five times at each mAs setting and axial 5-mm thickness images were reconstructed with FIRST, AIDR 3D and FBP. The reconstruction time and dose length product (DLP) were recorded for each scan. Image noises were defined by standard deviation of CT number of the material simulating subcutaneous fat. Contrast to noise ratio (CNR) was calculated from the contrast between liver parenchyma and portal vein. As a qualitative analysis, the image quality was visually assessed on a four-point scale. Paired t-test and Wilcoxon rank-sum test with Bonferroni adjustment were used to compare the continuous values and scores, respectively.

RESULTS

In the same mAs setting, FIRST yielded 40 - 70% and 13 - 31% noise reduction and 62 - 231% and 11 - 44% CNR increase compared to FBP and AIDR 3D, respectively. FIRST showed 270-s longer reconstruction time compared to FBP and AIDR 3D. Mean image noise and CNR of FIRST at 25 mAs (42.1 mGy/cm) were 8.3HU and 3.8, which were comparable to those of FBP at 200 mAs (352.6 mGy/cm; 10.0 HU and 3.3) and AIDR 3D at 50 mAs (84.2 mGy/cm; 9.4 HU and 3.4). However, the mean visual scores of FIRST were not significantly different with FBP and AIDR 3D at each mAs setting (P>0.05).

CONCLUSION

FIRST suppressed image noise and increased CNR compared to FBP and AIDR 3D in upper abdominal CT images. The reconstruction time (270 seconds increase) was supposed to be acceptable for routine clinical practice.

CLINICAL RELEVANCE/APPLICATION

FIRST, which has clinically acceptable reconstruction time of 270 seconds for 20 cm scan, is a promising technique for upper abdominal CT in terms of the radiation dose and image quality.

SSE09-04 Abdominal CT: Comparison of Low-Dose Spectral CT with Adaptive Statistical Iterative Reconstruction (ASIR) and Routine-Dose Conventional CT with ASIR in Patients with High BMI Values

Monday, Nov. 27 3:30PM - 3:40PM Room: E353B

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PURPOSE

To compare the radiation dose, noise and image quality of abdominal low-dose CT in spectral imaging mode reconstructed with ASIR and routine-dose conventional CT reconstructed with ASIR in patients with high body mass index (BMI) values

METHOD AND MATERIALS

With institutional review board approval and informed consent, 81 patients with high BMI values (>=29kg/m2) underwent contrast-enhanced abdominal CT during arterial phase (AP) and portal venous phase (PVP) were prospectively included .In chronological order, 41 patients were assigned to the control group using tube voltage of 120 kVp and images reconstruction with 30% ASIR (group A1) and 50% ASIR (group A2). Based on the volume CT dose index (CTDI vol) in the control group (21.71mGy), the nearly half of the dose in spectral CT with GSI-22 mode (CTDI=10.76mGy) was selected in the study group (n=40). Monochromatic images (40 to 70keV) were reconstructed using 50% ASIR (group B) in the study group. Quantitative parameters (image noise and contrast-to-noise ratio [CNR]of the liver, pancreas, aorta and portal vein) and qualitative visual parameters were compared. Statistical analysis was performed with two sample t tests, one-way ANOVA or Kruskal-Wallis H tests

RESULTS

During the AP and PVP,at the energy level of 40 keV and 50 keV,the study group showed higher CT values than control group,group B showed higher or similar CNRs,higher image noise and lower overall image quality scores point than group A1 and A2.At the energy levelof 60 keV,the study group showed higher CT values than control group except the CT values of live in AP,group B showed higher or similar CNRs,slightly higher image noise than group A1 and A2,and lower overall image quality scores than group A2 but similar scores to group A1.At the energy level of 70 keV,the study group showed similar CT values to the control group except the CT values of live in AP,group B showed higher CNRs and similar image noise than group A1 and A2,higher overall image quality scores than groupA1 and similar scores to group A2.

CONCLUSION

Compared with routine-dose conventional CT with ASIR, abdominal low-dose spectral CT with ASIR maintain overall image quality from 60 to 70 keV, thereby permitting diagnostic abdominal examinations with lower (by 51%) radiation doses

CLINICAL RELEVANCE/APPLICATION

Low-dose spectral CT with ASIR can maintain overall image quality from 60 to 70 keV, thereby permitting diagnostic abdominal examinations.

SSE09-05 The Diagnostic Performance of Low-dose CT for Suspected Appendicitis in Pediatric and Adult Patients: A Systematic Review and Diagnostic Meta-Analysis

Monday, Nov. 27 3:40PM - 3:50PM Room: E353B

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PURPOSE

To evaluate the diagnostic performance of low-dose CT for suspected appendicitis and to investigate the diagnostic performance of low-dose CT and standard-dose CT for a head-to-head comparison.

METHOD AND MATERIALS

A systematic search of the MEDLINE and EMBASE databases was combed through until January 10th, 2017. Pooled summary estimates of sensitivity and specificity were calculated using hierarchical logistic regression modeling. Meta-regression was performed.

RESULTS

14 original articles including a total of 3,262 patients were included. For all studies using low-dose CT, the summary sensitivity was 96% (95% CI, 93%-98%) with a summary specificity of 94% (95% CI, 92%-95%). For the 11 studies providing a head-to-head comparison between low-dose CT and standard-dose CT, low-dose CT demonstrated a comparable summary sensitivity of 96% (95% CI, 91%-98%) and specificity of 94% (95% CI, 93%-96%) without any significant differences (p=.41). In meta-regression, there were no significant factors affecting the heterogeneity. The median effective radiation dose of the low-dose CT was 1.8mSv (1.46-4.16mSv), which was a 78% reduction in effective radiation dose compared to the standard-dose CT.

CONCLUSION

Low-dose CT shows excellent diagnostic performance for suspected appendicitis. Low-dose CT has a comparable diagnostic performance with a 78% dose reduction compared to standard-dose CT.

CLINICAL RELEVANCE/APPLICATION

Low-dose CT has a comparable diagnostic performance with a 78% dose reduction for evaluating suspected appendicitis compared to standard-dose CT.

SSE09-06 Comparison of Two Commercial Adaptive Statistical Iterative Reconstruction (ASiR, ASiR-V) on Routine Liver CT: Objective and Subjective Image Quality Evaluation

Monday, Nov. 27 3:50PM - 4:00PM Room: E353B

Participants
Ning Pan, Xian, China (*Presenter*) Nothing to Disclose
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Lihong Chen, Xian, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To compare image quality for routine liver CT reconstructed with adaptive statistical iterative reconstruction (ASiR) and ASIR-V.

METHOD AND MATERIALS

This IRB-approved study included 46 patients clinically suspected hepatic metastases. Patients were divided equally into ASiR group (GE HD750 CT) and ASiR-V group (GE Revolution CT). Scan parameters were the same on both systems (120 kVp, auto mA for Noise Index of 12HU, detector collimation 0.625*64mm). Images were reconstructed with ASiR and ASiR-V from 0%-100% at 10% interval. Mean and standard deviation of CT numbers within regions of interest placed on 3 locations at the level of the right portal vein (erector muscle of spine, anterior abdominal fat and liver parenchyma) was recorded, and SNR was calculated. Two experienced radiologists independently graded image noise, visual sharpness of liver boundary, conspicuity of the hepatic veins within liver, visualization of the extrahepatic duct and diagnostic acceptability, using a 1-5 grading score. Statistical analysis was performed using Mann-Whitney U test for subjective image quality assessment.

RESULTS

The average effective dose of ASiR and ASiR-V group were 3.15±6.2mSv and 3.01±562mSv respectively with no difference. Objectively, Compared with FBP, as the percentage of ASiR and ASiR-V increased from 10% to 100%, image noise reduced by 8.6% to 57.9% and 8.9% to 81.6% respectively, and the SNR increased accordingly. For subjective evaluation, substantial inter-observer agreement was obtained for determination of image quality for reconstruction with ASiR as well as with ASiR-V. Compared with FBP reconstruction, subjective image quality score of ASiR and ASiR-V groups improved significantly as percentage increased from 10% to 70% for ASIR (42% noise reduction compared with FBP) and 60% (52% noise reduction compared with FBP) for ASIR-V, and declined afterwards due to waxy artifacts.

CONCLUSION

ASiR-V algorithm considerably improved objective and subjective image quality of routine liver CT images compared with those of FBP or ASiR. ASiR-V60% was the most appropriate strength for keeping a best balance between the noise and waxy artifacts of routine liver images in Revolution CT.

CLINICAL RELEVANCE/APPLICATION

Selecting a appropriate strength of ASiR-V algorithm can improve image quality in routine liver CT scanning.

SSE10

Science Session with Keynote: Gastrointestinal (Contrast Enhanced Ultrasound)

Monday, Nov. 27 3:00PM - 4:00PM Room: E353C

GI US BQ

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

FDA Discussions may include off-label uses.

Participants
Anthony E. Samir, MD, Boston, MA (*Moderator*) Consultant, Pfizer Inc; Consultant, General Electric Company; Consultant, PAREXEL International Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, Toshiba Medical Systems Corporation; Research Grant, General Electric Company; Research Grant, Samsung Electronics Co, Ltd; Research Grant, Analogic Corporation; Research support, SuperSonic Imagine; Research support, Hitachi, Ltd
Aya Kamaya, MD, Stanford, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSE10-01 Gastrointestinal Keynote Speaker: Update on Contrast Enhanced Ultrasound (CEUS)

Monday, Nov. 27 3:00PM - 3:10PM Room: E353C

Participants
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SSE10-02 Preoperative and Intraoperative Contrast-Enhanced Ultrasound (CEUS/IOCEUS) of Liver Tumors in Comparison to Magnetic Resonance Imaging and Histopathology

Monday, Nov. 27 3:10PM - 3:20PM Room: E353C

Participants
Ernst Michael Jung, MD, Regensburg, Germany (*Presenter*) Speaker, Bracco Group
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Christian R. Stroszczynski, MD, Regensburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic significance of preoperatively and intraoperatively performed contrast-enhanced ultrasound (CEUS/IOCEUS) in the diagnosis of liver tumors, in comparison to magnetic resonance imaging (MRI) and histopathology.

METHOD AND MATERIALS

Findings of CEUS and IOCEUS were compared to MRI findings in 70 cases. CEUS and IOCEUS were performed using multifrequency linear probes (1-5, 6-15 MHz) after bolus injection of 1-5 ml sulphur hexaflouride microbubbles. Evaluation of histopathology after surgical resection, of MRI morphology (T1, T2, VIBE, Diffusion sequences) and wash-in/wash-out-kinetics of CEUS.

RESULTS

In 70 analyzed patient cases 64 malignant liver lesions could be detected 6 patients had benign liver lesions. Among the 64 malignant lesions there were 28 metastases, 24 hepatocellular carcinomas (HCC), 9 cholangiocellular carcinomas (CCC) and 3 gallbladder carcinomas. There was no significant difference when determining the lesion's malignancy/ benignity (p=1,000). Furthermore, there was no statistical significance between preoperative CEUS and MRI regarding the general differential diagnosis of a tumor (p=0,210) and the differential diagnosis classification between HCCs (p=0,453) and metastases (p=0,250).There was no statistical significance in tumor size (10 mm - 151 mm; Mean 49 mm SD +/- 31 mm) and localization (tumor size p=0,579; allocation to liver lobes p=0,132; segment diagnosis p=0,121) between preoperatively performed CEUS and MRI. IOCEUS offered the substantial advantage of locating additional liver lesions (p=0,004 compared to preoperative MRI, p=0,002 compared to preoperative CEUS). In 10/37 cases (27%) IOCEUS could locate further liver lesions which had not been recognized during CEUS and/or MRI preoperatively, so that operative therapy was adapted accordingly and resection was extended if necessary.

CONCLUSION

During liver operations CEUS plays an important role in surgical therapy decisions.

CLINICAL RELEVANCE/APPLICATION

After FDA permission very important indication for CEUS

SSE10-03 Hepatic Artery Obstruction after Liver Transplantation: Diagnostic Performance of CT Angiography and Contrast-Enhanced US

Monday, Nov. 27 3:20PM - 3:30PM Room: E353C

Participants
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PURPOSE

To evaluate diagnostic performance of computed tomographic angiography (CTA) and contrast-enhanced US (CEUS) to diagnose significant hepatic artery obstruction (HAO) in liver transplantation (LT) recipients suspected of HAO by Doppler US.

METHOD AND MATERIALS

The institutional review board approved this study, with a waiver of informed consent. Among 1246 adult LTs with 1320 grafts performed in a single institution from Jan 2014 to Feb 2017, 132 grafts in 130 recipients were suspected of HAO by Doppler US (no flow detection or pulsus parvus pattern). Of these, reference diagnosis of HAO was made by surgery (artery revision or retransplantation), hepatic arteriography, or by associated cross-sectional CT abnormality. We excluded 21 grafts in which neither CTA nor CEUS was obtained within 24 hours of reference diagnosis and the other 111 grafts with CTA (n=91), CEUS (n=68), or both (n=48) within 24 hours of the diagnosis were finally included. CTA and CEUS were retrospectively reviewed and the diagnostic performance of CTA and CEUS was assessed. Diagnostic accuracies of CTA and CEUS were compared using McNemar test in grafts evaluated with both modalities.

RESULTS

Incidence of significant HAO was 1.7% (23/1320). Most significant HAOs were found within 2 weeks after LT (mean, 8.7 days). The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of CTA were 92.9% (26/28), 91.0% (59/63), 86.7% (26/30), 96.7% (59/61), and 93.4% (85/91), respectively. Those of CEUS were 94.7% (18/19), 93.9% (46/49), 85.7% (18/21), 97.9% (46/47), and 94.1% (64/68), respectively. The accuracies of the two modalities were not significantly different ($p = 0.68$). CTA found one HAO that were missed by CEUS, and CEUS found two HAOs that were missed by CTA, vice versa. All false positive cases (n=4) of CTA were stenosis more than 50 % without significant flow disturbance. Two of three false positive cases of CEUS were dual grafts with poor sonic window.

CONCLUSION

Both CEUS and CTA are helpful and complementary tool for diagnosis of significant HAO in recipients with suspected HAO with Doppler US. CEUS was more accurate than CTA, but there was no statistical significance.

CLINICAL RELEVANCE/APPLICATION

Both CEUS and CT are helpful and complementary tool for evaluation of significant hepatic artery obstruction in recipients with suspected hepatic artery abnormality with Doppler US.

SSE10-04 Quantitative Ultrasound Spectroscopy to Differentiate Between Hepatocellular Carcinoma and At-Risk Liver Parenchyma

Monday, Nov. 27 3:30PM - 3:40PM Room: E353C

Participants
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PURPOSE

Ultrasound is the first-line imaging technology for HCC screening in high risk patients; however, it has limited sensitivity and specificity, in particular in patients with liver cirrhosis. Quantitative ultrasound spectroscopy (QUS) is an emerging technology that allows differentiation of tissue microstructures by analyzing the radiofrequency (RF) signals backscattered from biological tissues. QUS is independent of operator or instrumental settings by normalizing ultrasound signals against a reference. The aim of this study was to clinically assess QUS parameters in HCC compared to cirrhotic and non-cirrhotic at risk liver parenchyma.

METHOD AND MATERIALS

This prospective HIPAA-compliant study was approved by the IRB. Fifteen patients with liver cirrhosis and HCC and 15 non-HCC patients with chronic liver disease (7 chronic hepatitis B; 7 chronic hepatitis C; 1 cryptogenic cirrhosis) were included. Ultrasound RF data were obtained from each of the eight liver segments as well as from all HCC lesions by using an Ultrasonix Tablet at 2 center frequencies (3.3 and 5 MHz) and at 4 focal depths (3, 6, 9 and 12 cm). Regions-of-interest (ROI) were drawn and the three quantitative spectral parameters including mid-band fit (MBF), spectral intercept (SI), and spectral slope (SS) were extracted. Differences in QUS parameters were tested by a mixed-effects regression on ROI location.

RESULTS

There was a significant intra-individual difference in MBF and SI values between HCC and cirrhotic liver parenchyma (p<0.001), as well as a significant inter-individual difference between HCC lesions and the liver parenchyma in at-risk non-HCC liver parenchyma (p<0.001) (Figure). No statistical significance was noted between any of the parameters obtained in liver cirrhosis vs. non-cirrhotic at-risk liver parenchyma. No statistical significance was noted for the SS parameter between any of the groups.

CONCLUSION

The two QUS parameters MBF and SI are significantly different in HCC vs. non-HCC liver parenchyma and could be used for improved HCC detection.

CLINICAL RELEVANCE/APPLICATION

QUS is a complementary technology that can be further developed for improving screening results of ultrasound in patients at increased risk for HCC.

SSE10-05 Diagnostic Performance of 2015 American Thyroid Association Consensus Guidelines, 2005 Society of Radiologists in Ultrasound Consensus Guidelines and a Morphologic-based Likert Scale for Thyroid Cancer Detection after Ultrasound Guided FNA

Monday, Nov. 27 3:40PM - 3:50PM Room: E353C

Participants
Nelly Tan, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the performance of 2015 American Thyroid Association (ATA) Consensus Guidelines, 2005 Society of Radiologists in Ultrasound (SRU) Consensus Guidelines, and a morphology-based Likert scale for detecting thyroid cancer after fine needle aspiration (FNA) of thyroid nodules.

METHOD AND MATERIALS

A HIPAA-compliant, IRB-approved prospective study of 986 patients who underwent FNA from July 2014 to June 2016 was performed. Clinical, imaging, and pathology information were extracted from the medical records. The diagnostic performance of ATA, SRU and a morphologic-based Likert scale for predicting malignancy were assessed. Area under the receiver operating characteristic curve values for each of the reference guidelines and each interpreter were determined and subsequently compared.

RESULTS

986 patients with 1170 nodules were evaluated. The nondiagnostic rate was 63/1170 (5.4%). The malignancy rate was 162/1170 (13.8%). Papillary thyroid cancer made up 160/162 (71.6%) of the thyroid malignancies. Non-diagnostic FNAs (63/1170, 5.4%) were excluded, and the remaining 1107 nodules were analyzed. 691/1107 (62.4%) of nodules met 2005 SRU criteria for FNA. Of those, 90/691 (13.0%) were malignant on FNA. 686/1107 (62.0 %) of nodules met 2015 ATA criteria for FNA. Of those, 108/686 (15.8%) were malignant. 435/1170 (39%) of nodules reached suspicion levels of 3-5 on a 5 point morphologic based Likert scale. Of those 121/435 (27.8%) were malignant. The AUC for predicting malignancy for the morphologic-based Likert scale was 0.76; for ATA 0.68; and for SRU 0.57.

CONCLUSION

A morphologic-based Likert Scale performed better than 2015 ATA Consensus Guidelines, which performed better than the 2005 SRU Consensus Guidelines in predicting thyroid cancer on FNA.

CLINICAL RELEVANCE/APPLICATION

Our study supports the importance of morphologic-based criteria in predicting thyroid malignancy and the need for inter-societal consensus and guidelines, so that primary care physicians, radiologists, endocrinologists and endocrine surgeons can follow standardized lexicon and recommendations.

SSE10-06 Utility of Contrast Enhanced Ultrasound (CEUS) in the Evaluation of Postoperative Recurrence of Crohn's Disease

Monday, Nov. 27 3:50PM - 4:00PM Room: E353C

Participants
Mj Martinez-Perez, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess the diagnostic accuracy of contrast enhanced ultrasound (CEUS) in the detection of endoscopic postsurgical recurrence of Crohn´s disease (CD) and its severity compared with ileocolonoscopy.

METHOD AND MATERIALS

A prospective study of 108 patients with CD who had undergone ileocolonic resection was performed. Several sonographic parameters were analyzed: neoterminal ileum wall thickness, transmural complications, color Doppler grade and contrast mural enhancement. Colonoscopy results were evaluated according the Rutgeerts score. The ability of ultrasound (US) and CEUS to diagnose endoscopic recurrence, as well as its severity, was assessed by calculating the sensitivity, specificity and positive and negative predictive values, accuracy and odds ratio. In addition a sonographic scale of severity was designed, including our best cutoff and data described in the literature. This scale and the combination of parameters were compared with endoscopic findings of severity.

RESULTS

Recurrence was detected in 90 cases (83%), and severe recurrence was present in 57% of them. The best parameters for the diagnosis of postsurgical endoscopic recurrence were: a) wall thickness >= 3 mm, with sensitivity 94%, specificity 72% and accuracy 91%, with good agreement with the colonoscopy (k = 0.66) and b) the combination of wall thickness >= 3 mm and enhancement >=46 % showing sensitivity, specificity and accuracy of 91%, 89% and 91%, respectively, with good agreement (k = 0.70). The sonographic score of severity obtained a sensitivity of 90% and specificity of 74% in the detection of severe endoscopic recurrence. The presence of any of the next three parameters, thickness >= 6 mm, thickness between 5-6 mm with mural enhancement or the presence of extraintestinal complications showed the best results for the diagnosis of severe recurrence (sensitivity 90%, specificity 87% and accuracy 89%).

CONCLUSION

The combination of neoterminal ileum wall thickness and the parameters of contrast enhanced ultrasound (CEUS) show excellent sensitivity and specificity for the detection of postoperative recurrence in CD and can predict its severity.

CLINICAL RELEVANCE/APPLICATION

CEUS is a tool that can increase our confidence in both postoperative recurrence detection and severity assessment in Crohn´s disease. The application of CEUS in the management of this type of patients can be an alternative to colonoscopy in the follow-up.

SSE11

Genitourinary (GU Intervention: Non-prostate)

Monday, Nov. 27 3:00PM - 4:00PM Room: E351

GU IR MR

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

FDA Discussions may include off-label uses.

Participants
Meghan G. Lubner, MD, Madison, WI (*Moderator*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;
K. Pallav Kolli, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSE11-01 Clinical Outcome of Uterine Fibroids Treatment: MR Guided High Intensity Focused Ultrasound Compared to Current Therapeutic Strategies

Monday, Nov. 27 3:00PM - 3:10PM Room: E351

Participants
Fabrizio Andrani, MD , Roma, Italy (*Presenter*) Nothing to Disclose
Alessandro Napoli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Hans Peter Erasmus, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Federica Fanto, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To prospectively evaluate clinical outcome of Magnetic Resonance Focused Ultrasound (MRgFUS), Uterine Artery Embolization (UAE) and Surgery in the treatment of Symptomatic Uterine Fibroid.

METHOD AND MATERIALS

585 symptomatic uterine fibroids underwent to pre-treatment MR evaluation in order to assess myoma characteristics and MRgFUS eligibility. 187 (32%) were considered eligible to MRgFUS and treated in our department using ExAblate-InSightec, while 398 resulted ineligible and were directed toward other therapeutic strategies. Of these, 137 underwent to UAE, 143 to myomectomy and 61 to hysterectomy. Clinical outcome for each treatment was evaluated comparing pre-treatment Symptoms Severity Score (SSS) with post-treatment SSS at 3-month and 12-month follow-up. Data concerning number and type of complications, days of hospitalization and days of convalescence were also collected and compared.

RESULTS

SSS mean reduction at 3 and 12-months was of 27,4% and 56,3%, respectively, for MRgFUS group; 48,7% and 56,9% for UAE group; 69,8% and 67,1% for myomectomy group; 96,6% and 94,5% for hysterectomy group. MRgFUS group demonstrated fewer complications (4 patients, 2,3 %), while the major adverse events rate was reported in UAE group (33 patients, 25,4 %). All MRgFUS patients were treated in outpatient setting, while mean days for hospitalisation and convalescence for other groups were respectively 3,4±2 and 11,7±9 days for UAE group; 4,1±2 and 16,9±12 days for myomectomy group; 4,5±1 and 24,6±14 days for hysterectomy group.

CONCLUSION

Clinical efficacy of MRgFUS for uterine fibroids treatment is comparable to UAE but slightly lower than myomectomy. However, MRgFUS is feasible in an outpatient setting and adverse events rate is significantly lower than other therapeutic strategies.

CLINICAL RELEVANCE/APPLICATION

MRgFUS is a new therapeutic strategy for symptomatic uterine fibroids, representing a non-invasive, safe and effective choice for selected patients.

SSE11-02 Percutaneous Ablation Therapy of Small Renal Tumors in Healthy Patients: A First Line Treatment

Monday, Nov. 27 3:10PM - 3:20PM Room: E351

Awards
Student Travel Stipend Award

Participants
Renato N. Zangiacomo, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
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Guilherme L. Martins, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The purpose of our study is to evaluate the oncologic outcomes of ablative percutaneous therapies, such as radiofrequency (RFA) and cryoablation (Cry), used as first-line therapy for small renal masses (SRM) (T1a) in healthy / surgical patients.

METHOD AND MATERIALS

This study consisted of an institutional review board approved retrospective review at a multicentric center. Between November 2010 and July 2016, 85 healthy patients (those with an American Society of Anesthesiologists [ASA] physical status classification score of 1 or 2) with 95 SRM who underwent RFA (n=19) or cryoablation (n=76) were identified with a median largest tumor diameter of 2,4 cm (range 0,7 - 4,0 cm). Inclusion criteria were: American Society of Anesthesiologists [ASA] physical status classification score of 1 or 2; a diagnostic biopsy prior to the treatment; a malignant T1a renal tumor; and more than 6 months follow-up. Patients with an identified genetic disease predisposing them to RCC were excluded from the analysis. Patients who had undergone a previous intervention in the ipsilateral kidney were not excluded, based on ASA criteria. The minimally invasive approach, such as ablation therapies, was achieved either by the patient's choice or after multidisciplinary discussion. Patients were followed up with contrast-enhanced CT or MRI at 3, 6, 9 and 12 months and every 6 months thereafter sequentially. Oncological outcomes were calculated from the time of the ablation therapy.

RESULTS

Technique effectiveness was almost 98% (93 of 95). Median follow-up was 19 months (range 6-77). LTP were found in two patients (2%) with a median follow-up tume 11 months. All LTP were retreated successfully with ablation percutaneous therapy. Median LTPFS could not be calculated due to the fact that most of the patients in the study were still alive at the conclusion of the study period. No patient developed metastatic renal cell carcinoma (RCC) and none died from RCC.

CONCLUSION

Percutaneous ablations therapies seem to be a reasonable option to treat SRM as the first line due to the similarly oncological outcomes to the surgery in healthy patients.

CLINICAL RELEVANCE/APPLICATION

Percutaneous ablations therapies may be a reasonable treatment choice for the SRM in healthy patient.

SSE11-03 Percutaneous Microwave Ablation of Renal Cell Carcinoma

Monday, Nov. 27 3:20PM - 3:30PM Room: E351

Participants
Sepideh Shakeri, Los Angeles, CA (*Presenter*) Nothing to Disclose
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Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the safety and efficacy of image guided Microwave ablation (MWA) in biopsy - proven renal tumors within a minimum of 1- year postablation follow-up.

METHOD AND MATERIALS

In this retrospective study, 95 biopsy - proven renal tumors in 73 patients who underwent the renal MWA procedure from 2013 to 2016 at our institution were evaluated. This was an institutional review board-approved study. Data collected included demographic data, tumor characteristic data, procedural protocols and clinical follow-up visits within a 1 year. Primary outcomes were assessed by technical success, local recurrence-free (LRFS), and complications. Technical success was evaluated with Imaging immediately after MWA. Presence LRFS was examined with Imaging at 3-month target intervals for the first 2 years. Complications were categorized using the Clavien-Dindo classification system.

RESULTS

73 patients with 95 biopsy-proven renal lesions within 1 year postablation follow up were included. The mean patient age was 64(27-93) years and 63% were male. The mean tumor size was 2.7cm (0.8-7.4). 19% were benign while 81 % were RCC with clear cell 61 %(58/95), papillary13 %(12/95), chromophobe1.2%(1/95),oncocytoma 15% (14/95) and the rest were metastatic, unclassified lesions and benign cyst. Tumors were located 56% in the left kidney and most 39%(37/95) in lower pole.89/95 lesions were treated in a single encounter with 94% technical success but 6%(6/95) required a second ablation which most was 83%(5/6) CC with mean size of 4.1cm.The primary and secondary technical and overall technical success rate was 94%,100% and 100% respectively.The local recurrence rate was10.5% (10/95) with mean tumor size of 3.3cm and most 50%(3/6) had Interpolar location.The highest recurrence rate was in 70%(7/10) CC,10% Papillary (1/10) and the rest were unclassified and metastatic tumors. The complication rate was 7%(6/95) with minor complication (hematoma and severe pain) and no major one.The mean cancer-free survival was 11.9 months. All patients (99.4%) are alive only one patient died with unrelated cause (Melanoma,metastasis RCC) to the MW ablation.

CONCLUSION

Image-guided MWA appears to be a reliable and effective treatment option with low recurrence and complication rates in early

Image-guided MWA appears to be a reliable and effective treatment option with low recurrence and complication rates in early (1year) postablaton follow up.

CLINICAL RELEVANCE/APPLICATION

Percutaneous Microwave Ablation has achieved mature development in renal cancer therapy Since It shows the great safety and efficacy.

SSE11-04 The Increasing Utilization of Percutaneous Radiofrequency- and Cryo-ablation of Kidney Tumors in Recent Years

Monday, Nov. 27 3:30PM - 3:40PM Room: E351

Participants
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Vijay M. Rao, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Percutaneous radiofrequency ablation (PRFA) and percutaneous cryoablation (PCRYO) have been billable since 2006 (PRFA) and 2008 (PCRYO). They are alternatives to surgical treatment. Our purpose was to study trends in their use compared with similar surgical approaches, and to determine the degree to which radiologists participate.

METHOD AND MATERIALS

The data source was the Medicare Part B Physician/Supplier Procedure Summary Master Files for 2003-2015. Procedure codes for PRFA, PCRYO, laparoscopic ablation, and open ablation were selected. Volumes for each of these ablative approaches were tracked. Medicare specialty codes were used to identify the specialty of the provider of each service. The code for partial nephrectomy was also studied for comparison.

RESULTS

Medicare volume of percutaneous ablation (both PRFA and PCRYO combined) was 927 in 2006. It then increased steadily, reaching 3378 in 2015 (+526%). Radiologists have always done the vast majority of these interventions; their share in 2015 was 89.9% while urologists' share was 9.0%. Of the percutaneous procedures that year, 33% were PRFA and 67% were PCRYO. Laparoscopic ablation volume was 452 in 2003, peaked at 1691 in 2007, but then declined sharply over the ensuing years to 470 in 2015. Virtually all of these were done by urologists. Open ablation volume was 241 in 2006 (the first year a code was available), increased to 260 in 2007, but then declined sharply to 84 in 2015. Almost all were done by urologists. Partial nephrectomy volume hovered in the 3400-3700 range but then began to drop in 2013, 2014, and 2015. Volume in 2015 was 2540.

CONCLUSION

Use of percutaneous ablation of renal lesions (both PRFA and PCRYO) has grown rapidly in recent years. By comparison, laparoscopic ablation and open ablation volumes have dropped sharply. The percutaneous approach is now used with considerably greater frequency than even partial nephrectomy. Radiologists strongly predominate in the percutaneous procedures. PCRYO is used twice as often as PRFA.

CLINICAL RELEVANCE/APPLICATION

Percutaneous techniques now appear to be the preferred approach in many patients with renal tumors, outstripping all 3 surgical approaches.

SSE11-05 Submucosal vs Intramural Uterine Fibroids (UFs): Follow-Up in Patients Treated by MRgFUS (Magnetic Resonance-Guided Focused Ultrasound Surgery)

Monday, Nov. 27 3:40PM - 3:50PM Room: E351

Participants
Sonia Iafrate, L'Aquila, Italy (*Presenter*) Nothing to Disclose
Ilaria Capretti, LAquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess the volume reduction and, symptom improvement rate following MRgFUS in patients affected by submucosal and intramural fibroids 2 years after treatment of MRgFUS.

METHOD AND MATERIALS

A total of 35 women, aged between 38 and 52, with only one symptomatic uterine fibroid underwent MRgFUS between February 2014 and February 2015.They were studied with preliminary MRI and UFs were classified with the FIGO staging system. Thirteen/35

patients were affected by submucosal fibroids (GROUP A, 3 of type 0, 4 of type 1 and 6 of type 2). They mainly were affected by reproductive problems but also by dismenoerrea. Twenty-two/35 patients were affected by intramural fibroid (GROUP B, 7 of type 3, 8 of type 4 and 7 of type 5) and were symptomatic for abnormal uterine bleeding, pelvic pressure and menorrhagia.The following parameters were evaluated: the non-perfused-volume (NPV) that represent the treated area immediately after treatment; the reduction of UFs and, the clinical symptomatology (evaluated by Symptoms severity score questionnaire (UFS-QOL).

RESULTS

All treated patients showed a very good procedural outcome with a mean initial extension of the NPV about 80-90 %. After 2 years from the MRgFUS, in the GROUP A, 8/13 showed progressive reduction of the UFs with a restoration of uterine wall morphology. Four/13 showed a complete disappearance of the UFs and in one patient, the fibroid of type 0 were partially expelled from the uterine cavity, without necessity of hysteroscopy. Also in the GROUP B we recorded a reduction in UFs volume , (18/22 about 70%, and 4/22 about 90%). In addition, all the women experienced an improvement of UFS-QOL around 90%, when compared with the pre-MRgFUS and no severe adverse events were identified in these patients during and post the procedure.

CONCLUSION

A sustained symptomatic improvement may be observed in patients affected by both submucosal and intramural uterine fibroids that underwent to MRgFUS, along the 2 year-follow-up.

CLINICAL RELEVANCE/APPLICATION

To improve the management of the patients affected by symptomatic submucosal and intramural uterine fibroids with mini-invasive treatment.

SSE11-06 Comparison of General Anesthesia and Conscious Sedation during Percutaneous Radiofrequency Ablation of T1a Renal Cell Carcinoma

Monday, Nov. 27 3:50PM - 4:00PM Room: E351

Participants
Byung Kwan Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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PURPOSE

Percutaneous radiofrequency ablation (RFA) is so painful that this treatment requires pain control such as conscious sedation (CS) or general anesthesia (GA). It is still unclear which type of anesthesia is better for treatment outcomes of renal cell carcinoma (RCC). This study aimed to compare GA and CS in treating patients with RCC with RFA.

METHOD AND MATERIALS

Between 2010 and 2015, 51 patients with biopsy-proven 51 RCCs (<4 cm) were treated with CT-guided RFA. GA was performed in 41 and CS in 10 patients. Tumor size, local tumor progression, metastasis, major complication, effective dose, glomerular filtration rate (GFR) difference, and recurrence-free survival rate were compared between these groups.

RESULTS

The mean tumor size was 2.1 cm in both groups (p=0.673). Local tumor progression occurred in 0% (0/41) of GA group, but in 20% (2/10) of CS group (p=0.035). Metastases in these groups occurred in 2.4% (1/41) of GA group and 10% (1/10) of CS group (p=0.357). No major complications developed in either group after the first RFA session. The mean effective doses in these groups were 21.7 mSv and 21.2 mSv, respectively (p=0.868). The mean GFR differences in GA and CS groups were -13.5 mL/min/1.73m2 and -19.1 mL/min/1.73m2, respectively (p=0.575). Two-year recurrence-free survival rates in these groups were 97.5% and 78.8%, respectively (p=0.043).

CONCLUSION

GA may provide lower local tumor progression and better intermediate outcomes than CS in treating small RCCs with percutaneous RFA.

CLINICAL RELEVANCE/APPLICATION

GA instead of CS is recommended for pain control in treating a small RCC with image-guided RFA.

SSE12

Genitourinary (Imaging of Renal Stones)

Monday, Nov. 27 3:00PM - 4:00PM Room: E353A

CT GU

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

Participants
Steven C. Eberhardt, MD, Albuquerque, NM (*Moderator*) Nothing to Disclose
Sadhna Verma, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSE12-01 Low Bone Mineral Density on CT Predicts High Urinary Calcium, Low Citrate, and Larger Urinary Calculi

Monday, Nov. 27 3:00PM - 3:10PM Room: E353A

Awards
Student Travel Stipend Award

Participants
Ryan Ward, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
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Juan Calle, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Nephrolithiasis is associated with systemic conditions including low bone mineral density (BMD), which may correlate with hypercalciuria in kidney stone formers (KSF). Typically, low BMD is diagnosed with dual-energy x-ray absorptiometry. We evaluated the association of vertebral bone mineral density on CT with 24-hour urine parameters in KSF.

METHOD AND MATERIALS

99 KSF who had CT and 24-hour urine studies were retrospectively evaluated. BMD was estimated using an oval ROI on L1 trabecular bone. A literature-based threshold for a balanced sensitivity (73.9%) and specificity (70.6%) of 160 HU was used to distinguish normal from low BMD. Univariate and multivariate logistic regression analysis was performed to compare patients with low and normal BMD. Multivariate linear regression was performed to assess for variables associated with 24-hour urine parameters.

CONCLUSION

CT-based diagnosis of low mineral bone density is associated with larger urinary calculi and derangements in 24-hour urine calcium and citrate.

CLINICAL RELEVANCE/APPLICATION

CT-based diagnosis of low mineral bone density is associated with larger urinary calculi and derangements in 24-hour urine calcium and citrate.

SSE12-02 Comparison of Detection Rate for Uric Acid Uroliths among Variable Parameters of CT: Phantom Study

Monday, Nov. 27 3:10PM - 3:20PM Room: E353A

Participants
Jin Kyem Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate whether uric acid stone can be detected by reduced radiation dose using 160mm ultra-wide coverage CT after

loading uroliths collected from the human body into the phantom.

METHOD AND MATERIALS

This study was approved by IRB. Six uric acid stones (size range from 1.8mm to 11mm) derived from the patients were embedded into silicon cylinder model, and then it was inserted into the human phantom along the ureter course. CT scan was undertaken with two sessions (abdominal cavity and pelvic cavity, respectively) with the same silicon model by various combinations of different tube-voltage (100 kVp, 80 kVp, 70 kVp) and tube-current (300 mA, 250 mA, 200 mA, 150 mA, 100 mA) using 160mm ultra-wide coverage CT. Three radiologists evaluated the presence of uric acid stones in each data set. The radiation dose was reported on CT system after CT acquisition was finished. The reader-averaged detection rate was compared using logistic regression with generalized estimating equation.

RESULTS

The radiation dose was from 6.32 mGy (CTDIvol) with 100kVp and 300mA, to 0.69 mGy (CTDIvol) with 70kVp and 100mA. The overall reader-averaged detection rate was from 50.00 to 88.98. The reader-averaged detection rate showed significant different only in tube-voltage and tube-current of abdomen ($p=0.0004$, <0.0001). The stone over 4 mm was detected in all parameter sets except two parameter sets (70kVp with 100 and 150mAs).

CONCLUSION

Ultralow-dose CT showed the promising result for uric acid stone detection in a phantom study with profound radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION

We present the detection rate of the uric acid stone in a variable parameter using a phantom. Our result showed the possible application of ultralow-dose CT, even with 70kVp, for the detection of uric acid stones and clinical study needs to be followed to confirm our results.

SSE12-03 Uric Acid versus Non-Uric Acid Urinary Stones: Differentiation with CT Texture Analysis

Monday, Nov. 27 3:20PM - 3:30PM Room: E353A

Participants
Gu Mu Yang Zhang, MD, Beijing, China (*Presenter*) Nothing to Disclose
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Hao Sun, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To investigate the diagnostic accuracy of CT texture analysis (CTTA) to differentiate uric acid (UA) from non-UA urinary calculi with ex vivo Fourier transform infrared spectroscopy (FT-IR) as the reference standard

METHOD AND MATERIALS

In this institutional review board-approved retrospective case-control study, 14 patients with 18 UA stones and 34 patients with 35 non-UA stones were identified from the database. All the patients had preoperative unenhanced CT evaluation and underwent surgical removal of the stones subsequently. CTTA was performed on unenhanced CT images by using TexRAD software. Receiver operating characteristic (ROC) curves were performed and the area under the ROC curve (AUC) was calculated for texture parameters that were significantly different. The optimal discriminative features were used to train support vector machine (SVM) classifiers. Diagnostic accuracy of textural features was evaluated and 10-fold cross validation was performed

RESULTS

Compared to non-UA stones, UA stones had significantly lower Mean at all texture scales, lower SD and MPP at all except coarse texture scales, lower skewness at no filtration and higher kurtosis at no filtration and fine texture scale ($P<0.001$). The average SVM accuracy of textural features for differentiating UA from non-UA stones ranged from 77.4% to 98.1% (after 10-fold cross validation). A model incorporating Mean, SD, MPP and kurtosis quantified from no filtration resulted in an AUC of 0.99 ± 0.01 with a SVM accuracy of 98.1%, sensitivity of 100% and specificity of 94.4%.

CONCLUSION

CTTA on unenhanced CT images could be used to accurately differentiate UA from non-UA urinary stones

CLINICAL RELEVANCE/APPLICATION

CTTA could help to characterize urinary stone composition beyond the basic evaluation and allow optimization of treatment options for patients with urolithiasis.

SSE12-04 Low-Dose CT of Suspected Urolithiasis: Diagnostic Yield for Assessment of Alternative Diagnoses

Monday, Nov. 27 3:30PM - 3:40PM Room: E353A

Participants
Frank Oliver G. Henes, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
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Marc Regier, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
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Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Julius M. Weinrich, Hamburg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To assess the diagnostic yield of low-dose computed tomography (LDCT) for alternative diagnoses (AD) in patients with suspected urolithiasis.

METHOD AND MATERIALS

776 consecutive patients who underwent non-contrast enhanced abdominal CT for evaluation of suspected urolithiasis were included in this study. All examinations were performed with a low-dose CT protocol; images were reconstructed using an IR system (iDose4™, Philips Healthcare, Best, the Netherlands). The leading CT diagnosis was recorded for each patient and compared with the final clinical diagnosis, which was referred to as the reference standard. The final clinical diagnosis was determined by review of hospital discharge records and reports of surgical procedures.

RESULTS

The prevalence of urolithiasis was 82.5% (640/776). LDCT reached a sensitivity of 94.1% (602/640), a specificity of 100% (136/136) and an accuracy of 95.1% (738/776) for the detection of urolithiasis. In 91 patients without urolithiasis (66.9%) AD were established as final clinical diagnoses. AD were most commonly located in the genitourinary (n=51) and gastrointestinal tract (n=18). LDCT correctly provided AD in 57 patients (62.6%) and was false negative in 34 patients (37.4%). The most common clinical AD missed in LDCT were urinary tract infections (n=22). Seven diagnosis missed in LDCT were located outside of the scan-volume. In 43 patients neither LDCT nor clinical workup could establish a final AD (5.5%). Sensitivity, specificity and accuracy of LDCT for detection of AD was 62.6% (57/91), 95.6% (41/43) and 73.5% (100/136), respectively.

CONCLUSION

LDCT enables the diagnosis of the majority of AD in the setting of suspected urolithiasis. Most frequent alternative diagnoses missed by LDCT in this study were urinary tract infections or diagnoses located outside of the scan-volume.

CLINICAL RELEVANCE/APPLICATION

Although the prevalence of urolithiasis in patients undergoing CT is high, there is still the need to the detect significant alternative pathologies by low-dose protocols. Besides genitourinary and gastrointestinal disorders osseous pathologies in this patient group are frequent findings.

SSE12-05 Urinary Stone Detection with Deep Convolutional Neural Networks on Unenhanced Computed Tomography Images

Monday, Nov. 27 3:40PM - 3:50PM Room: E353A

Awards
Student Travel Stipend Award

Participants
Anushri Parakh, MBBS, MD, Boston, MA (*Presenter*) Nothing to Disclose
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Jung Hwan Cho, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Synho Do, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The study aimed to determine if deep-learning models can perform detection of clinically relevant urinary stone disease on unenhanced CT images with high-fidelity.

METHOD AND MATERIALS

Retrospective identification of patients (n=289) who presented with suspected renal stone disease and underwent CT on Discovery CT 750 HD, GE Healthcare between January-December 2016 was performed. Patients were categorized according to presence (n=128) and absence (n=161) of stones. 13,278 image slices were first used to train for anatomy recognition. Of the 544 total image slices (ISf) each for stone and no-stone, 437 served as training (ISt) and 107 as validation (ISv) set for DL. Stones were grouped according to size: Group A < 4mm (ISf 89, ISt 72, ISv 17), Group B 4-9.9mm (ISf 287, ISt 230, ISv 57) and Group C > 10mm (ISf 168, ISt 135, ISv 33). Area (AUC) under the receiver-operating-characteristics curve analyses for total and size-based accuracy for stone detection was calculated in abdomen and bone windows.

RESULTS

The accuracy for stone detection was 91.12% with 0.964 AUC. DL correctly predicted 14/17 in Group A, 51/57 in Group B and 32/33 in Group C. No significant difference was found in detection reults on abdomen and bone windows. The incorrectly classified cases were due to extremely small stones, presence of phlebolith along the ureter or anatomical misregistration.

CONCLUSION

DL has the potential to segment anatomy and detect urinary stone disease, irrespective of location in the urinary tract and stone size.

CLINICAL RELEVANCE/APPLICATION

There has been an increase in the utilization of CT for urinary stone disease. Being relatively task-specific, DL for stone detection has the potential to be applied in real-time as a diagnostic support by pre-analyzing and triaging positive cases for radiology read-

outs. This would improve workflow and patient management in an emergency setting.

SSE12-06 Prediction of Successful Shock Wave Lithotripsy: Potential of Texture Analysis and Machine Learning in Computed Tomography

Monday, Nov. 27 3:50PM - 4:00PM Room: E353A

Participants
Manoj Mannil, Zurich, Switzerland (*Presenter*) Nothing to Disclose
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Christian Fankhauser, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Hatem Alkadhi, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To apply texture analysis (TA) in computed tomography (CT) of urinary stones and to correlate TA findings with the number of required shockwaves for successful shock wave lithotripsy (SWL).

METHOD AND MATERIALS

CT was performed on thirty-four urinary stones in an in-vitro setting. Urinary stones underwent SWL, the number of required shockwaves for disintegration was recorded. TA was performed after postprocessing for pixel spacing and image normalization. Feature selection and dimension reduction were performed according to inter- and intrarater reproducibility and by evaluating the predictive ability of the number of shock waves along with the degree of redundancy between TA features using machine learning algorithms. Three regression models were tested: (1) linear regression with elimination of colinear attributes (2), sequential minimal optimization regression (SMOreg) using machine learning, and (3) simple linear regression model of a single TA feature with lowest squared error. Urinary stone samples were grouped using the median of required shockwaves. Correlation coefficients were calculated between each model and absolute number of shockwaves. Receiver operating characteristics (ROC) analysis was performed for dichotomized results, areas-under-the-curve (AUC) were calculated.

RESULTS

92 out of 308 TA features with excellent reproducibility (ICC > 0.8) remained. Highest correlations were found for the linear regression model (r=0.55): y=0.4892*Percentile10-37.6313*S33SumAverg+2023.7399, followed by the sequential minimal optimization regression model (r=0.51) and simple linear regression model (r=0.47). Using the median number of required shockwaves (n=72) as cutoff showed highest AUCs for the SMOreg model (AUC=0.838): y=0.4491*ZPercentile10+0.0044*ZS11InvDfMom-0.0294*ZS33SumAverg-0.0804*ZS4-4SumVarnc+0.0564.

CONCLUSION

Our in-vitro study indicates the potential of TA of urinary stone CT enabling the prediction of successful stone disintegration with SWL with high accuracy.

CLINICAL RELEVANCE/APPLICATION

Successful prediction of stone disintegration with SWL using TA in CT may prevent repeated SWL treatment or alternative, more invasive procedures associated with higher morbidity and costs.

SSE13

Health Service, Policy and Research (Economic Analyses)

Monday, Nov. 27 3:00PM - 4:00PM Room: S104B

HP

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

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose
Gelareh Sadigh, MD, Atlanta, GA (*Moderator*) Nothing to Disclose

Sub-Events

SSE13-01 A Comparison of Time-Driven Activity-Based Costing to RVU-Based Absorption Costing in Breast Imaging Services

Monday, Nov. 27 3:00PM - 3:10PM Room: S104B

Awards
Student Travel Stipend Award

Participants
Aditi A. Desai, MD, Nashville, TN (*Presenter*) Nothing to Disclose
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PURPOSE

Value-based health care delivery models, where value is defined as the outcomes achieved per unit cost, necessitate accurate cost measurements. While traditional accounting methods such as absorption costing (AC) rely upon relative value units (RVUs) to estimate costs, time-driven activity-based costing (TDABC) uses process mapping to measure costs of resources utilized. We compared RVU-based AC (R-AC) and TDABC methods in estimating the costs of breast imaging services.

METHOD AND MATERIALS

Costs of screening MG, diagnostic MG, breast ultrasound (US), stereotactic biopsy, and US-guided biopsy were calculated using R-AC and TDABC models. For R-AC, the ratio of total costs (direct, indirect, and overhead) to total RVUs generated was multiplied by the RVUs assigned to a specific procedure. For TDABC, cost capacity rates of personnel, equipment, space, and consumables were combined with process maps based on actual resource utilization (Figure).

RESULTS

R-AC estimates of both screening and diagnostic MG costs were $90.07, given their identical RVU assignment. TDABC estimates were lower for screening MG ($56.59), but higher for diagnostic MG ($127.38). Similarly, TDABC costs exceeded R-AC costs for diagnostic MG and breast US ($211.82 vs $170.79). However, TDABC significantly underestimated costs for US-guided biopsy ($376.44 vs $2590.69) and stereotactic biopsy ($406.49 vs $2,666.81).

CONCLUSION

TDABC is based on actual resource utilization and more accurately reflects costs of screening MG, diagnostic MG, and breast US than R-AC, as RVU assignments are not always reflective of work involved. However, TDABC significantly underestimates the costs of biopsies compared to R-AC, as TDABC does not take into account overhead costs, unused capacity, and waste. While TDABC provides a more accurate measure of resource utilization to help refine cost estimates and understand what costs "should be", R-AC provides a global assessment, taking into account what costs "are". These findings carrying significant implications in understanding costs of providing imaging services in the current health care landscape, particularly with the rise of altenative payment models and bundled payments.

CLINICAL RELEVANCE/APPLICATION

TDABC accurately quantifies costs of imaging services and identifies cost-saving opportunities, but understimates unused capcity costs captured by R-AC.

SSE13-02 ED Length-of-Stay for "Rule-Out" Appendicitis Patients is Decreased When Normal CT Findings are Directly Communicated to Referring Clinicians

Monday, Nov. 27 3:10PM - 3:20PM Room: S104B

Participants
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PURPOSE

Verbal communication is typically used by ED radiologists to report important findings likely to impact immediate patient care, but less frequently used to report normal findings; the value of notifying ED clinicians that an "actionable" negative result is available that could facilitate ED discharge is unknown. Our aim was to correlate verbal communication of CT results with report turnaround time (TAT) and ED length of stay (LOS), for patients presenting with right-lower-quadrant (RLQ) pain who received a "rule-out appendicitis" CT protocol.

METHOD AND MATERIALS

Abdominal CT reports from ED patients (Apr-Nov 2016) with suspected acute appendicitis ("Appy") were retrieved from our radiology database. Frequency, time & type of verbal communication were extracted from reports and correlated with diagnosis, TAT & ED LOS. Chi-square and T-test were used.

RESULTS

Of 220 reports, 37% (82/220) were positive for Appy, 36% (80/220) were normal, and 27% (58/220) were positive for other causes of RLQ pain. Overall, 34% (75/220) of reports had documentation of direct communication. Positive Appy reports were communicated faster & more frequently (34+/-26 min; 61%, 50/82) than normal or other diseases (72+/-65 min, p=0.01; 18%, 25/138, p<0.001). In patients with normal reports (n=80), mean ED LOS was shorter by 123 min with communication (n=4/80, 5%, 412+/-67 min) versus without (n=76/80, 95%, 535+/-409 min, p=0.04), without difference in TAT (p=0.8). With positive appendicitis reports (n=82), TAT was shorter for non-communicated than for communicated reports (49+/-44 min versus 90+/-72min; p=0.002), without difference in ED LOS (p=0.3). For other diseases (n=58), there was no difference in TAT (p=0.3) or ED LOS (p=0.07) between communicated and non-communicated reports.

CONCLUSION

Verbal communication of CT results was associated with longer TAT in patients with confirmed Appy, and shorter ED LOS in patients with normal CT's without Appy.

CLINICAL RELEVANCE/APPLICATION

Although TAT is an accepted metric of "value-based" ED radiology performance, it does not account "for time-to-notification" of results to referring ED clinicians, which impacts ED LOS. A standardized, expedited system for immediate result notification - such as texting - might help improve ED LOS, especially in patients with normal exam findings who can be safely discharged.

SSE13-03 Cost-Effectiveness of Endovascular Thrombectomy in Acute Ischemic Stroke: The Impact of Patient Age from a United States Health Care Perspective

Monday, Nov. 27 3:20PM - 3:30PM Room: S104B

Awards
Trainee Research Prize - Resident

Participants
Wolfgang G. Kunz, MD, Munich, Germany (*Presenter*) Nothing to Disclose
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Thomas Huber, MD, Munich, Germany (*Abstract Co-Author*) 04-11-2017:- Consultant for Brainlab AG (Feldkirchen, Germany), ended 09/2016 - not related to the present study; - Consultant for Smart Reporting GmbH (Munich, Germany), started 03 / 2017 - not related to the present study.
Wieland H. Sommer, MD, Munich, Germany (*Abstract Co-Author*) Founder, Smart Reporting GmbH
Kolja M. Thierfelder, MD,MSc, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Maximilian F. Reiser, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Endovascular thrombectomy in addition to IV thrombolysis (EVT+IVT) has been proven to be more effective compared to IV thrombolysis alone (IVT alone) in acute ischemic large vessel occlusion stroke. Our aim was to determine the impact of patient age on cost-effectiveness of EVT+IVT.

METHOD AND MATERIALS

A decision model based on Markov simulations estimated lifetime costs and quality-adjusted life years (QALY) associated with both strategies (see Figure 1). The analysis was performed in a United States setting from a health care perspective. Model input

parameters were based on best available and most recent evidence in the published literature (see Table 1), including a meta-analysis of 5 recent randomized clinical trials (MR CLEAN, ESCAPE, REVASCAT, SWIFT PRIME, EXTEND-IA). The impact of patient age on the parameters was considered. Deterministic (DSA) and probabilistic sensitivity analyses (PSA) were performed, the latter using 10,000 Monte Carlo simulation runs to estimate the overall uncertainty of the results. Net monetary benefit (NMB), incremental costs (IC), incremental effectiveness (IE), and incremental cost-effectiveness ratios (ICER) were derived. The willingness to pay (WTP) thresholds were set to $50/$100/$150,000/QALY respectively.

RESULTS

The DSA and PSA performed with patient age at index stroke ranging from 50 to 100 years yielded incremental QALYs for EVT+IVT for every age level (see Table 2, Figure 2 and 3). Among patients aged 50-79 years, EVT+IVT additionally implied lower lifetime costs compared to IVT alone, and hence was the dominant strategy. For patients aged 80 years at index stroke, EVT+IVT implied incremental costs of $19,041 and incremental QALYs of 1.13, resulting in an ICER of $16,870/QALY with an acceptability rate of 99.9% at a WTP threshold of $100,000/QALY. Up to 100 years, EVT+IVT had acceptability rates of >80% and >96% at WTP thresholds of $100,000/QALY and $150,000/QALY respectively (see Figure 4).

CONCLUSION

EVT+IVT is a cost-effective therapy of large vessel occlusion stroke in all patient ages from 50 to 100 years. Our results suggest that there is no upper age limit to withhold EVT, neither from a medical point of view, nor from an economic perspective.

CLINICAL RELEVANCE/APPLICATION

EVT treatment is on the verge of large-scale implementation. Based on its cost-effectiveness, increased investments into the medical infrastructure to establish nationwide EVT access may be justified.

SSE13-04 Split-Bolus Dual-Enhancement Abdominal Pelvic Computed Tomography Angiography before Lung Transplantation: Image Quality, Protocol Design, and Resource Utilization

Monday, Nov. 27 3:30PM - 3:40PM Room: S104B

Participants
Ranish D. Khawaja, MBBS, Durham, NC (*Presenter*) Nothing to Disclose
Daniele Marin, MD, Durham, NC (*Abstract Co-Author*) Research support, Siemens AG
Bhavik N. Patel, MD,MBA, Stanford, CA (*Abstract Co-Author*) Consultant, General Electric Company; Research support, General Electric Company
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PURPOSE

Pre-lung transplant suitability for high risk patients often requires screening for vascular integrity and solid organ malignancy. This, for most patients, utilizes two separate imaging studies: single-injection single-enhancement abdominal-pelvic CTA(*sCTA*) and an additional exam to assess for solid organ malignancy(using CT/MR/U/S). The purpose of this study is to assesses image quality and resource utilization for a single-injection split-bolus dual-enhancement abdominal-pelvic CTA(*dCTA*) for combined solid-organ and vascular assessment.

METHOD AND MATERIALS

In this single-center IRB-approved HIPAA compliant quality assessment study, 106 consecutive patients being evaluated for lung transplantation over a 12-month period, who underwent CTA abdomen-pelvis were included and divided into two cohorts: those imaged in the first 6 months underwent standard-of-care sCTA(cohort A; n,50; mean age,63y) and in later 6 months dCTA(cohort B; n,56; mean age,60y). Image quality of the vasculature was assessed by extraction of enhancement(HU) along the abdominal aorta through the right femoral artery in 1-mm increments using ImageJ software. Solid organ enhancement for liver and renal cortex were measured using a 1cm2 region-of-interest. Mean radiation exposure and intravenous contrast exposure, total and type of cost of studies for both subgroups was compared.

RESULTS

Mean(±coefficient-of-variance) vascular enhancement for sCTA and dCTA was 225HU(±0.36) and 235HU(±0.11;*P*0.09), respectively. Mean liver enhancement for the sCTA and dCTA was 65HU(±7) and 108HU(±41;*P*0.01). Mean renal enhancement for the sCTA and dCTA was 140HU(±42) and 218HU(±77;*P*0.02). Mean intravenous contrast exposure was 225mL and 131mL, respectively. Cohort A underwent 50 sCTA and 23 additional imaging studies (hence, mean radiation exposure 23mGy) for the total cost of $10,839 USD/patient. Cohort B underwent 56 dCTA exams (11mGy) at the cost of $8,623 USD/patient.

CONCLUSION

Single injection split-bolus dual enhancement abdomen pelvic CT protocol results in improved vascular enhancement and optimal portal-venous opacification for solid-organ assessment as a single CT examination with 54% reduction in radiation exposure, 42% reduction in IV contrast exposure and 11% reduction in cost.

CLINICAL RELEVANCE/APPLICATION

Combined dual-phase abdominal-pelvic CTA provides optimal vascular assessment and parenchymal enhancement with improved image quality, patient safety profile and lower cost.

SSE13-05 Radiology Exams on End-Stage Oncologic Patients before Hospice Admission

Monday, Nov. 27 3:40PM - 3:50PM Room: S104B

Participants
Elena Belloni, MD, Castel San Giovanni, Italy (*Presenter*) Nothing to Disclose
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PURPOSE

Data on radiology exams performed on end-stage oncologic patients before Hospice admission are scarce. The purpose of our study was to evaluate frequency, type and cost of diagnostic and interventional radiology exams performed on this population in the 90 days before admission to Hospice.

METHOD AND MATERIALS

Data of patients admitted to Hospice between January 2012 and June 2013 were cross-checked with the data of the Radiology Department archive. Frequency and type of the radiology exams performed on patients in the 90 days before Hospice admission were retrospectively analized across three 1-month periods, namely M-3, M-2, M-1, corresponding to 90-61, 60-31 and 30-1 days before admission, respectively. The Regional Health Care Range of Fees was used to determine the costs.

RESULTS

389 patients were admitted to Hospice in the 18-month period. In the 90 days before admission, 335 patients (86%) underwent 1543 radiology exams: 919 X-Rays, 555 CTs, 39 MRs, 30 interventional procedures. The cost of these services was € 106988, so distributed: € 19918 for X-Rays, € 73956 for CTs, € 9502 for MRs, € 3612 for interventional procedures. Across the three periods (M-3, M-2, M-1), both the proportions of examined patients and of performed exams varied significantly, increasing as Hospice admission approached. Similar results were obtained also when analyzing the types of radiology exams. During Hospice stay, only 25 patients (6%) underwent radiology exams.

CONCLUSION

A substantial number of end-stage oncologic patients underwent radiology exams in the 90 days before Hospice admission, and these number grew as Hospice access approached. These exams generated high expenditures for the National Health Service. In the end-of-life span, patient care should be devoted to improve the quality of life and not to try to prolong it. For this reason, diagnostic excesses should be avoided.

CLINICAL RELEVANCE/APPLICATION

A great number of radiology exams are performed on end-stage oncologic patients before Hospice admission, potentially configuring a form of diagnostic obstinacy and generating high expenditures.

SSE13-06 Patient Preferences for Receipt of Imaging Findings: A Systematic Review

Monday, Nov. 27 3:50PM - 4:00PM Room: S104B

Participants
Navneet Natt, Toronto, ON (*Presenter*) Nothing to Disclose
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Ravi Menezes, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To promote patient-centered delivery of services in radiology, it is important to understand patient preferences and experiences as they undergo medical imaging procedures. The purpose of the study was to perform a systematic review of publications describing outpatient preferences for receipt of imaging findings.

METHOD AND MATERIALS

An information specialist was consulted to create a literature search strategy to query MEDLINE, Embase, CINAHL and Cochrane publications from 2000 to 2015. Two screening rounds and extraction were performed independently by two reviewers. Modified versions of the CASP and the NHLBI Quality Assessment Tools were used for critical appraisal. A narrative approach was used to synthesize evidence.

RESULTS

Of 25,455 entries initially identified, 22 were included. Quality ranged from low to medium. Generalizability was affected by narrowly-defined target groups and low response rates. Heterogeneity was observed in the framing of specific questions and whether preferences were evaluated via survey (n=14) or following an intervention (n=8). Surveys: There were four studies that queried desire to meet with a radiologist; 64-77% of respondents indicated 'yes'. The outlier (23% 'yes') was in the study that asked about abnormal results. In nine studies that queried preferences for who provide results, the ordering physician was preferred in five; results were equivocal when participants understood the radiologist's role. There were high-levels of interest in having direct access to results (81-99%). Interventions: When the effect of radiologist interactions were evaluated, 72-98% indicated a desire to consult with radiologists again in the future. There was a consensus that the interactions improved the experience and understanding of the diagnostic process.

CONCLUSION

Preferences varied by how questions were asked and what information was provided to participants. Those informed about the expertise of the radiologist indicated a stronger preference to consult with a radiologist than those who were uninformed. This was supported by studies that incorporated a radiologist consultation; participants felt it improved their experience and wanted similar consultations in the future.

CLINICAL RELEVANCE/APPLICATION

Careful design of radiologist consultation services, including addressing key knowledge gaps in participants, has the potential to positively impact the experience of patients receiving imaging services.

SSE14

Science Session with Keynote: Musculoskeletal (Upper Extremity)

Monday, Nov. 27 3:00PM - 4:00PM Room: E450B

CT MK MR

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

FDA Discussions may include off-label uses.

Participants
Jenny T. Bencardino, MD, Lake Success, NY (*Moderator*) Nothing to Disclose
Adam C. Zoga, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSE14-01 Musculoskeletal Keynote Speaker: Update on Upper Extremity Imaging

Monday, Nov. 27 3:00PM - 3:10PM Room: E450B

Participants
Lynne S. Steinbach, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

SSE14-02 4D MSK MRI: Feasibility in the TMJ and GHJ and Comparison with 2D Dynamic Evaluation

Monday, Nov. 27 3:10PM - 3:20PM Room: E450B

Participants
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PURPOSE

There are limited reports of 2D dynamic MR evaluation in the MSK system. These are appealing for evaluating dynamic stabilization in joints. 2D dynamic imaging has limited slice profile with out-of-plane movement of imaging targets. Our objective was to develop a 4D (3D volume + 1D time) technique with application in the temporomandibular (TMJ) and glenohumeral (GHJ) joints and compare to its 2D counterpart.

METHOD AND MATERIALS

4D MR technique was developed for in vivo imaging at 3-T (Toshiba), and compared with 2D dynamic technique. In a volunteer, TMJ during a mouth opening-closing was imaged with: 1) 2D FASE (single shot spin echo; TR=400 ms, TE=10 ms, ETS=5 ms, FA=90/160 deg, FOV=20 cm, matrix=160x160, slice=6 mm (single slice), and 3.3 frames per sec, fps); and 2) 3D FASE (similar to 2D except: FOV=25 cm, matrix=256x256, slice=2 mm (6 slices), 1.1 fps). GHJ was imaged during a medial rotation of a forearm with: 3) 2D FASE at 2.5 fps and 4) 3D FASE at 0.4 fps with 8 slices.

RESULTS

Dynamic 2D and 4D techniques both yielded images of the TMJ (Fig.1) and GHJ (Fig.2) that depicted major structures with good quality and contrast. For example, in the GHJ, SNR of humeral head was 9.0 and 12.6, and CNR was 8.0 and 11.6, for 2D and 4D respectively. In the TMJ, the movement of mandibular condyle (Fig.1, circle) can be seen against stationary temporal bone (Fig.1, star). In the GHJ, changing orientation of humeral head (Fig.2, star) and glenoid (Fig.2, circle) during forearm rotational motion is seen. 4D technique, however, offered a crucial advantage of volume acquisition. For both TMJ and GHJ, evaluation of the soft tissues (TMJ disc, biceps tendon in groove) through range of motion is important for diagnosis and treatment. With 2D imaging, target structure can move out of the imaging slice. The 4D acquisition remedies this, albeit at a slower frame rate.

CONCLUSION

This feasibility study suggests that 2D dynamic and 4D MR techniques are available for evaluation of MSK structures in real-time motion, and that 4D has added advantage in case where complex, out-of-slice motions are involved.

CLINICAL RELEVANCE/APPLICATION

The 4D MR technique has utility for evaluation of joint instability.

SSE14-03 Rapid High-Resolution MRI of Elbow Injuries: Comparison of a Novel 10-min 3D TSE Technique

Against a 20-min 2D TSE Standard of Reference

Monday, Nov. 27 3:20PM - 3:30PM Room: E450B

Participants
Filippo Del Grande, MD, MBA, Baltimore, MD (*Presenter*) Speaker, Siemens AG; Speaker, Bayer AG; Institutional research collaboration, Siemens AG;
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PURPOSE

To test the hypothesis that a 4-fold accelerated 10-min 3D CAIPIRINHA SPACE prototype protocol is equivalent to a 2-fold accelerated 2D TSE standard for the MRI diagnosis of internal derangement of the elbow.

METHOD AND MATERIALS

Our study was approved by our internal review board. Following informed consent, 40 patients underwent 3T MRI of their symptomatic elbow consisting of six axial, sagittal and coronal IW and T2FS 2D TSE (20 min) and two sagittal isotropic IW and T2FS 3D TSE (10 min) pulse sequences. The novel 4-fold acceleration of the 3D SPACE TSE sequences was facilitated by bi-directional parallel imaging and CAIPIRINHA sampling pattern. Corresponding 2D and 3D TSE data sets were separated, anonymized and randomized into 80 studies and independently evaluated by two musculoskeletal radiologists. Outcome variables in each study included the integrity and diagnostic confidence of the 3 joints, 4 ligaments, 4 tendons, and 3 bones of the elbow. Descriptive statistics, inter-rater reliability, inter-modality concordance, and diagnostic confidence test were applied. A p-value of <0.05 was considered significant.

RESULTS

There was a high degree of inter-rater reliability with exact agreements of 78% for 2D and 89% for 3D studies ($p<0.05$). The degree of diagnostic concordance between 2D and 3D TSE was high with a Kendall's coefficient W for cartilage of 0.842, ligaments of 0.769, tendons of 0.890, and bone of 0.894. Raters diagnosed a total of 6 cartilage defects on 2D and 8 on 3D images, 14 ligament tears on 2D and 12 on 3D, 31 tendon tears on 2D and 33 on 3D, and 26 bone abnormalities on 2D and 28 on 3D. The disagreements between 2D and 3D diagnoses for cartilage, ligaments, tendons, and bone were 17.8%, 5.6%, 5.0%, and 3.8%, respectively. The readers' diagnostic confidence was significantly higher for 3D TSE ($p<0.05$).

CONCLUSION

For the diagnosis of internal derangement of the elbow, the presented 10-min 3D CAIPIRINHA SPACE MRI protocol is equivalent to a 20-min 2D TSE standard of reference. Radiologists' concordance and confidence were significantly higher for 3D studies, indicating a higher diagnostic definitiveness and possibly increased accuracy.

CLINICAL RELEVANCE/APPLICATION

Rapid 3D CAIPIRINHA SPACE TSE MRI is at least equivalent to a 2D TSE MRI reference standard for diagnosing elbow abnormalities and holds promise to substantially improve the efficiency of elbow MRI exams.

SSE14-04 Four-Dimensional Computed Tomography (4DCT) Evaluation of the Modified Radio-Ulnar Line in Correlation with Imaging Features of the Distal Radio-Ulnar Joint Osteoarthritis

Monday, Nov. 27 3:30PM - 3:40PM Room: E450B

Participants
Nima Hafezi Nejad, MD, MPH, Baltimore, MD (*Presenter*) Nothing to Disclose
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Scott D. Lifchez, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Modified Radio-Ulnar line (mRU) is a previously validated and reliability tested index of the Distal RadioUlnar Joint (DRUJ) and ulnar head alignment. The purpose of our study was to investigate the association between mRU measurements derived from Four-Dimensional Computed Tomography (4DCT) examination with clinical symptoms and imaging features of DRUJ osteoarthritis (OA).

METHOD AND MATERIALS

This is an IRB approved HIPAA compliant retrospective evaluation of 18 wrists (10 patients with unilateral wrist pain and instability) that were prospectively recruited in our 4DCT cohort study. Imaging of the contralateral asymptomatic side was performed to aid the diagnosis in the symptomatic side. The 4DCT was obtained using a 320-row detector scanner (Aquilion One, Toshiba Medical Systems) in active pronation-supination. Our previous study confirmed the reliability of mRU measurements using 4DCT examination. The mRU measurements were obtained in pronation, midpoint and supination by a fellowship trained MSK radiologist. Presence of symptoms (yes vs. no) and the Kellgren-Lawrence grade of OA (0-4) were assessed in correlation with mRU measurements in active motion.

RESULTS

The mRU values indicated a significantly greater volar motion of the ulnar head in asymptomatic wrists (mRU mean values (standard error): -0.10 (0.03) vs. 0.10 (0.03); P<0.001) in supination. Changes in the mRU measurements from pronation to midpoint (mean change: 0.11 (0.03), P:0.002) and to supination (0.19 (0.03), P<0.001) were significant only in the asymptomatic wrists. Unlike wrists with KL grade >=2, wrists with KL grade <2 had significant changes in the mRU values while moving from pronation to midpoint (mean change: 0.09 (0.02), P:0.004) and from pronation to supination (0.14 (0.06), P:0.059). The mRU values in pronation were not associated with the presence of symptoms or DRUJ OA. However, mRU values in supination were significantly correlated with both the presence of symptoms (correlation coefficient: 0.796, P<0.001) and KL grade of DRUJ OA (correlation coefficient: 0.647, P:0.005).

CONCLUSION

Presence of clinical symptoms and imaging features of DRUJ OA severity are associated with restricted volar motion of the ulnar head (assessed by the mRU line) while moving from pronation to supination.

CLINICAL RELEVANCE/APPLICATION

4DCT can feasibly detect dynamic changes in DRUJ alignment that are associated with clinical symptoms and imaging features of DRUJ OA.

SSE14-05 ECU Pseudolesion: A Spectrum of Change with Radiologic-Pathologic Correlation

Monday, Nov. 27 3:40PM - 3:50PM Room: E450B

Participants
Leah C. Davis, DO, Charleston, SC (*Presenter*) Nothing to Disclose
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PURPOSE

Axial MRI of the distal extensor carpi ulnaris (ECU) tendon commonly demonstrates increased central signal often attributed to tendinosis but recently described as 'ECU pseudolesion' from central tissue degeneration. On ultrasound (US), the ECU often appears heterogeneous, sometimes with a discrete cleft, even in asymptomatic patients which likely correlates with signal changes on MRI. The purpose of our study is to evaluate the distal ECU tendon by US, gross dissection and histologic evaluation to identify the ECU subsheath and elucidate the underlying cause of central signal abnormality.

METHOD AND MATERIALS

Distal ECU tendons in 28 cadaveric wrists were evaluated with static and dynamic US; images were reviewed in blinded fashion by two MSK radiologists for the presence of ECU subsheath (visible, not visible) and echogenicity of distal ECU tendon (homogeneous, heterogeneous, discrete cleft). 20 wrists were dissected by a plastic surgeon for gross evaluation of the ECU subsheath and distal ECU tendon to assess for split tear. Seven dissected ECU tendons were cross-sectioned and stained by one MSK pathologist for histologic evaluation.

RESULTS

The ECU subsheath was visible in 92.3% and 100% cases, with interreader reliability of 92%. No ECU subluxation was visualized in any wrist, with less than 40% volar displacement of the tendon during wrist rotation. In regards to echogenicity, interreader reliability was 54%, with a cleft noted in six cases by reader 1 but only one by reader 2. Of the 20 specimens dissected, all of them demonstrated an intact ECU subsheath and none of them demonstrated a tear. Of the 7 pathology specimens, all of them demonstrated internal bands of connective tissue between tendon bundles but within the tendon sheath and none of them demonstrated a tear.

CONCLUSION

The ECU subsheath is well visualized by US. Hypointensity in the distal ECU tendon on US represents bands of connective tissue, not tendinosis or longitudinal tear, and in some cases is contiguous with the external ECU tendon sheath on histologic evaluation.

CLINICAL RELEVANCE/APPLICATION

Distal ECU tendon often appears heterogeneous on US, sometimes with a discrete hypoechoic cleft, which is attributable to bands of connective tissue between tendon bundles and does not represent tendinosis or a longitudinal split tear. US is a reliable method to visualize the ECU subsheath, which can be assesed during dynamic maneuvers to diagnose ECU subluxation.

SSE14-06 Cost Effectiveness of MRI versus Ultrasound for the Detection of Symptomatic Full-Thickness Supraspinatus Tendon Tears

Monday, Nov. 27 3:50PM - 4:00PM Room: E450B

Participants
Soterios Gyftopoulos, MD,MSc, New York, NY (*Presenter*) Nothing to Disclose
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Naveen Subhas, MD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Siemens AG
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PURPOSE

To determine the value of MRI and ultrasound-based imaging strategies in the evaluation of a hypothetical population with a symptomatic full thickness supraspinatus tendon (FTST) tear using cost effectiveness.

METHOD AND MATERIALS

Decision analytic model from the health care system perspective for 60-year-old patients with symptoms secondary to a suspected FTST tear was used to evaluate the incremental cost effectiveness of three imaging strategies over a two-year time-horizon: MRI, ultrasound, and ultrasound followed by MRI (US/MRI). Comprehensive literature search and expert opinion provided input data on cost, probability and utility estimates. The primary effectiveness outcome was quality-adjusted life years (QALYs) through 2-year follow up. Costs were estimated in 2016 U.S. dollars. Costs and health benefits were discounted at 3%.

RESULTS

Ultrasound was the least costly imaging strategy ($1385). MRI was the most effective (1.332 QALYs). Ultrasound was the most cost-effective imaging strategy, but was not dominant. Incremental cost-effectiveness ratio for MRI was $22,756/QALY gained, below the $100,000 willingness-to-pay threshold. Two-way sensitivity analysis demonstrated that MRI was favored over the other imaging strategies over a wide range of reasonable costs. In probabilistic sensitivity analysis, MRI was the preferred imaging strategy in 78% of the simulations.

CONCLUSION

MRI and ultrasound represent cost-effective imaging options to evaluate the patient suspected of a symptomatic FTST tear.

CLINICAL RELEVANCE/APPLICATION

Based on our results, MRI is the preferred strategy from the standpoint of cost effectiveness although the decision between MRI and US for a radiology department or group is likely dependent on additional factors, such as available resources and workflow.

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SSE15

Science Session with Keynote: Musculoskeletal (Arthritis)

Monday, Nov. 27 3:00PM - 4:00PM Room: E451B

CT MR MK NM

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

Participants
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (*Moderator*) Nothing to Disclose
Arvin Kheterpal, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSE15-01 Musculoskeletal Keynote Speaker: Update on Arthritis Imaging

Monday, Nov. 27 3:00PM - 3:10PM Room: E451B

Participants
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (*Presenter*) Nothing to Disclose

SSE15-02 Integrated 18F PET/MRI for Assessment of Association of Inflammatory Activity in Psoriatic Arthritis and Vascular Calcification Metabolism

Monday, Nov. 27 3:10PM - 3:20PM Room: E451B

Participants
Nika Guberina, MD, Essen, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

The study aimed to scrutinize the association between vascular calcification metabolism and musculoskeletal manifestations in patients with active psoriatic arthritis.

METHOD AND MATERIALS

In a prospective clinical trial 21 patients with psoriatic arthritis were included in the study. The participants were examined according to a standardized whole-body protocol on the PET/MRI-scanner Magnetom Biograph mMR (Siemens Healthcare, Germany) within a single session. Joint inflammation based on 18F-NaF PET/MRI images was assessed with respect to 8 different variables (SUVmax, tenosynovitis, bone and soft tissue oedema, bone erosions, joint-space narrowing, joint-subluxation, and interphalangeal ankylosis). Vascular calcification metabolism was evaluated based on 18F-NaF-PET/MRI images in terms of 18F-NaF-uptake in large (aorta ascendens, aortic arch, thoracal and abdominal aorta descendens) and medium vessels (supra-aortic arteries, arteria mesenterica superior, iliac arteries, arteria femoralis superficialis). SUVmax was normalized for the mediastinal blood pool. Furthermore, association with laboratory parameters (CRP, CCP, leukocytes, rheumatoid factor, triglycerides and cholesterol) was investigated.

RESULTS

A total of 21 subjects (71.4% men, 28.6% women, age range 23?-?97 years) were evaluated. Vascular calcification metabolism of large and medium vessels showed a significant positive correlation with changes observed in advanced stage of psoriatic joint manifestation ($p < 0.05$). Moreover, arthritic changes were not associated and showed no correlation with laboratory markers of inflammation ($p > 0.05$).

CONCLUSION

The severity of psoriatic joint manifestations in advanced stage of psoriatic arthritis does significantly correlate with vascular calcification metabolism. Patients with psoriatic arthritis showing mild clinical symptoms may present severe atherosclerotic changes. Both, psoriatic changes and vascular inflammation may precede the actual onset of clinical symptoms.

CLINICAL RELEVANCE/APPLICATION

Both, psoriatic joint changes and vascular inflammation may precede the actual onset of clinical symptoms. Integrated 18F-NaF-PET/MRI allows the detection and severity monitoring of vascular calcification metabolism in patients with psoriatic arthritis.

SSE15-03 Diffusion Weighted Imaging of the Sacroiliac Joints: Does It Improve Diagnosis of Inflammatory Sacroiliitis?

Monday, Nov. 27 3:20PM - 3:30PM Room: E451B

Participants
Luis S. Beltran, MD, New York, NY (*Presenter*) Nothing to Disclose
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Catherine N. Petchprapa, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Mohammad M. Samim, MD, MRCS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
James S. Babb, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Determine if diffusion weighted imaging (DWI) improves diagnostic performance of conventional MRI in detection of sacroiliitis

METHOD AND MATERIALS

63 adult MRI studies of the sacroiliac joints (SIJ) including conventional MRI (STIR, T2FS, T1) and DWI were retrospectively collected into two versions: 1) MRI without DWI, and 2) MRI with DWI. Three musculoskeletal fellowship trained radiologists independently reviewed each version for bone marrow edema (BME) lesions around the SIJ as the test marker of sacroiliitis. DWI measurements were obtained using normalized ADCmean in BME lesions and normal appearing bone marrow around SIJ. Patient medical charts were reviewed using Assessment of SpondyloArthritis (ASAS) International Society criteria as the reference standard diagnosis of sacroiliitis. Diagnostic performance (accuracy, sensitivity, and specificity) of each version was compared based on combined data from all readers using generalized estimating equations. Kappa coefficient and McNemar test were used to compare inter-reader concordance rates. Mann-Whitney test was used to compare nADCmean values between patients with and without sacroiliitis based on reference standard ASAS criteria. ROC analysis was used to assess utility of nADCmean as a predictor of sacroiliitis.

RESULTS

29 patients with sacroilliitis and 34 patients without sacroiliitis were evaluated using ASAS criteria. Accuracy, sensitivity, and specificity of MRI without DWI was 65.1% (95% CI: 56.6-72.7), 65.5% (52.6-76.5), and 64.7% (53.3-74.7), and for MRI with DWI was 67.2% (57.7-75.5), 60.9% (45.8-74.2), and 72.5% (60.7-81.9), with no significant difference for all parameters (p>0.1). Kappa coefficient for MRI without DWI was 0.28 and for MRI with DWI was 0.46 (p=0.041). The mean nADCmean in patients without sacroiliitis was 2.01 (SD=4.05) and in patients with sacroiliitis was 2.91 (SD=3.14) (p=0.012). The nADCmean AUC was 0.697 (0.60-0.79). The nADCmean did not significantly improve ability to detect sacroiliitis relative to accuracy achieved using MRI without DWI alone (p=0.977).

CONCLUSION

Addition of DWI to conventional MRI does not significantly improve diagnostic performance in detection of inflammatory sacroiliitis.

CLINICAL RELEVANCE/APPLICATION

The potential utility of DWI for improving detection of sacroiliitis is currently of great interest. However, based on our data, we cannot recommend adding DWI to routine MRI of the sacroiliac joints.

SSE15-04 Postpartum Changes in the Sacroiliac Joints May Mimic Sacroiliitis of Axial Spondyloarthritis on MR Imaging

Monday, Nov. 27 3:30PM - 3:40PM Room: E451B

Participants
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PURPOSE

To compare bone marrow edema (BME) on MRI in the sacroiliac joints of women in the early postpartum period with women suffering from axial spondyloarthritis.

METHOD AND MATERIALS

This multicenter study was IRB-approved and informed consent was obtained from all participants. We prospectively acquired MR images of the sacroiliac joints of healthy postpartum women within three days after giving birth. We retrospectively acquired an age- and gender-matched control group of patients with known axial spondyloarthritis (based on diagnostic codes in our university hospital database) and used the initial MR scan of these patients in our PACS (i.e. before consecutive treatment). All MR scans comprised a coronal oblique STIR sequence of the sacroiliac joints. We assessed all MR images according to the Assessment of SpondyloArthritis international Society (ASAS) criteria for the presence of BME, and compared between the postpartum and spondyloarthritis group (Chi-square test). In a subgroup analysis, we compared BME between vaginal deliveries and cesarean sections (Chi-square test).

RESULTS

Thirty women were imaged postpartum (mean (±standard deviation) age 33±5 years, 17 vaginal deliveries, 13 cesarean sections, after 39±1 weeks of gestation, baby weight 3270±503g), and 30 women with axial spondyloarthritis (36±5 years). MRI was positive (based on ASAS-criteria) for axial spondyloarthritis in 19/30 (63.3%) of postpartum women and in 22/30 (73.3%) of women with

axial spondyloarthritis without a statistically significant difference (P=.579). Lumbar back pain at the time of MRI was present in 10/30 (33%) of postpartum women. Of those, 6/10 (60%) showed positive MRI for axial spondyloarthritis. In postpartum women without lumbar back pain, 13/20 (68.4%) showed positive MRI for axial spondyloarthritis. BME was present in 8/17 (47.1%) women with vaginal deliveries and in 8/13 (61.5%) of women with cesarean sections (P=.676).

CONCLUSION

Postpartum women may show similar bone marrow changes in the sacroiliac joints on MR imaging as patients with axial spondyloarthritis.

CLINICAL RELEVANCE/APPLICATION

Pregnancy induced BME in the sacroiliac joints may mimic sacroiliitis of axial spondyloarthritis on MRI. Caution is warranted not to overcall all BME as sacroiliitis of axial spondyloarthritis.

SSE15-05 The Significance of Subchondral Sclerosis at the Sacroiliac Joints in the Diagnosis of Inflammatory Sacroiliitis

Monday, Nov. 27 3:40PM - 3:50PM Room: E451B

Participants
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PURPOSE

To determine whether subchondral bone sclerosis is a specific finding for the CT diagnosis of sacroiliitis.

METHOD AND MATERIALS

CT scans of 215 patients with low back pain were retrospectively reviewed, comprising 107 with clinically proven spondyloarthritis (SpA) and a control group of 108 age and gender matched subjects. Three blinded musculoskeletal radiologists received formal training and scored the CT scans for diagnosis and the features of sacroiliitis. Sclerosis was specifically defined and scored if located along the cartilaginous compartment, measuring more than 5mm in all 3 planes and present more than 5mm from the joint perimeter. Discrepant scores were arbitrated by majority and reader correlation calculated using ICC statistics. Sclerosis was compared with clinical diagnosis and using statistical logistic regression, the relationship was determined by calculating sensitivity and specificity for each variable using 95% confidence intervals (CI).

RESULTS

The cohort comprised 140 males and 75 females, with a mean age of 45. For any single articular surface, the specificity range of subchondral sclerosis for sacroiliitis was between 84% (CI 79-89%) and 94% (CI 91-97%), and for any two articular surfaces 94 (CI 91-97) to 97% (CI 95-100). If all four articular surfaces were affected, specificity was 99% (CI 98-100%). Sensitivity ranged from 14% for all four articular surfaces, to 55% for either ilium. The inter-observer correlation for the three readers was substantial and, calculated individually for each articular surface, ranged between 0.65-0.76. Subchondral erosion had comparable specificity range 90-100% (CI 85-100% depending on number of surfaces affected), and ICC range 0.71-0.78.

CONCLUSION

When subchondral bone sclerosis measures more than 5mm in three planes and is located more than 5mm from a joint perimeter, it has high specificity for sacroiliitis, regardless of how many articular surfaces are involved, with comparable specificity and reader correlation to erosion.

CLINICAL RELEVANCE/APPLICATION

When subchondral bone sclerosis satisfies location and minimum size criterion, it is specific for inflammatory sacroiliitis. Understanding the application of these location and size criteria is important to Reporting Radiologists analyzing radiological imaging for sacroiliitis.

SSE15-06 Evaluation of Bone Erosions in Rheumatoid Arthritis Patients using CBCT and MRI

Monday, Nov. 27 3:50PM - 4:00PM Room: E451B

Participants
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PURPOSE

This study assessed the utility of a novel cone beam CT (CBCT) extremity scanner for evaluation of radiological signs of rheumatoid

This study, assessed the utility of a novel cone beam CT (CBCT) extremity scanner for evaluation of radiological signs of rheumatoid arthritis (RA), such as bone erosions in wrist and metacarpophalangeal (MCP) joints. For this purpose, we compared the bone erosion scores for CBCT and MRI in RA patients along with test-retest reproducibility of the CBCT data.

METHOD AND MATERIALS

In this IRB approved study, informed consent was obtained from 10 patients (5 males, 5 females; mean age 58 years, age range 34 - 81 years) who had clinically confirmed diagnosis of RA. All patients underwent 1 MRI scan and 1 CBCT scan of the wrist and hand followed by a second CBCT scan one week later. The field of view for all scans extended from the distal radioulnar joint to the phalanges. The MRI was done on a 3T clinical MR scanner with dedicated hand coil, while the CBCT was done using a prototype CBCT extremity scanner. A radiologist with 7 years of musculoskeletal imaging evaluated all images for bone erosions in MCPs, carpal bones and distal radius and ulna, using RAMRIS like scoring between 1 to 10 (1 is 0-10% erosion, 2 is 11-20% erosion etc). Repeatability and agreement of both methods were evaluated with Intraclass Correlation Coefficients (ICC) and Bland-Altman plots.

RESULTS

Bland-Altman analysis showed agreement of 0.007±3.5, 3.5 to -3.5 (bias ± repeatability coefficient, 95% limits of agreement interval) with ICC score of 0.65 showing moderate correlation between MRI and CBCT bone erosion scores. Correlation was higher for bone erosion scores of MCPs than for wrist joints. Test-retest reproducibility for the CBCT scans showed agreement of 0.03±1.13, 1.17 to -1.10 with an excellent ICC score of 0.95.

CONCLUSION

Moderate correlation for bone erosion scores between MRI and CBCT can be attributed to higher spatial resolution of CBCT, while the prototype extremity CBCT images showed high test-retest reproducibility. Further analysis of image data for bone edema and synovitis will provide additional validation of utility for CBCT extremity systems.

CLINICAL RELEVANCE/APPLICATION

The prototype CBCT extremity scanner may, after further validation in longitudinal studies, become a useful tool for detection of RA diagnostic evaluation.

SSE16

Nuclear Medicine (Neurodegenerative Disease Imaging)

Monday, Nov. 27 3:00PM - 4:00PM Room: S505AB

BQ CT MR NR 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

SSE16-01 Parallel Artificial Intelligence (AI) to Simulate Human Consensus Reading of Amyloid PET in Alzheimer's Disease (AD)

Monday, Nov. 27 3:00PM - 3:10PM Room: S505AB

Participants
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Presenter*) Research Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;
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PURPOSE

This study is to develop and evaluate a parallel AI system to simulate human consensus reading of amyloid PET scans and to improve AI interpretation of imaging data in dementia.

METHOD AND MATERIALS

Parallel AI architecture was realized using 'U Health Vivian' AI Framework (University of Utah) in which 3 multi-layer perceptron (MLP) AI cores were adjudicated by a concurrent MLP AI to simulate human consensus reading. 3D-SSP extracted regional values from [F-18]florbetapir PET data (165 normals, age 75±6.9 yrs, 78 female and 148 AD patients, age 75±8.2 yrs, 62 female, normalized to the cerebellum) were used for testing. Each AI core was trained independently via randomization and bootstrap with 1) a different number of scans (50% and 100% of total cases) and 2) an unequal case mix of positive and negative scans (one-third positives vs negatives) to simulate heterogeneity in the human observer experience. The discriminatory accuracy by the Parallel AI was compared to that by the conventional SUVr analysis.

RESULTS

Each AI core achieved the average discriminatory accuracy of 84% by training with an unequal case mix; 88% with a smaller number of balanced cases; and 90% with a larger number of balanced cases. Smaller numbers of the training data sets and an unbalanced case mix resulted in larger variances and lower accuracy (79%-88%, $p<0.05$ compared to the larger balanced cases). The parallel AI with a concurrent AI consistently improved the accuracy of individual AI cores from 84% to 89% for the unbalanced case mix and 88% to 89% for a smaller number of balanced cases while the accuracy with a larger number of balanced cases remained same at 90%. The Parallel AI performed equal to or better than the discrimination using the conventional SUVr (88% accuracy at SUVr threshold of 1.35).

CONCLUSION

This study demonstrates that a Parallel AI might be a novel approach to improve AI-based interpretation of amyloid PET scans, similar to the improvement typically seen by human consensus reading, especially when the training data set is limited and heterogeneous. Further investigation is warranted to test various configurations of the parallel AI system.

CLINICAL RELEVANCE/APPLICATION

AI is potentially a powerful way to support radiologist's work and improve consistency and accuracy of image interpretation. Unique AI technologies and applications will need to be explored further.

SSE16-02 PET Image Classification in Dementia: Comparison of a Deep Learning Algorithm to Standard Clinical Methods and Patient Follow-Up

Monday, Nov. 27 3:10PM - 3:20PM Room: S505AB

Participants
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PURPOSE

Deep learning has the potential to improve accuracy of diagnosis among patients presenting with symptoms of dementia, which could influence treatment decisions affecting this population. We describe the training and validation of a deep learning model to classification of FDG PET images from the Alzheimer's Disease Neuroimaging Initiative ADNI dataset, and the generalization of the model to a clinical dataset.

METHOD AND MATERIALS

~3500 FDG PET exams were downloaded from (ADNI) and ~50 FDG Neuro PET exams were obtained from PACS. Metadata was used to assign a diagnosis (Dx) of Normal (NL), Mild Cognitive Impairment (MCI), or Alzheimer's disease (AD) to each exam. UCSF images were labeled using Radiology reports to assign a Dx at the time of imaging, and chart review to assign a final Dx. All images were resampled to 2 mm isotropic voxels and cropped to a 20 x 20 x 18 cm3 region centered on the brain. A set of axial slices spanning the mid-cerebellar region to just inferior to the skull apex was determined, and slices were arranged into a 4 x 4 grid. Each grid was converted to PNG format and RGB channels were used to spatially encode the slices such that homologous slices were assigned the same color. ADNI subjects were divided into a training and validation set. An off-the-shelf deep learning model with ImageNet trained weights was implemented in Python using the Keras library and fine-tuned using the ADNI training set. The model was applied to the ADNI validation set and to the UCSF data. ROCs and AUCs were computed.

RESULTS

AUCs predicted by the model for the AD category were 0.89, 0.97, and 0.99 for the ADNI validation, UCSF Folow-up labeled and UCSF Rad-report labeled sets, respectively AUCs predicted by the model for the MCI category were 0.69, 0.64, and 0.51. AUCs predicted by the model for the NL category were 0.81, 0.78, and 0.82.

CONCLUSION

Deep learning may be an effective tool in AD diagnosis, however training and validation with larger data sets is required.

CLINICAL RELEVANCE/APPLICATION

Although qualitative interpretation by an expert is the most accurate method, other interpretive aids have been shown to be helpful to those who are less experienced with 18F-FDG PET. Deep learning models could support management of patients presenting with symptoms of dementia.

SSE16-03 Regional Brain Uptake Variations in Alzheimer's disease, Mild Cognitive Impairment and Normal Controls: 18F-FDG vs 18F-Florbetapir (Amyvid)

Monday, Nov. 27 3:20PM - 3:30PM Room: S505AB

Participants
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PURPOSE

Brain discrepant distribution patterns of amyloid radiotracers compared with that of FDG in subjects with different levels of dementia has long been a source of debate. This study aims to measure the uptake of two tracers in various brain regions and to compare how 18F-florbetapir (Amyvid) and 18F-FDG regional uptake values vary from Normal Controls (NC) to Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD).

METHOD AND MATERIALS

19 patients with a clinical diagnosis of AD, 23 with MCI and 21 elderly controls underwent PET/CT imaging with Amyvid and FDG. Regional brain uptakes were measured by manual delineation of ROIs on PET/CT fused image slices around Frontal (F), Temporal (T), and Prieto-Occipital (PO) regions, and cerebellum based on predefined anatomical Criteria. Average global glucose metabolism and average global amyloid burden were calculated by generating mean standardized uptake values (GSUVmean). Values were then normalized to cerebellum by developing GSUVmean ratios.

RESULTS

The highest SUVmean ratio for FDG was noted in the F region followed by PO and T regions. In NC group, the PO region had the highest uptake ratio followed by F and T regions. However, in MCI and AD groups, decreased PO ratios were observed and were followed by those of T region, while F region had the highest ratio. In NC and MCI groups, T region ratio was significantly lower than those of F and PO ($P<0.001$), but in the AD group, this difference was not statistically significant. In either MCI or AD groups, F, PO and T ratios were significantly decreased compared to the NC group.($P<0.001$) Amyloid imaging showed the highest SUVmean ratios in the F region followed by those of PO and T regions. This pattern was the same in NC, MCI and AD Group independently. As a whole, F ratios were the highest among the values measured. In spite of increased ratios in regions examined in MCI and AD, the differences were not statistically significant.

CONCLUSION

FDG images indicated major hypo-metabolism in the PO region as the disease converts from MCI to AD. While Amyvid shows the highest amyloid burden and the highest uptake rise in the F region which is not supported by histopathological findings and suggests a substantial contribution of non-specific binding.

CLINICAL RELEVANCE/APPLICATION

FDG accurately differentiates between NC and MCI and AD and appears to be more applicable and reliable method for assessing patients with Alzheimer's disease.

SSE16-04 Plasma Glucose Effect upon Regional Brain FDG Uptake: Implications for Semi-Quantitative Image Analysis and Dementia Classification

Monday, Nov. 27 3:30PM - 3:40PM Room: S505AB

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PURPOSE

We recently demonstrated that plasma glucose level can affect FDG uptake in the brain and basal ganglia. Additionally, prior studies have also suggested that plasma glucose, above or below 125 mg/dl could change the regional cerebral pattern of FDG uptake and thus may affect clinical interpretation. This current study attempted to look at the plasma glucose effect as a continuum on regional cerebral FDG uptake.

METHOD AND MATERIALS

We used our prior dataset of 436 scans from 229 patients was used to act as a comparison population. 100 consecutive patients scanned for tumor evaluation were obtained. Patient were excluded if they had history of dementia, CVA, prior treatment (chemotherapy or XRT), known structural brain lesion, or high tumor burden. This latter has been shown to affect brain FDG uptake (see separate abstract). Brain PET images were reformatted and analyzed by Scenium (Siemens Biograph T6; Siemens Medical Solutions, Hoffman Estates, IL, USA). The mean SUV from the different cortical brain regions were compared to the basal ganglia measurements using four different methods: absolute difference, normalized (to blood pool) absolute difference, population average absolute difference and normalized (to blood pool) population absolute difference. Additionally, Z-scores for these different regions were also looked at, using the internal Scenium database. These 4 "differences" and the Z-score were then plotted as a function of plasma glucose level; residual analysis and/or subsequent linear regression were performed. A region was deemed significantly different if the slope of this linear regression was significant ($p<0.05$).

RESULTS

We were able to confirm our previous finding that diffuse brain uptake decreases with increasing plasma glucose. However, we noted also regional cerebral differences, in particular the mesiotemporal lobes and cerebelli.

CONCLUSION

Variation in plasma glucose affects FDG uptake in brain regions differentially, in particular the mesiotemporal lobes and cerebelli.

CLINICAL RELEVANCE/APPLICATION

These findings may impact imaged based dementia classification, choice of normalization technique when analyzing brain PETs, and/or suggest a need in developing a normalized database that corrects for plasma glucose

SSE16-05 The Impact of Total Counts on Iodine-123 Ioflupane SPECT Quantification

Monday, Nov. 27 3:40PM - 3:50PM Room: S505AB

Participants
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PURPOSE

I-123 Ioflupane SPECT can be used to quantify the concentration of regional cerebral dopamine transporters (DAT) in patients with movement disorders to differentiate normal and abnormal states. The objective of this RSNA Quantitative Imaging Biomarker Alliance sponsored study is to determine the total counts needed for accurate and precise estimation of the striatal specific binding ratio

(SBR).

METHOD AND MATERIALS

An I-123 striatal phantom with SBRs of 4:1 and 2:1, which represent realistic uptake patterns of normal and abnormal distribution, was imaged on SPECT/CT with clinical acquisition parameters and 12 million total counts. Poisson resampling was implemented on Matlab to simulate 5 noise realizations corresponding to each of 4 reduced count levels of 3, 2, 1 and 0,5 million counts. Each data set was reconstructed with FBP, OSEM, and OSEM with resolution recovery and correction for attenuation and scatter. OSEM parameters included 12 iterations, 8 subsets and a Gaussian filter. Striatal compartments and background were defined on CT and applied to SPECT to determine mean counts. A generalized linear model was used to test the null hypothesis that the bias and precision of SBR measurements do not change when count levels of 0.5, 1, 2 million are compared to 3 million.

RESULTS

As expected, due to partial volume effects, the SBR was substantially underestimated in all cases. However, compared to the 3 million count level the 2 and 1 million levels resulted in similar bias and variance and only the 0.5 million level resulted in a statistically significant increase in bias and variance. This was consistent across brain regions and reconstruction methods, except for the left caudate where an increase in variance was not detected. For the 3, 2, 1, and 0.5 million levels the mean bias in measured SBR was 2.26, 2.29, 2.27 and 2.52, respectively, while the mean variance was 0.0069, 0.0056, 0.0057 and 0.0147, respectively.

CONCLUSION

The data suggests that apart from the 0.5 million level the bias and precision of measured SBR are similar for evaluated count levels, hence a count level down to 1 million can be used to quantify DAT with reduced acquisition time or radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Guideline in USA and Europe recommend > 1.5 and > 3 million counts for I-123 Ioflupane SPECT. Low count acquisitions without compromising imaging objectives allows reducing patient discomfort and/or radiation exposure.

SSE16-06 Evaluation of the PET Performance of Hybrid PET/MRI Compared to PET/CT in Non-Lesional Epilepsy

Monday, Nov. 27 3:50PM - 4:00PM Room: S505AB

Participants
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PURPOSE

PET/MRI can provide greater rates of lesion localization in patients with medically refractory epilepsy (MRE). However, the use of PET/MRI can be limited by MRI based attenuation correction (MRAC), where inaccurate estimation of AC may lead to erroneous estimation of PET activity. Recent advances in MR image processing have improved the performance of MRAC for PET/MR neuroimaging. This paper compares a novel MRAC approach to CT based attenuation correction (CTAC) - the current clinical standard, in patients with MRE.

METHOD AND MATERIALS

PET/MRI was acquired simultaneously in 15 patients with MRE on a hybrid system (Siemens Healthcare, Erlangen, Germany) immediately after a clinical PET/CT scan. PET/MRI data were corrected for attenuation using CT (PET-MRI-CTAC) and RESOLUTE MRAC method (PET-MRI-MRAC). PET images were compared through visual rating of metabolic activity in the frontal, temporal, parietal, occipital lobes and cerebellum and augmented by quantitative comparison of each patient's PET scan to controls (MI Neurology, Siemens Medical Solutions, USA). The mean relative difference (RD) between the two PET images was calculated for whole brain and in selected brain regions. PET/MRI performance was further evaluated using Pearson correlation to compare regional mean SUV and z-scores between PET AC methods.

RESULTS

The global RD between PET-MRAC and PET-CTAC activity was (mean ± SD%) -4.66 ± 1.93%, while regional RD ranged from -4.71 to -3.65%. A strong correlation between PET AC methods was seen across brain regions (range $r2 = 0.79$ to 0.98, $p<0.0001$) and in particular the mesial temporal lobe ($r2 = 0.98$, $p<0.0001$), an area commonly associated with MRE. Visual assessments between PET/MRI and clinical PET/CT were matched in all but 3 patients, where PET/MRI revealed mild abnormalities not reported on PET/CT.

CONCLUSION

Similar PET performance was observed between AC methods highlighting the feasibility of PET/MRI imaging in epilepsy. Further clinical evaluation using multiple raters is ongoing as well as evaluation of PET/MRI diagnostic accuracy compared to reference standards (histology and seizure-free outcomes).

CLINICAL RELEVANCE/APPLICATION

PET/MRI is emerging as a powerful tool for detecting abnormalities in epilepsy. Wider clinical adoption would occur if diagnostic equivalence to current clinical standard (PET/CT) is demonstrated.

SSE17

Neuroradiology (Dementia Imaging: Looking Through the Fog)

Monday, Nov. 27 3:00PM - 4:00PM Room: N227B

NR

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

SSE17-01 Evaluation Changes of Cerebral Iron Deposition in Patients with Alzheimer's disease and Mild Cognitive Impairment using SWI Phase Data

Monday, Nov. 27 3:00PM - 3:10PM Room: N227B

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PURPOSE

Based on voxel-based method, susceptibility weighted imaging (SWI) phase value was used to investigate the changes of iron deposition in Alzheimer's disease (AD) and Mild Cognitive Impairment (MCI) patients.

METHOD AND MATERIALS

24 AD patients, 22 MCI patients and 20 no cognitive impairment (NCI) cases were investigated (Table 1). For all cases, SWI scanning was conducted with phase images acquired on a SIEMENS Trio 3T scanner. The acquisition parameters were: slice per slab = 80, TR/TE = 27/20 ms, voxel size = 0.9X0.9X1.5 mm3. High-resolution T1 MPRAGE images were acquired as well. After image acquisition, phase maps were calculated using in-house software. T1 MPRAGE was segmented using SPM8 and registered onto phase maps. Gray matter (GM) phase value of whole brain was calculated for each case. Preprocessing and statistical analyses were performed on SPM8.

RESULTS

Among the three groups, the Phase value was different significantly ($p < 0.005$, $F=7.64$, uncorrected for multiple comparisons) in right hippocampus, right amygdale, right middle, right caudate and bilateral putamen and insula (figure). The phase value difference was significant between MCI and NCI ($p < 0.005$, $T=3.18$, uncorrected for multiple comparisons) in right superior temporal gyrus and middle temporal gyrus. The phase value difference was significant between AD and NCI ($p < 0.005$, $T=4.20$, uncorrected for multiple comparisons) in right hippocampus, right amygdale, right superior temporal gyrus, right middle temporal gyrus and bilateral putamen and insula.

CONCLUSION

Our results revealed patterns of regional iron deposit of AD and MCI patients, suggesting underlying iron metabolism abnormality. As a potential biomarker, Phase value is effective to measure regional iron deposit changes in AD and MCI patients.

CLINICAL RELEVANCE/APPLICATION

SWI is a useful noninvasive MRI sequence to identify the cerebral iron deposit in Alzheimer's disease and MCI patients.

SSE17-02 Imaging Alzheimer Disease Plaques Using Small-Angle X-ray Scattering

Monday, Nov. 27 3:10PM - 3:20PM Room: N227B

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PURPOSE

Beta-amyloid plaques have been shown to play a role in the development of Alzheimer's (AD), a neurodegenerative disease characterized by impaired memory, reduce cognitive skills, and diminished ability to perform everyday tasks for which there is currently no cure or effective treatment. Optical imaging has been shown to characterize molecular AD hallmarks but lacks the ability to image deep tissue. On the other hand, PET imaging is widely used to locate beta-amyloid plaques in the brain but suffers from low spatial resolution and low specificity. We report on small-angle x-ray scattering (SAXS) computed tomography for detecting amyloid plaques for Alzheimer's disease in vivo with higher resolution than PET. Analysis of physical phantoms and mouse brain measurements along with computational simulations of x-ray transport are reported to explore this technique.

METHOD AND MATERIALS

SAXS can characterize and selectively image structures based on electron density maps without any exogenous contrast agent. We describe phantoms for demonstrating planar SAXS imaging with improved contrast of molecular targets. We measured normal and transgenic Alzheimer's disease mouse model brains using planar SAXS to assess normal and disease patterns. We perform simulations using a publicly available, GPU-accelerated, Monte Carlo radiation transport tool to assess feasibility and optimization of SAXS imaging for detecting amyloid plaque in mice and humans in vivo reporting radiation dose and SNR estimates.

RESULTS

We were able to detect a bovine serum albumin (BSA) fibril amyloid model target placed on top of a slice of wild-type mouse brain at q angles lower than 0.5 nm-1. The target shows higher intensity than normal brain tissues. Peaks belonging to myelin in the corpus callosum region were visible at 1 and 1.6 nm-1. SAXS imaging simulations with 16-, 20-, and 33-keV x rays were performed on a voxelized DIGIMOUSE digital phantom with embedded targets of 0.1, 0.4, and 0.6 mm in diameter showing that 33-keV x rays achieve significant contrast in a mouse head approximately 1.5x1.5 cm2 in size.

CONCLUSION

The findings of the study indicate that amyloid plaque imaging is feasible using SAXS-CT.

CLINICAL RELEVANCE/APPLICATION

Our study contributes to assessing feasibility and providing the computational and experimental tools needed for the design and optimization of SAXS imaging to measure AD biomarkers *in vivo*.

SSE17-03 Cerebral Perfusion Changes after Acetyl-1-Carnitine Treatment in Early Alzheimer's Disease: A Single Photon Emission Tomography Study

Monday, Nov. 27 3:20PM - 3:30PM Room: N227B

Participants
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PURPOSE

Although beneficial effects of acetyl-L-carnitine (ALC) in Alzheimer's disease (AD) have been reported, underlying neural correlates remain unclear. The current study aimed to investigate cerebral perfusion changes after ALC treatment in AD patients using technetium-99m hexamethylpropylene amine oxime single photon emission computed tomography (SPECT).

METHOD AND MATERIALS

A total of 18 patients with early AD were recruited and assessed with brain SPECT, Mini-Mental State Examination (MMSE), Clinical Dementia Rating (CDR), Global Deterioration Scale (GDS), and Neuropsychiatric Inventory (NPI). Changes in brain perfusion, severity of dementia, cognitive performance, and neuropsychiatric disturbances after ALC administration were examined.

RESULTS

After approximately 1.4 years of ALC administration, changes in the scores of MMSE, CDR, GDS, and NPI were not significant. Voxel-wise whole-brain image analysis revealed that increased perfusion was found in the right precuneus ($p < 0.001$) whereas perfusion reductions were detected in the left inferior temporal gyrus ($p < 0.001$), right middle frontal gyrus ($p < 0.001$), and right insular cortex ($p = 0.001$) at the follow-up.

CONCLUSION

Our findings suggest that ALC-induced perfusion increase in the precuneus may attenuate progressive deterioration of cognitive function and neuropsychiatric symptoms.

CLINICAL RELEVANCE/APPLICATION

This is the first SPECT study that examined cerebral perfusion changes associated with ALC administration in early AD patients. After 1.4 years of ALC administration, cognitive performances, severity of dementia, and levels of neuropsychiatric symptoms were not significantly changed, whereas rCBF in the precuneus increased. Our findings suggest that ALC-induced rCBF increase in the precuneus may attenuate progressive deterioration of cognitive function and neuropsychiatric disturbances.

SSE17-04 The Association between CD33 Gene and Cognitive Impairment in Alzheimer's Disease Spectrum: Functional Connectivity Density as Mediator and Moderator

Monday, Nov. 27 3:30PM - 3:40PM Room: N227B

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PURPOSE

The object of this study is to explore the role of CD33 gene in the brain function and its relationship with cognitive function in Alzheimer's disease (AD) spectrum patietns by using resting-state functional magnetic resonance imaging (R-fMRI).

METHOD AND MATERIALS

One hundred and eighty-nine AD spectrum participants were selected form ADNI database. All subjects completed R-fMRI scan, CD33 (rs3865444) gene detection and cognitive function assessment (ADAS-Cog score). The brain function was assessed using a voxel-based analysis of global functional connectivity density (gFCD) using R-fMRI data. 3 × 2 analysis of covariance was employed to conduct the main and interactive effect of disease and CD33 genotype. Further, conditional process analysis was used to investigate mediated and moderated effects of brain function on the relationship between CD33 and cognitive function.

RESULTS

The main effect of the disease showed that in the default mode network, the gFCDs in AD group were significantly higher than that of MCI and CN group, but no significant difference between CN and MCI group. The main effect of CD33 genotype was found in dorsal anterior cingulate cortex (dACC) and right caudate nucleus. The interactive effect of disease and CD33 was located in the right parahippocampal gyrus, specially, the gFCD in the rs3865444 A+ group is higher than rs3865444 CC group in the stage of CN, while lower in the stage of MCI but no difference in the stage of AD. The gFCDs in DMN and dACC were positively correlated with cognitive function among AD spectrum patients. The conditional process analysis revealed that the gFCD in precuneus is a moderator, while gFCD in dACC is a mediator for the relationship between CD33 genotype and cognitive function among all participants. Interesting, the mediated effect of dACC was moderated by the gFCD in precuneus. Further subgroup analysis showed that the mediated and moderated effects also occurred in the MCI subgroup.

CONCLUSION

During the progression of AD, CD33 gene polymorphism presents an inverse effect between the stage of CN and MCI, but equally in the stage of AD. The gFCD played as moderator and mediator for the association between CD33 genotype and cognitive performance in AD spectrum patients.

CLINICAL RELEVANCE/APPLICATION

The brain functional features may confer vulnerability to cognitive impairment between AD spectrum patients with different CD33 genotype.

SSE17-05 Multi-Scale Full-Organ to Intra-Cellular 3D Detection of Alzheimer's disease Neurodegeneration via X-Ray Phase Contrast CT

Monday, Nov. 27 3:40PM - 3:50PM Room: N227B

Participants
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PURPOSE

Full-organ MRI-based imaging of Alzheimer's Disease (AD) lacks the spatial resolution necessary to discriminate nervous tissue complexity at the cellular level. Other pre-clinical techniques for imaging neuronal populations, such as deep two-photon calcium imaging, 3D light microscopy or tissue-cleared full-organ fluorescence microscopy are also limited, respectively by the spatial restriction of neuronal staining with calcium indicator dyes, the size of dissected sample sections, or by an only partial labelling of cell populations. X-ray Phase Contrast CT (PCI-CT) provides soft-tissue sensitivity without any application of stains, labels or contrast agents. Most interestingly, PCI can visualize nervous tissue structure at multiple scales, from full-organ anatomy to single cells without the need for sample dissection. We thus choose PCI-CT for a unique analysis of AD pathology in the brain of 3xTgAD mice expressing three mutant alleles Psen1, APP and tau, which display both amyloid-ß plaque and tangle pathology and represent an experimental model of AD.

METHOD AND MATERIALS

Multi-scale 3D images of brain samples from wild-type mice (n=6) and 3xTgAD mice (n=6, all at 13 months of age), were obtained by synchrotron PCI-CT. We used 30 keV X-rays, a sCMOS-sensor PCO camera, and switched between optics systems with voxel sizes from 3^3 µm³ to 0.3^3 µm³.

RESULTS

Full-organ 3-micron brain CTs showed PCI's sensitivity to microscopic deposits within both hippocampal and cortical cell layers which suggest protein aggregation. Moreover, localized 0.3 µm CTs detected single neuronal cells, intra-neuronal aggregates, and extracellular deposits. We observed both healthy and altered pyramidal neurons and recognized them alongside agglomerates. Image contrast allowed quantification of aggregate load and of cell-layers-specific plaque-size 3D distributions. Sub-cellular structures (conic-shaped somas, circular high-density nuclei) were also visible at this resolution.

CONCLUSION

PCI-CT detects aggregates resembling amyloid plaques in different brain regions and provides unique 3D mappings of neuronal tissues, their surrounding angio-structures, and of single neurons, in aged healthy and diseased 3xTgAD mice.

CLINICAL RELEVANCE/APPLICATION

PCI-CT opens a fascinating novel avenue for post-mortem imaging of neurodegenerative diseases. It provides a full-organ virtual histology, which shows local 3D cellular anatomy and pathology.

SSE17-06 Classification of Alzheimer's Disease by Compartmental Sparse Feature Selection in Structural MRI Data

Monday, Nov. 27 3:50PM - 4:00PM Room: N227B

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PURPOSE

A compartmental sparse feature selection method was used for identification of Alzheimer's Disease from the healthy and compared with voxel-based morphometry method.

METHOD AND MATERIALS

64 Alzheimer's disease(AD) patients and 60 healthy control cases(HC) were investigated(Table 1). For all cases, high-resolution T1 MPRAGE images were acquired on a SIEMENS Trio 3T scanner. The acquisition parameters were: TR/TE=2530/3.44ms, voxel size=1X1X1mm3. Depending on prior knowledge, the whole gray matter and 10 ROIs (bilateral amygdala(AMYG),hippocampus(HIP),parahippocampal gyrus(PHG),cuneus(CUN),cingulate gyrus(CG),parietal gyrus(PG), precuneus(PCUN), frontal gyrus(FG), temporal gyrus(TG) and amygdala+hippocumpus+parahippocampal gyrus(AHP)) were selected according to AAL template. The proposed method partitioned the normalized 3D T1-weighted gray matter images into several compartments. It performs feature selection and classification compartmentally according to the local feature dimension estimation and local feature selection using sparse principal component analysis(SPCA) method followed with elastic-net logistic regression(ENLR) classifier. Voxel-based morphmetry(VBM) method was used and the same normalized T1-weighted gray matter data were statistically analyzed on SPM8 by two-sample t-test for comparing AD with HC.

RESULTS

The classification accuracy of all gray matter and 10 ROIs are as follow (Figure1). Accuracy of all gray matter, AMYG, HIP, PHG, CUN, CG, PG, PCUN, FG, TG and AHP is 0.78, 0.76, 0.68, 0.73, 0.60, 0.63, 0.69, 0.67, 0.65 and 0.83 respectively. Cortical volumes decreased significantly($p<0.001$, $t=3.82$) in AD compared to HC in bilateral hippocampi, amygdalae, superior temporal pole, left parahippocampal gyrus, left inferior temporal cortex (Figure 2).

CONCLUSION

Our results revealed high classification accuracy for AD diagnosis by using compartmental sparse feature selection method and the accuracy of ROIs was consistent with results of classic VBM method.

CLINICAL RELEVANCE/APPLICATION

Compartmental sparse feature selection is an effective computer-aided diagnosis method to help clinician to identify AD.

SSE18

Neuroradiology (Spine Imaging: Backbone of Neuroradiology?)

Monday, Nov. 27 3:00PM - 4:00PM Room: N229

MR NR

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

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Sub-Events

SSE18-01 Biochemical Intervertebral Disc Alterations in Patients with Low Back Pain and Radiculopathy

Monday, Nov. 27 3:00PM - 3:10PM Room: N229

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PURPOSE

To assess the glycosaminoglycan (GAG) content of lumbar intervertebral discs (IVD) in patients with low back pain (LBP) and radiculopathy using glycosaminoglycan chemical exchange saturation transfer imaging (gagCEST).

METHOD AND MATERIALS

258 lumbar IVDs of 53 participants, 21 healthy volunteers, 19 patients with LBP and 13 patients with radiculopathy (28 female; 25 male; mean age: 45.5 ± 16.7 years; range: 23 - 83 years), were examined with a 3T MRI scanner. Biochemical gagCEST imaging was used to determine the GAG content of each nucleus pulposus (NP) and annulus fibrosus (AF).

RESULTS

Significantly reduced gagCEST values of NP were found in patients with LBP and/or radiculopathy ($p < 0.0001$) compared to healthy control group. NP gagCEST values were significantly lower in patients with LBP ($p < 0.0001$) and radiculopathy ($p = 0.0005$) compared to healthy volunteers, respectively. We saw an association between pain and GAG loss with significantly lower gagCEST values in participants with dorsal pain at examination day ($p = 0.0004$) and higher pain scores ($p < 0.0001$) compared to participants without LBP. Participants with body mass index >= 25 revealed lower gagCEST values compared to participants with BMI < 25 ($p = 0.02$).

CONCLUSION

GagCEST analysis indicated significantly lower GAG values of NP in patients with LBP or radiculopathy, in participants with elevated BMI, current pain at examination day and elevated pain scores.

CLINICAL RELEVANCE/APPLICATION

1. Biochemical lumbar disc alterations are associated with clinical symptoms like low back pain, radiculopathy, current pain or elevated pain scores. Additionally, participants with elevated BMI showed GAG loss of the lumbar IVDs. 2. Biochemical imaging with gagCEST may provide an early biomarker for IVD and spine degeneration. 3. GagCEST imaging may be helpful in monitoring therapy effects. 4. Molecular imaging with gagCEST is a non-ivasive tool that allows to dicriminate between healthy participants and patients with low back pain..

SSE18-02 Assessment of Imaging Appropriateness Based on the ACR Appropriateness Criteria in MRI Evaluation of Back Pain

Monday, Nov. 27 3:10PM - 3:20PM Room: N229

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PURPOSE

The purpose is to evaluate the appropriateness of MR imaging in the lumbar spine for back pain using ACR Appropriateness Criteria and to assess whether information provided by the requesting clinician at the time of order entry is adequate in allowing assessment of imaging appropriateness.

METHOD AND MATERIALS

This is a retrospective study of 111 outpatient MRI examinations of the lumbar spine performed for back pain. Cases were identified via an informatics query for MR exams associated with an ICD10 code of M54.5 (low back pain). Exclusion criteria included absence of a clinical note in the medical record. Using the history obtained, the study was placed into one of six Variants as outlined in the ACR Appropriateness Criteria document for Low Back Pain. Imaging appropriateness was assessed using only text provided by the clinician in the 'Reason for Exam' or 'Ordering Comments' fields, and appropriateness scores were assigned for the Variant that was deemed most likely based on the limited information provided. Following review of the medical record, each MRI exam was re-categorized into one of six Variants based on history components or potential 'red flags' as outlined in the ACR Appropriateness Criteria document. Based on the Variant assigned, the study was then given a rating of 1-9 based on the ACR Appropriateness Criteria, with 1-3 considered 'usually not appropriate' and 7-9 considered 'usually appropriate'.

RESULTS

Of the 111 MRI examinations reviewed, 15 were excluded due to aforementioned criteria. After review of the medical record for the included 96 studies, 77 (80%; 95% CI: 72-88%) ultimately received a rating of at least 7, the range considered 'usually appropriate'. Based solely on the clinician-provided 'Reason for Exam' or 'Ordering Comments' fields, 25 exams (26%; 95% CI: 17-35%) were considered 'usually appropriate'.

CONCLUSION

Most lumbar spine MRI examinations for low back pain are appropriate based on ACR Appropriateness Criteria, but a large portion of appropriate examinations could be falsely deemed inappropriate if only information provided by the clinician at order entry is evaluated.

CLINICAL RELEVANCE/APPLICATION

Communication of relevant clinical information from referring providers improves assessment of imaging appropriateness at the time of protocolling, performing, or interpreting a lumbar spine MRI study.

SSE18-03 Immunotherapy Associated Pseudoprogression of Spinal Leptomeningeal Disease

Monday, Nov. 27 3:20PM - 3:30PM Room: N229

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PURPOSE

Metastatic melanoma (MM) with leptomeningeal disease (LMD) has a poor prognosis. Immunotherapy has recently demonstrated improved outcomes, but very little is known about changes on imaging studies in the central nervous system during treatment. The purpose of this study was to characterize the imaging features of spinal leptomeningeal enhancement in metastatic melanoma patients during intrathecal (IT) interleukin-2 (IL-2) immunotherapy for LMD.

METHOD AND MATERIALS

The clinical and imaging data of 43 MM patients with LMD undergoing treatment with IT IL-2 were retrospectively reviewed. IL-2 was administered via an Omaya reservoir daily for 5 days during the 1st week, and 2-3 times per week for an additional 3 weeks, guided by patients' tolerance to treatment.

RESULTS

In 8 cases increased spinal leptomeningeal enhancement was identified after the initial IT administration of IL-2. The median time interval between administration of IL-2 and increase in the leptomeningeal enhancement in the first follow-up scan was 24 days. In all 8 cases there was a decrease in leptomeningeal enhancement on the subsequent scan acquired at a median of 38.5 days after the first follow-up MRI study.

CONCLUSION

Intrathecal IL-2 immunotherapy can result in a transient increase in spinal leptomeningeal enhancement. This is likely reflective of pseudoprogression secondary to IL-2 induced inflammatory reaction.

CLINICAL RELEVANCE/APPLICATION

Radiologists interpreting MRI spine studies in MM patients with LMD receiving intrathecal IL-2 should be cognizant of this transient increase in leptomeningeal enhancement so as to not mistake it for disease progression.

SSE18-04 High Field Magnetic Resonance Imaging of Microstructural Changes in Post-Mortem ALS Spinal Cord

Monday, Nov. 27 3:30PM - 3:40PM Room: N229

Participants
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PURPOSE

Amyotrophic lateral sclerosis (ALS) is characterized by progressive loss of upper (UMN) and lower motor neurons. UMN loss leads to degeneration of lateral and ventral corticospinal tracts (LCST and VCST). In this work we imaged post-mortem ALS spinal cord with diffusion tensor imaging (DTI) and echo-planar spectroscopic imaging (EPSI) and correlated results with histology. Both methods are sensitive to microstructural tissue changes and may serve as biomarkers of disease.

METHOD AND MATERIALS

Cord sections were imaged at 9.4T. DTI data were acquired using a Stejkal-Tanner sequence over 60 directions (b=3000s/mm^2, 0.1x0.1x0.4mm voxels) and radial diffusivity (rADC) was computed. EPSI data were acquired using a multi-gradient echo pulse sequence (128 echoes, 1.85ms echo spacing, 0.07mm^3 voxels) from which voxel-wise water proton spectra were produced. The asymmetry (ASYM) of each spectrum was computed as the integral of the spectral half below the peak subtracted from that above the peak (normalized by the total peak area). Regions of interest (ROIs) were defined in myelin stained (LFB) histology and registered with MRI data.

RESULTS

Increased rADC values in left and right LCSTs and VCSTs reflect ALS dependent neuronal loss compared with unaffected dorsal column (DC) white matter (2.07, 2.08, 2.1, 2.13, and 1.79 x10^-4 mm^2/s, respectively). ASYM values computed across the same ROIs also suggest sensitivity of the water spectrum shape to disease. The spectrum shape is sensitive to microstructural magnetic field perturbations, such as demyelination. ASYM values in CST ROIs are smaller than the more heavily myelinated DC and larger than the myelin free grey matter.

CONCLUSION

rADC and ASYM values are sensitive to ALS pathology in post-mortem spinal cord and could potentially serve as a biomarker to stratify UMN burden in ALS. Both rADC and ASYM results suggest sensitivity to underlying microstructural tissue changes. Of particular interest, similar myelin concentrations between VCSTs and LCSTs produce opposite changes in the water spectrum; positive asymmetry suggests increased spectral density at frequencies above the peak, while negative asymmetry suggests the same, but below it.

CLINICAL RELEVANCE/APPLICATION

These results obtained from post-mortem tissue suggest methods that could be used in vivo for non-invasive assessment of ALS as well as serve as an intermediary between histopathology and in vivo MRI.

SSE18-05 Comparative Analysis of Conventional T2 MRI versus Volumetric T2 MRI in the Evaluation of Spinal Vascular Malformations

Monday, Nov. 27 3:40PM - 3:50PM Room: N229

Awards
Student Travel Stipend Award

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PURPOSE

Importance of volumetric T2 in spinal vascular malformations is less studied. Our objective was to determine the sensitivity and specificity of conventional T2 as well as volumetric T2 imaging findings in the detection of spinal vascular malformations.

METHOD AND MATERIALS

We conducted a retrospective case control study of subjects, who had spinal DSA for suspected vascular malformations, during a 11-year period from Jan 2006 to Dec 2016. Subjects with angiographically proven vascular malformations were taken as cases and remaining as controls. Anonymized images of conventional T2 and volumetric T2 MR sequences were analysed at an interval of 2 weeks. MRI was evaluated for the presence of flow voids, cord hyper-intensity, cord expansion, presence of nidus, based on which the spinal vascular malformations was identified. The sensitivity and specificity of these MRI observations in both conventional T2 and Volumetric T2 was analysed.

RESULTS

Totally 89 subjects were included in the final analysis. There were 70 angiographically proven vascular malformations {38 cases were spinal cord arterio-venous malformations (SCAVM) which includes spinal arteriovenous malformations and peri-medullary AV

fistulas, 32 cases were spinal dural AV fistulas(SDAVF)} and remaining 19 were normal. The sensitivity and specificity of flow voids in the identification of spinal vascular malformations were 98.1% and 90% for volumetric T2 sequences, compared to 83% and 89.4% of conventional MRI. For detecting flow voids in SDAVF, Volumetric T2 had 100% sensitivity while conventional T2 had only 71.8% sensitivity. For SCAVM sensitivity of volumetric T2 (96.4%) was slightly better compared to conventional T2 (92%). There was no significant difference in nidus detection rate between conventional (77%) and volumetric T2 (78.9%).

CONCLUSION

Volumetric imaging is superior to conventional T2 MR sequences in detecting vascular malformations, especially SDAVF. This sequence should be routinely included in the evaluation of suspected spinal vascular malformations.

CLINICAL RELEVANCE/APPLICATION

1. Spinal vascular malformations are a rare entity and failure to detect and treat early can lead to devastating complications. 2. Conventional T2 has significantly very low sensitivity compared to volumetric T2, in detecting spinal vascular malformations, especially for SDAVF. 3. Volumetric T2 MRI should routinely be done in all suspected spinal vascular malformations.

SSE18-06 MRI Features of Aquaporin-4 Immunoglobulin G Antibody Positive Longitudinally Extensive Transverse Myelitis (LETM) in Asians: Suggestive of Neuromyelitis Optica Spectrum Disorders

Monday, Nov. 27 3:50PM - 4:00PM Room: N229

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PURPOSE

To evaluate imaging features of spinal cord MRI for aquaporin-4 immunoglobulin G antibody (AQP4-IgG) positive longitudinally extensive transverse myelitis (LETM), which is highly associated with neuromyelitis optica spectrum disorders (NMOSD).

METHOD AND MATERIALS

This study was approved by the institutional review board. Forty-one patients with LETM from 2004 to 2014 who underwent aquaporin-4 antibody test were included in our study. Cervicomedullary junction extension, cord expansion ratio, bright spotty lesion, number of involved segments, presence of skipped lesion, enhancement pattern, axial distribution pattern was evaluated in spine MRI. Univariate logistic regression analysis was performed to identify factors associated with the presence of AQP4-IgG positive results. Statistically significant factors which was associated with AQP4-IgG positive results were used to build a scoring system. Interrater reliability for the measurement of cord expansion was evaluated using the intraclass correlation coefficient derived from a 2-way mixed effects model. Interrater agreement for the judging the presence of bright spotty lesion was evaluated with kappa values.

RESULTS

Fifteen patients (15/41, 38.9%) were aquaporin-4 antibody positive LETM. The regression analysis showed that gender, cervicomedullary junction extension, cord expansion ratio > 1.4, and bright spotty lesion was significantly associated with positive AQP4-IgG result.The sensitivity of the scoring system was 73.3% and specificity was 96.2%. Interclass correlation value of the cord expansion ratio was 0.78 and Kappa value of bright spotty lesion was 0.61.

CONCLUSION

Cervicomedullary junction extension, higher cord expansion ratio, bright spotty lesion, and female highly suggests AQP4-IgG positive in LETM, which is highly suggestive of NMOSD.

CLINICAL RELEVANCE/APPLICATION

The result of AQP4-IgG which orientates the treatment in LETM, could be predicted with specific spinal MRI findings(cervicomedullary junction extension, higher cord expansion ratio, bright spotty lesion) and gender.

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SSE19

Neuroradiology (CNS Trauma: What is Broken?)

Monday, Nov. 27 3:00PM - 4:00PM Room: N230B

ER NR

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

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSE19-01 Reproducibility of Advanced Neuroimaging Metrics across Sessions, Sites, and Subjects

Monday, Nov. 27 3:00PM - 3:10PM Room: N230B

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PURPOSE

This work reports a portion of a large study of sports related concussion (SRC) and head impact exposure in collegiate athletes and service academy cadets. A subset of subjects have been enrolled in an enhanced protocol, which includes head impact measurement, blood biomarker assessment, and magnetic resonance imaging (MRI). Here we assess the stability of metrics derived from the MRI examination in subjects in non-contact sports. This is foundational to the larger study, establishing a baseline of noise across MRI measurements above which effects must rise to be observed.

METHOD AND MATERIALS

Imaging was performed on the GE Healthcare (one site), and Siemens (three sites). Imaging parameters of normalized T1 weighted, normalized T2 FLAIR weighted, normalized T2* weighted, quantified T2*, mean diffusivity, fractional anisotropy, relative cerebral blood flow, fractional amplitude of low frequency BOLD fluctuations, and regional homogeneity of low frequency BOLD fluctuations. Coefficients of variation for each metric were computed across: repeated sessions for each subject (n=30), traveling human phantoms imaged at each site (n=2), and subjects at each site (n=35).

RESULTS

Coefficients of variation were found to be lowest within subjects over scanning sessions in all contrasts. In all regions of interest, except deep brain gray matter regions of interest in T2* weighted images and cerebrospinal fluid regions of interest in T2 FLAIR and mean diffusivity contrasts, the between-subject coefficient of variation was greater the between-site coefficient of variation. In these regions of interest and contrast combinations, however, the considered signal is expected to be poor.

CONCLUSION

Results of this study illustrate the stability of the larger-scale SRC study. Within-subject repeatability is very good, even over the span of 60 days, which will allow detailed consideration of the time course of SRC (or exposure) and recovery. Between-site stability was greater than subject-to-subject stability. Thus, the inter-site and inter-vendor study design, which enables large-scale recruitment of injured athletes, does not negatively impact the pooling of data across the sites.

CLINICAL RELEVANCE/APPLICATION

This establishes stability expected in multi-center neuroimaging studies with advanced imaging technology. Cross-site variability was less than cross-subject, and intra-subject repeatability was best.

SSE19-02 Computed Tomography (CT) Overuse for Minor Head Injury (MHI) in Young Patients: Analysis of Contributing Factors

Monday, Nov. 27 3:10PM - 3:20PM Room: N230B

Participants
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PURPOSE

To assess the amount of CT scan for MHI performed in young patients in our Emergency Department (ED), that are not indicated by National Institute for Health and Care Excellence (NICE) and Canadian CT Head Rule (CCHR) guidelines and to analyze factors that contribute to unnecessary examinations.

METHOD AND MATERIALS

We retrospectively evaluated head CT examinations performed for MHI in patients aged 18-45 years who presented to our ED from January 1 to June 30 2016. Medical records were assessed for the following parameters: demographics, cause of head trauma, referring physician's seniority and specialty. For each CT scan, it was determined whether the CT referral met the NICE and CCHR criteria and was calculated the effective dose (ED) from the dose-length product.

RESULTS

A total of 492 CT examinations were collected; 260 (52.8%) and 376 (76.4%) examinations were not indicated according to the CCHR and NICE, respectively. There was no statistically significant difference between the specialty and seniority of the referring physician and over-referral (p=.29, p=.87, respectively, for CCHR; p=.24, p=.95, respectively, for NICE) and between patient's age and unwarranted CT studies (p=.81 for CCHR and p=.79 for NICE). Motor vehicle accidents (as a passenger or driver) were associated with a higher rate of non-indicated CT examinations for both CCHR (p=.018) and NICE (p=.02), 2-wheel vehicle driver accidents were associated with a higher rate of appropriate CT exams for both CCHR and NICE (p<.01). Only 15 CT scans were positive (brain hemorrhages, subarachnoid hemorrhage, skull fracture). In our study, CCHR and NICE had sensitivity and NPV of 100% for brain injury. Mean ED for head CT scan was 2.6+/-0.3 mSv. Analyzing our series of patients, we found a correlation between young age of patients (<25 years) and sports injuries (p=.02) and between seizures and CT positive for brain injury (p=0.012).

CONCLUSION

We demonstrate an important overuse of CT examinations for MHI in young patients in our ED, with an excess of 52.2 and 76.4% according to the CCHR and NICE, respectively. The main contributing factor for over referral was injury mechanism.

CLINICAL RELEVANCE/APPLICATION

CT overuse cases unnecessary radiation exposure and health care burden. An analysis of the causes for overuse should be carried out in every ED to target specific intervention, as education of staff members and revision of the management protocols.

SSE19-03 Increased Cerebral Venous Oxygen Saturation in Mild Traumatic Brain Injury Patients Using Quantitative Susceptibility Mapping

Monday, Nov. 27 3:20PM - 3:30PM Room: N230B

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PURPOSE

To explore the relative changes of regional cerebral venous oxygen saturation (SvO2) using quantitative susceptibility mapping (QSM) in mild traumatic brain injury (mTBI) patients and correlation with elapsed time post trauma (ETPT) and post-concussion symptoms.

METHOD AND MATERIALS

32 mTBI patients and 32 age-and gender-matched healthy controls (HCs) were enrolled in this prospective study. The diagnosis of mTBI was made based on the definition of mTBI by the American Congress of Rehabilitation Medicine. No abnormal findings were found in the CT and MRI examination of mTBI patients. QSM reconstructed from original phase data of 3.0T susceptibility weighted imaging was used to measure the susceptibility of major cerebral veins and calculate the relative changes of cerebral SvO2. Spearman's correlation analysis was performed to explore the correlation between ETPT, post-concussion symptoms and the susceptibility of major cerebral veins. The receiver operating characteristic curve (ROC) was performed for the diagnostic efficiency of susceptibility to discriminate mTBI patients from HCs.

RESULTS

The susceptibility of straight sinus in mTBI patients was 255.51±35.25 ppb, which was significantly lower than HCs (310.63±43.05

ppb, P=0.000). The cerebral SvO2 of straight sinus in mTBI patients was increased 5.32%. The susceptibility of straight sinus in mTBI patients correlated with ETPT (r=0.573, P=0.003). The best cut-off susceptibility for the discrimination between mTBI patients and HCs was 272.52 ppb with a sensitivity of 75.00% (95%CI:57-89), specificity 84.37% (95%CI:67-95), and AUC value 0.86 (95%CI:0.75-0.93). The susceptibility of straight sinus did not correlate with the Rivermead post-concussion symptoms questionnaire scores (P>0.05).

CONCLUSION

The decreased susceptibility of straight sinus in mTBI patients indicated the increased cerebral SvO2, which returned back to normal level with ETPT. The susceptibility of straight sinus can be used to discriminate the mTBI patients from HCs.

CLINICAL RELEVANCE/APPLICATION

The susceptibility of straight sinus can be used to discriminate the mTBI patients from healthy controls. The susceptibility can be used to evaluate the condition of mTBI patients relative to ETPT.

SSE19-04 Intra-Default Mode Network Connectivity Changes from a Single Season of Youth Football Distinguish Levels of Head Impact Exposure

Monday, Nov. 27 3:30PM - 3:40PM Room: N230B

Participants
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PURPOSE

This purpose of this study is to determine whether intra-default mode network (DMN) connectivity changes occur from youth (ages 9-13) contact sports using a machine learning-based approach.

METHOD AND MATERIALS

In this IRB-approved study of youth football athletes, each player was instrumented with the HIT system to record head impact acceleration. The seasonal risk of concussion was calculated by converting each impact into a risk of concussion and summing to a value, the player's risk of concussion-weighted cumulative exposure (RWE). Players were dichotomized into highest and lowest 10% exposure groups (13/group). Players experiencing a concussion or with a history of concussion were excluded. 13 non-contact sport controls were used as a third group. A pre and post-season 6 minute rs-fMRI was performed in all players and controls at 3-month scan interval. The fMRI data was preprocessed for motion correction, spatial smoothing and normalization. Resting-state network (RSN) sub-components, including DMN sub-components, were extracted using a higher order (60 component) group independent-components analysis (ICA). 8 DMN sub-components were identified and back-reconstructed to form individual subject's DMN sub-components pre- and post-season. Connectivity was computed using Pearson's correlation between sub-component mean time courses. The post minus pre-season connectivity changes formed our features. Five machine learning classification algorithms were evaluated to predict whether a player was a non-contact, low, or high impact exposure player.

RESULTS

Ten-fold cross validation results demonstrated for a Linear SVM classifier accuracy (82%) discriminating high impact and control groups, moderate accuracy (70%) between control and low exposure players, and roughly chance classification accuracy (60%) between high and low impact. The results suggest an increasing functional change with increasing head impact exposure.

CONCLUSION

Our work suggests that RSN sub-components of can be extracted from rs-fMRI using ICA, analyzed with deep learning, and that the connectivities of the DMN sub-components are altered by repeated sub-concussive head impact exposure.

CLINICAL RELEVANCE/APPLICATION

This work demonstrates that playing a season of contact sports at the youth level, when brains are undergoing maturation, can produce neuroimaging brain changes, particularly for the DMN.

SSE19-05 MEG Measured Default Mode Network is Altered by History of Concussion in High School Football

Monday, Nov. 27 3:40PM - 3:50PM Room: N230B

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PURPOSE

The purpose of this study is to determine if history of previous concussion modulates connectivity changes in the magnetoencephalography (MEG) measured default mode network (DMN).

METHOD AND MATERIALS

Twenty players from a high school football team (mean age=16.9; right handed) were included in this study. Eight minutes of eyes-open, resting-state MEG data were acquired for each subject using a 275 channel CTF whole-head system, pre- and post-season. Structural anatomic MRI was acquired for co-registration with MEG. Using Brainstorm, MEG data were pre-processed and filtered to 1-100Hz. Eye blinks, and muscle artifacts were removed using independent component analysis. MEG data were projected into standard source space using the whitened and depth-weighted linear L2-minimum norm estimates algorithm (wMNE). A mean time series was extracted from eight regions of interest (ROIs) representing the DMN: inferior parietal L&R, medial orbitofrontal L&R, posterior cingulate L&R, superior frontal L&R. The correlation between all ROIs was computed. Each correlation was converted to z-scores, the average DMN correlation was computed, and the difference between pre- and post-season correlation was computed. The subjects were divided into two groups: those with a history of concussion (N=5) and those without a history of concussion (N=15). A two sample t-test was performed to estimate the difference in mean DMN correlation between the two groups.

RESULTS

Subjects with a history of concussion had significantly lower DMN correlations from pre-season to post-season ($p = 0.001$). The subjects with previous concussions had a negative change in correlation whereas subjects without a history of concussion had, on average, a positive change. No significant differences were found in age, BMI, or head impact exposure between the two groups. One data point was excluded based on outlier analysis.

CONCLUSION

Changes in the MEG measured DMN, over a season of football, may be dependent on the subject's history of concussion. fMRI literature has also demonstrated changes in the DMN are dependent on the history of concussion. Our previous work has shown that concussion history can modulate DMN connectivity changes associated with head impact exposure.

CLINICAL RELEVANCE/APPLICATION

MEG has shown promise as a sensitive modality for concussion diagnosis. Prior concussion history should be considered when performing analyses of MEG data involving repeated head impacts.

SSE19-06 Alteration of Brain Structure and Neural Function after Cervical Spinal Cord Injury

Monday, Nov. 27 3:50PM - 4:00PM Room: N230B

Participants
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PURPOSE

To explore the alterations of brain structural and functional after cervical spinal cord injury (CSCI) combined with voxel-based morphometry (VBM) and resting-state functional magnetic resonance imaging (fMRI), and to further study their associations with clinical variables.

METHOD AND MATERIALS

22 patients with traumatic CSCI and 22 age- and sex-matched healthy controls (HCs) were recruited. The CSCI was divided into acute (duration<1month;12 cases) and subacute-chronic (duration >1months;10 cases) group based on the injury duration. The 3D-T1WI and resting-state fMRI of all subjects were obtained using a 3.0 Tesla MRI system. VBM analysis was carried out to investigate the differences in GMV between patients with CSCI and HCs. Region of interest (ROI) based functional connectivity (FC) analysis was performed to study changes in the whole brain using the results of VBM as seed regions. Disease duration and American Spinal Injury Association (ASIA) Scale scores were also obtained from each patient. Associations between structural and functional changes and clinical variables were also analyzed. Using the general linear model in SPM, a voxel-wise two-sample t-test was used to compare the GMV differences between the CSCI group and the HC group, and between subgroups. Partial correlation analysis was performed to explore any potential association between structural and functional changes and clinical variables in patients with CSCI.

RESULTS

Compared with HCs, patients with CSCI showed significant gray matter volume (GMV) decrease in the right anterior insular cortex, right dorsal anterior cingulate cortex (dACC), bilateral orbital frontal cortex (OFC), and left Lingual gyrus(Fig.A). No significant difference in GMV in these areas was found between the acute and subacute-chronic sub-group. Furthermore, SCI patients showed decreased FC in left primary sensorimotor cortex (Fig.B) and this decreased FC negatively correlated with the VAS score (Fig.C).

CONCLUSION

Our study indicate that CSCI can cause dramatically atrophy of GMV in the core hubs of Salience Network and network-level functional alterations in the sensorimotor cortical regions, and the decreased FC within the left primary sensorimotor cortex negatively related to VAS score.

CLINICAL RELEVANCE/APPLICATION

These findings may provide new insights into the structural and functional plasticity of brain after CSCI.

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McCormick Place, Chicago
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SSE20

Pediatrics (Pediatric Oncology and Nuclear Medicine)

Monday, Nov. 27 3:00PM - 4:00PM Room: S102CD

NM PD

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

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Sub-Events

SSE20-01 Ferumoxytol-enhanced MR Imaging of Tumor Associated Macrophages: Clinical Translation

Monday, Nov. 27 3:00PM - 3:10PM Room: S102CD

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PURPOSE

Tumor associated macrophages (TAM) are key components of the tumor microenvironment and play a role in the pathogenesis and progression of many tumors. As new TAM-targeted immunotherapies are entering clinical trials, it becomes important to detect and quantify TAM with non-invasive imaging techniques. The purpose of this study was to determine if ferumoxytol-enhanced MRI can detect TAM in lymphomas and sarcomas of pediatric patients and young adults.

METHOD AND MATERIALS

In a single center, IRB-approved prospective clinical trial, 28 pediatric patients and young adults with lymphoma (n=15) or sarcoma (n=13) underwent MR imaging before, at 1-4 hours and at 20-24 hours after intravenous injection of ferumoxytol. MR sequences included STIR, T1-weighted SPGR, multi-echo T2* FSPGR and R2* IDEAL IQ sequences. Histopathology evaluation was performed by 2 pathologists with prussian blue and immunohistochemistry stains for macrophage markers CD-68 and CD-163. A threefold approach was taken to evaluate the ability of MRI to image TAMs: (1) In a pilot study of 3 patients who underwent pre and post contrast imaging, we confirmed tumor ferumoxytol enhancement. (2) To determine if ferumoxytol-MRI can differentiate tumors with different TAM content, we compared T2* enhancement data of lymphomas and sarcomas. (3) In all patients, we correlated tumor T2* values on post-contrast scans with TAM quantity on histopathology.

RESULTS

Tumor areas that showed hypointense enhancement on both T1- and T2-(or T2*)-weighted sequences were considered positive for TAM on MRI. (1) Significant iron oxide tumor enhancement was noted on post-contrast scans compared to pre-contrast scans ($p = 0.013$). (2) A significant difference in post-contrast T2* relaxation times was noted between lymphomas and sarcomas at 20 hr p.i. ($p=0.0005$) (3) All tumors demonstrated TAM on immunohistochemistry, with a positive correlation between T2* and TAM quantity (Pearson $r = 0.45$, $p < 0.0001$).

CONCLUSION

TAM can be detected in lymphomas and sarcomas of pediatric patients and young adults with ferumoxytol-enhanced MR Imaging.

CLINICAL RELEVANCE/APPLICATION

This non-invasive imaging test may help to study the effect of immune responses on tumor progression and outcomes in pediatric patients and serve as a new biomarker monitoring of new immune-targeted therapies.

SSE20-02 Spectral Ultrasound Parameters Could Predict Development of Sinusoidal Obstructive Syndrome in Pediatric Bone Marrow Transplant Patients

Monday, Nov. 27 3:10PM - 3:20PM Room: S102CD

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PURPOSE

Hepatic sinusoidal obstruction syndrome (SOS) is a potentially fatal complication following bone marrow transplantation (BMT). Imaging diagnosis of SOS is difficult because the only reported reliable indicator occurs very late in the clinical disease (reversal of portal venous flow). Our study objective was to identify other differences in spectral Doppler ultrasound parameters between BMT patients who developed SOS and those who did not.

METHOD AND MATERIALS

A single center cohort retrospective study was conducted on patients ages 0-21 years who underwent a BMT between September 2001 and May 2016. Patients were excluded if they did not have abdominal ultrasounds following BMT. Clinical information about the conditioning regimen and reasons for transplant, as well as spectral Doppler liver ultrasound findings were evaluated. The independent associations of Doppler ultrasound variables were assessed using hierarchical multivariable linear regression models which accounted for repeated measures and adjusted for number of relapses, regimen and disease type. ROC analysis was performed for main portal vein (MPV) peak velocity.

RESULTS

A total of 280 patients received a BMT and 161 were excluded due to lack of ultrasounds yielding 119 total subjects included in our cohort. 22 (18%) of the patients developed SOS. Several spectral Doppler ultrasound variables were statistically different between patients with SOS and those without. These variables included: end-diastolic and peak-systolic velocities of the main hepatic artery and the MPV peak velocity. Peak MPV velocity of 12.6 cm/s has 51% sensitivity and 88% specificity for SOS. Area under the ROC curve was 0.75. Branch hepatic artery velocities were also statistically different.

CONCLUSION

Spectral Doppler ultrasound variables such as MPV velocity are statistically different between SOS and non-SOS cohorts even after adjusting for clinical confounders.

CLINICAL RELEVANCE/APPLICATION

Spectral Doppler could be useful in risk stratifying pediatric BMT patients for development of SOS. MPV velocity could potentially identify these patients earlier than our current imaging parameters.

SSE20-03 Effect of Image-Defined Risk Factors for Surgical Treatment of Localized Neuroblastoma in Children: A Single Center Retrospective Study

Monday, Nov. 27 3:20PM - 3:30PM Room: S102CD

Participants
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PURPOSE

The purpose of this study was to present the effect of image-defined risk factors (IDRF) according to the INRG (International Neuroblastoma Risk Group) Staging System for surgical resectability and complication in localized neuroblastoma.

METHOD AND MATERIALS

Forty-two patients (20 males and 22 females, median age, 44.5 months) were retrospectively reviewed, who were diagnosed localized neuroblastoma between January, 2007 and December, 2010. These 42 patients underwent CT and/or MRI before surgical intervention or any other treatment. MSCT was performed on a 16-row CT scanner (Lightspeed 16, General Electric Medical Systems) and MRI on a 1.5 Tesla scanner (Signa; General Electric Medical Systems, Seattle, Wash.). We evaluated all 42 patients' initial imaging to identify IDRFs according to the INRG Staging System, and collected data including primary tumor site, INSS (International Neuroblastoma Staging System), initial surgical intervention, surgical complications and outcomes.

RESULTS

Forty-two neuroblastomas (abdomen 22, pelvis 3, mediastinum 10, neck 7) were evaluated. Total resection was underwent in 10 cases (24%), partial or subtotal resection in 7 cases (17%), and biopsy in 25 cases (59%). Fourteen percent (6/42) of the patients were presented no IDRFs (Stage L1). Total resection was performed in all six cases (Stage L1). Eighty-six percent (36/42) of the patients were presented one or more IDRF (Stage L2). A total of 104 IDRFs in 36 cases were demonstrated in the CT or MRI. In these 36 cases (Stage L2), only 11% (4/36) of cases had total resection. There was a significant, negative correlation between the number of IDRFs and the possibility of total resection of neuroblastoma ($p < 0.05$). Three surgical renal complications (renal atrophy, renal artery injury and nephrectomy respectively) were detected in three patients, all of whom demonstrated encasement

of the renal artery or infiltration of kidney.

CONCLUSION

In localized neuroblastoma, IDRFs are useful for determining the potential surgical risks and surgical outcome, and the assessment of IDRFs should become an integral part of therapy planning.

CLINICAL RELEVANCE/APPLICATION

Image-defined risk factors (IDRFs) according to the INRG Staging System are useful for surgical treatment of localized neuroblastoma in children.

SSE20-04 Radioactive Iodine Uptake in the Breast Tissue Nulliparous Young Women

Monday, Nov. 27 3:30PM - 3:40PM Room: S102CD

Participants
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PURPOSE

Radioactive iodine uptake in the breast tissue of lactating women is well described and may lead to the false positive diagnosis of lung metastasis. In contrast, the frequency of breast uptake among nulliparous women has not been described. We performed this study to test the hypothesis that breast activity is present in the majority of young, nulliparous female patients undergoing whole body scintigraphy with radioactive iodine.

METHOD AND MATERIALS

All female patients with known primary thyroid cancer who underwent whole-body I-123 scintigraphy from 9/25/2014 through 3/22/2017 were eligible for inclusion. Parous patients and patients whose exams did not include lateral planar images were excluded. Four pediatric radiologists (10, 8, 7, and 5 years post-fellowship experience) with additional subspecialty training in nuclear radiology evaluated I-123 whole body scintigraphy exams for the presence of breast activity on a 5-point Likert scale (1=highly unlikely; 5=highly likely). Four findings on planar images were evaluated independently by each of the readers: activity 1) present on the frontal images, 2) limited to the lower thorax on frontal images, 3) present on lateral images, and 4) present given all projections. Mean Likert values were calculated for each finding. Reader agreement on the Likert scale was measured by modified Fleiss's Kappa with weight and 95% CIs were calculated by Monte Carlo simulation.

RESULTS

During the study period 27 patients met inclusion criteria (mean age=15.9+/-2.3 years), - no patients were excluded. Mean Likert scores and agreement were: present on frontal images= 3.9 +/- 1.2, κ=0.74 (0.61-0.83); limited to the lower thorax on frontal images= 4.0 +/- 1.2, κ=0.77 (0.63 - 0.88); present on lateral images= 4.2 +/- 1.2, κ=0.85 (0.71 - 0.93); and present given all projections= 4.2 +/- 1.3, κ=0.85 (0.71 - 0.94).

CONCLUSION

Breast activity is present in the majority of nulliparous young women. Knowledge of this high frequency should minimize interpretations false positive for lung metastasis. We recommend routine lateral images of patients undergoing radioactive iodine scintigraphy for evaluation of thyroid cancer to confirm activity is located to the breast and not intrathoracic.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the high frequency of normal breast activity among young women undergoing I-123 scintigraphy should minimize interpretations false positive for lung metastasis.

SSE20-05 Differentiating High Uptake Normal Tissues From Tumor Using Pet Derived Radiomics Features

Monday, Nov. 27 3:40PM - 3:50PM Room: S102CD

Participants
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PURPOSE

Identification of FDG avid cancerous lesions can be obscured by high uptake normal tissues. In this study, we introduce a PET radiomics based tissue classifier for differentiating FDG avid normal tissues from tumor.

METHOD AND MATERIALS

Attenuation corrected PET intensities were converted to SUV for thresholding and segmented using a watershed algorithm. Gaussian filtering was used to suppress over segmentation of normal structures. Neighboring segments were combined using distance and SUV based criteria. A training set including 33 PET scans from 15 patients were used to segment 148 FDG avid regions. Ground truth classification was assigned to each volume as one of four classes, brain, bladder, heart, or others. Image and

shape based features were extracted from the training set to construct a support vector machine (SVM) prediction model. Classification performance was evaluated with additional 58 PET scans from 21 patients using the same image processing and feature analysis scheme. 215 FDG avid regions were labeled using the classifier.

RESULTS

The classifier correctly differentiated normal tissue from disease in 199 automatically segmented FDG-avid regions with 92% accuracy. The brain, heart and bladder were misclassified in 9, 4, and 3 cases, respectively. Heart misclassification was due to inconsistent uptake in the training set as 17 and 8 scans had absent or partial heart uptake. Brain misclassification was due to variation in volume given the difference in age range in the training and validation dataset (mean 5 vs. 13 years, p <= 0.001). Misclassified brain volumes were 694, 1036, 882, 992 mL (mean 1556, Z score 2.1, 1.3, 1.7, 1.6). Bladder misclassification was due to differences in intensity characteristics and bladder volume. One with large volume of 657 mL (mean 251.4, Z score 2.1), one with small surface area of 5.7 cm2 (mean 21, Z score 1.3), and one with a skewness of 5.3 (mean 2.3, Z score 1.7).

CONCLUSION

In this study, we demonstrated accurate automatic classification of high uptake normal tissues from PET studies using radiomics based SVM. Future improvements combining CT and PET radiomics features may improve segmentation and classification of FDG-avid regions and the assessment of disease burden and therapeutic response.

CLINICAL RELEVANCE/APPLICATION

Successful automatic classification facilitates radiomics analysis of FDG avid tissues potentially aids the assessment of total disease burden and response.

SSE20-06 Prognostic Value of FDG PET Metabolic Tumor Burden Parameters in High-Risk Pediatric Hodgkin Lymphoma (COG Trial AHOD0831)

Monday, Nov. 27 3:50PM - 4:00PM Room: S102CD

Participants
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PURPOSE

Bulk disease at staging is a known unfavorable risk factor in Hodgkin's lymphoma (HL). We compared the prognostic value of current anatomic mediastinal tumor bulk measurements with mediastinal and total metabolic tumor burden obtained from FDG PET/CT in high risk pediatric HL.

METHOD AND MATERIALS

Data were acquired from the COG AHOD0831 high-risk pediatric HL phase III trial in 94 of 164 patients with good-quality CXR, CT and FDG PET/CT obtained prior to therapy. Mediastinal bulk was defined as: mediastinal mass ratio (MMR) >0.33 on CXR, mediastinal mass diameters (MMD) >=10cm on CT, and mediastinal mass volume (MMV) >=200 ml on CT measured using the three largest perpendicular diameters. PET based parameters included SUVmax, SUVpeak, metabolic tumor volume (MTV), and total lesion glycolysis incorporating both MTV and FDG uptake (TLG). MTV and TLG were derived using absolute SUV 2.5 (SUV2.5) and 40% maximum tumor SUV (SUVmax40%) thresholds from mediastinal mass (mMTV and mTLG) and all FDG avid lymphadenopathy (tMTV and tTLG). An optimized cutoff value for PET parameters used a Youden index on receiver-operating characteristic (ROC) curve to determine high and low-risk groups. Kaplan-Meier survival analysis for event-free survival (EFS) was performed.

RESULTS

Standard anatomic mediastinal bulk disease defined as MMR and MMV was associated with lower EFS (p=0.034 for MMR and p=0.015 for MMV) with no difference with MMD. Mediastinal tumor PET parameters were not predictive of EFS. However, increased total metabolic tumor burden using TLG was associated with lower EFS (p=0.034 for tTLG2.5 and p=0.044 for tTLG40%, (Figure 1)) but other parameters were not predictive of survival. Increased total metabolic tumor burden was significantly associated with interim PET positivity (p=0.010 for tMTV2.5, p=0.0005 for tMTV40% and p=0.003 for tTLG40%).

CONCLUSION

In high-risk pediatric HL patients, baseline PET-based total metabolic tumor burden parameter, tTLG, was found to be predictive of survival. Both total metabolic tumor volume and level of glycolytic tumor activity may be needed to predict treatment outcome, which requires further validation in a larger cohort of patients.

CLINICAL RELEVANCE/APPLICATION

None.

SSE21

Physics (CT: Cone Beam)

Monday, Nov. 27 3:00PM - 4:00PM Room: S403A

CT PH

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

Participants
Jeffrey H. Siewerdsen, PhD, Baltimore, MD (*Moderator*) Research Grant, Siemens AG; Research Grant, Carestream Health, Inc; Advisory Board, Siemens AG; Advisory Board, Carestream Health, Inc; License agreement, Carestream Health,Inc; License agreement, Precision X-Ray, Inc; License agreement, Elekta AB; ; ;
Srinivasan Vedantham, PhD, Tucson, AZ (*Moderator*) Research collaboration, Koning Corporation

Sub-Events

SSE21-01 Three-dimensional Digital Subtraction Angiography (3D-DSA) from a Single C-arm Acquisition Using a Convolutional Neural Networks-Based Deep-Learning Method

Monday, Nov. 27 3:00PM - 3:10PM Room: S403A

Participants
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Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company Research funded, Siemens AG

PURPOSE

The purpose of this work was to develop a deep-learning method, based on convolutional neural networks (CNN), to generate 3D-DSA angiograms from a single contrast-enhanced exam without mask acquisition.

METHOD AND MATERIALS

Clinical image volumes of 30 patients scanned with a C-arm cone-bean CT system (Axiom Artis zee; Siemens Medical Solutions) using a standard 3D-DSA imaging protocol for the assessment of cerebrovascular abnormalities were retrospectively collected. Images from 22 subjects were used to extract labeled image patches that were used as training data set. A 30-layer CNN was trained to classify three tissue types (vasculature, bone and soft tissue). The trained CNN deep-learning model was then applied for the task of tissue classification in a test cohort consisting of the remaining image volumes from 8 subjects. The final vasculature tissue class was used to generate the 3D-DSA images. To quantify the generalization error of the trained model, tissue classification accuracy was measured in 8 million image patches from clinically relevant anatomy in the test data set. Finally, the generated 3D-DSA images were subject to a quantitative assessments of contrast enhancement in the internal carotid artery (ICA), middle cerebral artery (MCA), anterior cerebral artery (ACA) and the distal branches of the MCA and ACA. A qualitative assessment for the presence of inter-sweep motion artifacts was also performed.

RESULTS

Tissue classification accuracy in the testing dataset was 98.7% and 98.1% on a per-voxel and per-patient basis respectively. The average relative increase in vessel contrast enhancement compared to the vendor's DSA was 18.7%, 21.7%, 20.5% for the ICA, MCA, ACA respectively. Nearly a 2-fold increase in vessel opacification was observed for the distal branches of the MCA and ACA. No residual signal from osseous structures was observed for all cases generated using the proposed method.

CONCLUSION

A deep learning based method was developed to generate 3D-DSA images without mask data acquisition. The proposed method successfully eliminates mis-registration artifacts induced by inter-sweep patient motion, improves image quality and potentially reduces radiation dose in clinical 3D-DSA imaging.

CLINICAL RELEVANCE/APPLICATION

Mask-free 3D-DSA imaging using a deep-learning based method may allow radiation dose reduction by omitting a mask scan and eliminate mis-registration artifacts induced by inter-sweep patient motion.

SSE21-02 Time-Resolved CBCT Angiography (TR-CBCTA) Imaging from a Single-Sweep C-Arm CBCT Acquisition

Monday, Nov. 27 3:10PM - 3:20PM Room: S403A

Participants
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PURPOSE

Generating time-resolved cone-beam CT (CBCT) angiography (TR-CBCTA) images from multi-sweep CBCT acquisition has previously been demonstrated. To reduce dose, motion artifacts, and data acquisition time, in this work, a new technique was developed to generate high-quality TR-CBCTA images from a single-sweep CBCT data acquisition.

METHOD AND MATERIALS

A newly developed image reconstruction technique, Synchronized Multi-Artifact Reduction with Tomographic Reconstruction (SMART-RECON), enables several sub-image frames to be generated from a single 200-degree contrast enhanced scan. Each sub-image frame corresponds to a short segment of the projection data, but using SMART-RECON is reconstructed without limited-view artifacts. The first virtual non-contrast enhanced sub-image frame is subtracted from other sub-image frames, generating the desired TR-CBCTA images without requiring a separate mask scan. The proposed method was applied retrospectively to intra-arterial (IA-DSA) datasets of 15 human subjects with various neurovascular pathologies such as aneurysms, large vessel occlusion, or arteriovenous malformation.

RESULTS

Single-sweep TR-CBCTA images of the 15 human subjects were successfully generated. These images demonstrated time- resolved information of the cerebrovascular contrast dynamics. In addition, they demonstrated potentially improved image quality compared with the clinical standard multi-sweep images, as they were less prone to artifacts arising from inter-sweep involuntary patient motions and misregistration. The noise standard deviations measured in the SMART-RECON enabled TR-CBCTA images are 11±2 HU, compared with 31±5 HU of clinical 3D-DSA images. The CNR values of SMART-RECON enabled TR-CBCTA images, and clinical 3D-DSA images are 18±10 and 8±3, respectively. The subjective conspicuity of neurovascular abnormalities such as aneurysms and stenoses was improved in the SMART-RECON enabled TR-CBCTA images.

CONCLUSION

High-quality TR-CBCTA imaging can be achieved using a single C-arm CBCT data acquisition to reduce overall image acquisition time, reduce artifacts associated with inadvertent patient motion, and reduce radiation dose.

CLINICAL RELEVANCE/APPLICATION

TR-CBCTA from a single CBCT scan enables clinicians to extract precious time-resolved information of vasculature from a single CBCT acquisition to reduce dose and reduce motion artifacts.

SSE21-03 Importance of Prior Information for Accurate Scatter Correction of Truncated Cone-Beam CT (CBCT) Data

Monday, Nov. 27 3:20PM - 3:30PM Room: S403A

Participants
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PURPOSE

To compare different methods of detruncation with respect to scatter correction and to provide a quantitative scatter correction approach for truncated CBCT data.

METHOD AND MATERIALS

In CBCT scatter correction is of high importance to obtain artifact-free and quantitative CT images. While scatter correction itself is difficult it becomes even more challenging when the data are longitudinally and laterally truncated due to limited detector sizes, as it is often the case in C-arm CT or in dental CT, for example. Several scatter correction methods and several detruncation methods are known and need to be combined. It is unclear to what accuracy the extrapolation needs to be done in order to get accurate CT images. We therefore combined our Monte Carlo-based scatter correction with several detruncation approaches: no (N), constant (C), cosine roll-off (R), adaptive (A) [EurRadiol 15:1008-1014, 2005], and prior-based (P) detruncation [MedPhys 41(2):021906, 2014]. The latter uses anatomical data of a different patient for data-completion. To validate our approach we corrected measured dental CBCT data of a head phantom and patients (truncated to 11 cm diameter due to small detector size), CBCT patient data of a pelvis scan (manually truncated) and C-arm CT phantom measurement of the QRM liver phantom (truncated to 24 cm diameter).

RESULTS

Images corrected by the simple detruncation algorithms suffer from an overestimated scatter, the reason being the overestimation of the detected intensities, making a patient specific empirical correction factor necessary. For the dental CBCT patient case the CT-values for soft tissue/dentin were corrected from -140/1094 HU (FDK reconstruction) to -30/1879 HU (N), -30/1905 HU (C), -10/1976 HU (R), -23/1975 HU (A) and 69/2375 HU (P). In all cases (P) leads to the most accurate CT-values while not requiring the empirical factor.

CONCLUSION

Prior-based detruncation leads to a proper and robust scatter estimation which is mainly important for scatter correction.

CLINICAL RELEVANCE/APPLICATION

Quantitative CT images from truncated CBCT scans are possible. However, scatter correction must be combined with strong prior information incorporating anatomical data from a similar patient.

SSE21-04 Compensating for Irregular Respiratory Motion in Cone-Beam CT (CBCT): Motion Vector Field Resampling

Monday, Nov. 27 3:30PM - 3:40PM Room: S403A

Participants
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PURPOSE

To minimize motion blurring in 4D respiratory motion-compensated CBCT in case of irregular breathing patterns.

METHOD AND MATERIALS

CBCT images often suffer from respiratory motion. Gated reconstruction minimizes the motion artifacts but introduces significant sparse view artifacts. Motion-compensated (MoCo) image reconstruction has the potential to minimize both, motion artifacts and sparse view artifacts while simultaneously making use of 100% of the rawdata [MedPhys 40(10): 101913, 2013]. Irregular breathing, however, still is problematic. In general we have to distinguish between phase and amplitude gating for 4D image reconstruction. Depending on the breathing pattern less motion blurring emerges in amplitude-gated images than in phase-gated reconstructions. However motion estimation based on amplitude-gated images is not always realizable especially for non-cyclic breathing pattern or when strong variation of the breathing amplitude occurs during the image acquisition. This is also, because the procedure of amplitude gating is not well defined. We propose a hybrid MoCo approach that starts with a robust phase gating procedure for the initial motion vector field (MVF) estimation and switches later to an adapted amplitude gating method. This switching implies a resampling of the MVF to make them become amplitude-specific. Our MVF resampling method ensures that the MVFs, that have been estimated based on phase-gated reconstructions, are still valid for all amplitude-gated images. To validate the method we use an artificially deformed clinical CT scan with adaptive breathing pattern and several patient data sets acquired with a TrueBeam™ 4D CBCT system (Varian Medical Systems).

RESULTS

The MVF resampling-based hybrid 4D CBCT MoCo algorithm is able to significantly reduce motion blurring. This is visible in phantom and patient data especially for irregular breathing patterns. Our sharpness metric, measuring the slope of profiles normal to anatomical borders, improved by up to 8%, depending on breathing pattern, acquisition parameter and anatomical feature.

CONCLUSION

Resampling MVFs from phase- to amplitude-gating helps to improve the image quality of MoCo reconstructions in particular for rather irregular breathing patterns. Thus, the new method increases the robustness of motion estimation with CBCT.

CLINICAL RELEVANCE/APPLICATION

Improved motion estimation from CBCT images potentially allows for more accurate tumor tracking.

SSE21-05 Effect of Flat and Curved System Geometry on X-Ray Scatter Distribution and Selection of Antiscatter Grids

Monday, Nov. 27 3:40PM - 3:50PM Room: S403A

Participants
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PURPOSE

System geometries for cone-beam CT (CBCT) vary broadly according to clinical requirements, with strong implications for the magnitude of x-ray scatter and selection of antiscatter grid. This work analyzes such effects for a range of geometries, including curved configurations of the detector and grid that support increasingly compact system design.

METHOD AND MATERIALS

Scatter was estimated using a Monte Carlo (MC) engine with system geometry ranging from long (SDD = 1000 mm) to compact (SDD = 500 mm) for a broad range of grid / detector curvatures. We considered a 41 x 33 cm2 detector with 0.6 mm CsI scintillator and focused antiscatter grids with grid ratio ranging from 6:1 to 10:1 (all 1.25 lp/mm). Scatter distributions (3.6x1011 photons over

360 projections) were computed using a voxelized anthropomorphic head (0.5 mm voxels) containing a skull and heterogeneous brain with soft-tissue contrast up to 60 HU. Scatter estimates were denoised with a 6x6 mm2 Gaussian kernel. Primary fluence was computed with a polychromatic Siddon projector. Poisson noise was added to the total signal with dose fixed at 25 mGy at isocenter. CT volumes were reconstructed using a PWLS approach with a Huber penalty.

RESULTS

For longer system geometries, differences in scatter among curvatures were negligible. For the most compact geometry, the average magnitude of scatter increased up to 23% for the strongest curvature compared to a flat configuration. Interestingly, the increased scatter at the periphery of the field of view resulted in a more uniform SPR distribution and reduced cupping (80 HU cupping vs 115 HU for flat configurations). Antiscatter grids performed similarly for all scenarios up to GR = 8:1, beyond which gains were minimal. Using an 8:1 grid improved soft-tissue CNR from 0.85 to 1.56 for the long flat geometry and from 0.59 to 1.25 for the compact curved geometry.

CONCLUSION

MC provides guidance to selection of geometry, detector curvature, and antiscatter grid for increasingly compact CBCT configurations. Compact designs exhibited larger scatter magnitude but showed comparable performance using a knowledgeable chosen antiscatter grid.

CLINICAL RELEVANCE/APPLICATION

Understanding the effects of x-ray scatter in novel compact CBCT systems improves system design and guides the development of systems with improved image quality.

SSE21-06 Comparison of a Novel Two-Dimensional Antiscatter Grid Prototype with a Conventional Antiscatter Grid in CBCT

Monday, Nov. 27 3:50PM - 4:00PM Room: S403A

Participants
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CONCLUSION

2DASG can provide improved soft tissue visualization with respect to existing CBCT systems that employ conventional 1DASGs. With improved CT number accuracy provided by 2DASG, quantitative imaging applications may be enabled in CBCT based imaging modalities.

Background

A novel 2D antiscatter (2DASG) grid prototype was developed for flat panel detector (FPD) cone beam computed tomography (CBCT) systems, which aims to improve both quantitative accuracy and soft tissue visualization. A 2DASG prototype was fabricated by using scalable powder bed laser melting additive manufacturing process, and employed in Varian TrueBeam CBCT system. Gantry angle specific flat-field correction and a novel total variation minimization method were implemented to remove 2DASG's septal shadows. CBCT images were reconstructed using a modified FDK algorithm. A Catphan phantom and an annuli mimicking abdomen/pelvis anatomy was employed in imaging experiments. CT number accuracy and contrast to noise ratio (CNR) were assessed. Using the same imaging setup, a conventional ASG (1DASG) with 1D lead lamellae, fiber spacers and a grid ratio of 10 was evaluated, and compared to the 2DASG prototype.

Evaluation

Hounsfield Unit (HU) accuracy was measured across multiple ROIs located in the uniform sections of the Catphan phantom. With 1DASG HU values were underestimated by 300±43 HU. With 2DASG, HU underestimation was reduced down to 43±15 HU. With 1DASG, CNR in 3 inserts were 2.0, 2.892, and 14.2, respectively. With 2DASG, CNR was further increased to 3.2, 3.3, and 18 at the same material inserts.

Discussion

2DASG prototype showed significant improvements in CT number accuracy, and contrast resolution when compared to 1DASG and NOASG. Shading artifacts commonly observed in CBCT images were diminished with 2DASG. Additionally, gantry angle specific flat field correction and our novel total variation minimization approach successfully reduced 2DASG's footprint in projections and artifacts in CBCT images.

SSE22

Physics (Radiation Therapy and Cancer Imaging)

Monday, Nov. 27 3:00PM - 4:00PM Room: S403B

OI PH RO

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

FDA Discussions may include off-label uses.

Participants
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Rebecca M. Howell, PhD, Houston, TX (*Moderator*) Nothing to Disclose
Shiva K. Das, PhD, Chapel Hill, NC (*Moderator*) Nothing to Disclose

Sub-Events

SSE22-01 Prediction of Clinical Target Volume for Nasopharyngeal Carcinoma Using Hidden Markov Model Trained from 2000 Patient Dataset

Monday, Nov. 27 3:00PM - 3:10PM Room: S403B

Participants
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PURPOSE

Radiotherapy is one of the efficient routine treatment for nasopharyngeal carcinoma (NPC). Clinical target volume (CTV) of NPC, which not only contains gross tumor volumes (GTV) can be seen on scan images like CT or MRI, but also contains underlying irregular tumor region due to tumor invasion. Accurate delineation of CTV takes an essential role on assisting doctors to determinate the radiation dose and the range of exposure. It is noteworthy to point out that the delineation of CTV is time-consuming with about 4-6 hours/case, just for an initial treatment plan. Therefore, in order to develop an automatic delineation method for CTV, we design a new CTV prediction model for NPC, which can predict the tumor expansion and accurately compute tumor invasion probability.

METHOD AND MATERIALS

Our model includes two parts: Hidden Markov Model (HMM) and rule-based learning. HMM is employed in simulating three-dimensional tumor expansion. By computing transition probability between adjacent voxels from GTV iteratively, probability map is generated. Associate rules learned from large-set clinical data, which is able to discover interesting relations in dataset, is used to quantify the spread trend among tiny tissues. We collected 2000 patient's NPC patient data with IRB approval, which are used for training dataset. Each patient data contains a series of GTV contours that are manually annotated by experienced doctors. All GTV contours have been uniformly registered on CT templates. For model evaluation, 50 NPC patients was independently collect. Dice similarity coefficient (DSC) was used to compare computerized model with the reference standard.

RESULTS

In current clinical practice, the assessment time of CTV is between 4-6 hours. Our automated tool took less than 5 minutes to assess the CTV. We compute 50 patients' CTV1 and CTV2 for evaluation, which represent 10% and 5% invasion probability respectively. The average DSC between two radiologists was 0.81 while the average DSC of radiologists and computer was 0.80.

CONCLUSION

This model is applied successfully for the prediction of NPC CTV and can be easily used for other types of tumor. Our automated tool greatly reduces the total time by 48-72 times compared to clinical doctors.

CLINICAL RELEVANCE/APPLICATION

Our NPC CTV prediction model is very useful in radiotherapy treatment, not only reduces the workload of radiotherapists but also provides a more objective way for CTV prediction.

SSE22-02 Considerations and Experience in Lung Treatment with SBRT+DIBH in Arms-down Position

Monday, Nov. 27 3:10PM - 3:20PM Room: S403B

Participants
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ABSTRACT

Purpose/Objective(s): Many elderly and frail patients are unable to tolerate the arms-up position for extended periods. This creates a significant challenge for certain types of radiation treatment, such as lung SBRT. Although the arms-up position provides maximal freedom for optimal beam placement and avoids dose to arms, frequent involuntary arm movement can cause significant target displacement and adversely impact dosimetry. This phenomenon is further amplified for lung SBRT+DIBH treatment. The combined modality paradigm prolongs treatment time dramatically when delivered on a machine without FFF beams. From the perspective of treatment accuracy, patient comfort level and stability are crucial for the precision of any immobilization device and on-board imaging system. In this study, we investigated a technique to treat lung patients with SBRT+DIBH in the arms-down position. Our objective was to determine whether the arms-down position could produce a plan dosimetrically comparable to that for the arms-up position. Materials/Methods: A 92-year-old patient was diagnosed with lung cancer of the right lower lobe. The patient was simulated supine on a reversed wide prostate board with arms by sides and palms up under buttocks. Both arms were positioned tightly against the body for stability and reproducibility. A custom Aquaplast body mask was fabricated with an opening cut around the xyphoid process of the sternum for placement of an RPM gating block. A free-breathing CT scan was acquired first for patient marking, followed by a DIBH scan for treatment planning. The patient was treated with SBRT+DIBH protocol with a prescription dose of 1200 cGyx4. A VMAT plan was computed using 6X photon beams. To achieve acceptable PTV conformity and coverage, the plan used six partial arcs. To improve patient comfort during treatment, all six arcs were short and low in MU so that each arc could be delivered in two DIBH sessions. Results: We found that with a well-designed optimization strategy and a proper arc arrangement, the arms-down plan was dosimetrically comparable to the arms-up plan in terms of PTV coverage and OAR sparing. For this case, the right arm was only 3.4 cm away from the PTV. To create a sharp dose gradient, it was contoured and constrained during optimization, achieving PTV D95 = 100% without out-of-PTV hot spots. The maximum dose to the right arm was 1673.6 cGy, with a mean dose of 93.2 cGy. Other dosimetric parameters also met our institutional tolerances. By using multiple short arcs, the MU of each arc was significantly reduced, thus, favorable for DIBH treatment. The MUs were 527, 531, 434, 468, 406, and 409, respectively.Conclusion: Under special circumstances, the arms-down position is a safe and effective way to treat lung cancer patients. The central issue using this approach is determining how to securely confine the arms to minimize TMR perturbation. VMAT is relatively insensitive to small variations in arm position. The arc smearing effect will compensate for uncertain TMR.

SSE22-03 RTOG3507: A Multi-Institutional Planning Comparison Study to Determine the Feasibility of a Randomized Study of Pembrolizumab Plus Stereotactic Re-Irradiation versus SBRT Alone for Locoregionally Recurrent or Second Primary Head and Neck Cancer

Monday, Nov. 27 3:20PM - 3:30PM Room: S403B

Participants
Saiful Huq, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Si Young Jang, PHD, PITTSBURGH, PA (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): RTOG foundation will soon open a randomized phase II study to evaluate the safety of the addition of Pembrolizumab to re-irradiation with SBRT for patients with recurrent or new second primary head and neck carcinoma (CA). This is the first multi-institutional study that involves SBRT of head and neck cancer. Treatment planning requirements for this study are very stringent. Therefore, it is important to determine the feasibility of performing such a study in a multi-institutional clinical trial setting. The goal of this study was to evaluate whether cancer centers around the country can generate protocol compliant treatment plans for challenging locoregionally recurrent or second primary head and neck carcinoma test cases. Materials/Methods: Five challenging test cases were circulated among five institutions and each of the institutions was asked to generate treatment plans according to protocol guidelines. The cases investigated were all recurrent tumors including: 1) A squamous cell CA of the oral tongue located very close to the skin, 2) A squamous cell CA of the right base of tongue located at lower neck 3) A recurrent tumor of the oropharynx close to mandible, 4) A recurrent tumor of left neck located near spinal cord, and 5) A recurrent tumor located in right maxillary sinus. PTV volumes ranged between 27cc and 95cc. Static IMRT or VMAT techniques with a calculation grid size of = 2mm were used for dose calculation. The RX dose was 40Gy in five fractions. Treatment plans were normalized to the maximum dose of the plan in which 100% of the isodose line corresponded to. The prescription isodose line encompassed at least 99% of the GTV and 95% of the PTV and ranged between 80% and 90%.Results: The protocol provided specific guidelines for compliance for GTV_4000, PTV_4000, and various organs at risk such as spinal cord, brain stem, optic nerve/chiasm, brachial plexus, carotid artery, esophagus, skin, and dose spillage. The GTV and PTV coverages were found to be over 99% and 95% respectively for all institutions, and doses for various organs at risk were mostly within the protocol specifications: mean values of maximum cord, cord+5mm, and brain stem doses were 7.0Gy, 9.3Gy, and 4.1Gy, respectively; mean values of conformity index, R50%, and D2cm for all multi-institution plans were 1.1, 4.0, and 26.1Gy, respectively; however, some institutions could not meet protocol guidelines for skin dose for the case abutting with the skin and for carotid dose for the case located inside the target (skin: =30Gy, carotid artery: =42Gy). Conclusion: This multi-institutional study shows that it is feasible for centers around the country to meet protocol requirements when generating SBRT treatment plans for challenging recurrent and second primary head and neck carcinoma.

SSE22-04 Dosimetric Uncertainty of Homogeneous Dose Calculation in Lung SBRT Patients with Low Lung Density

Monday, Nov. 27 3:30PM - 3:40PM Room: S403B

Participants
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ABSTRACT

Purpose/Objective(s): For patients with low lung density, the lack of equilibrium and insufficient dose build-up may cause significant deviation from planned dose distributions if heterogeneous tissue is assumed to have water density. It is hypothesized that significant dosimetric variations may happen in peripheral lung SBRT cases using the RTOG protocols of 60 Gy in 3 fractions with homogenous dose calculation compared to a recalculated plan with heterogeneity corrections for patients with low lung density.Materials/Methods: The patient selection process narrowed down a group of 120 patients previously treated to 60 Gy in 3 fractions to patients with the twelve lowest (below -813 HU) and the twelve highest (above -657) lung density. For each patient, a 5 mm expanded internal target volume (ITV) represented the planning target volume (PTV). Additional ring structures were created by expanding the PTV (PTV ring) and ITV (ITV ring) by 1 cm to analyze the surrounding tissue density and Hounsfield Unit (HU) values. VMAT plans consisting of two coplanar half arcs were made for each patient without heterogeneity corrections. The clinically acceptable, optimized plan met several organs at risk (OAR) dose limits and the following planning goals: PTV V60Gy = 95%, PTV V54Gy = 100%, ITV V60Gy = 100%. Finally, the monitor units were held constant and the plan was recalculated with the original heterogeneous tissue densities from the image set using collapsed cone convolution algorithm. Results: Low Density High Density Mean HU Mean density (g/cm3) Mean HU Mean density (g/cm3) Lung -838 ± 21 0.20 ± 0.03 -613 ± 27 0.45 ± 0.03 RingPTV -774 ±107 0.26 ± 0.11 -478 ± 53 0.57 ± 0.05 RingITV -789 ± 93 0.25 ± 0.09 -562 ± 51 0.49 ± 0.04 Table 1. The mean Hounsfield Units (HU) for the 120 patient pool was -728 ± 69 HU (range: -875 – 557 HU). Results of this study showed that planning goals were not met for patients with low lung densities when dose calculation was completed using heterogeneous tissue densities. The PTV V60Gy goal of 95% dropped significantly to a mean of 76.9% ± 17.2% for patients with low lung density (range: 43.3% - 96.2%) while the patient group with high lung density met planning goals with a mean of 96.1% ± 3.0% (range: 88.5% - 99.9%) (p = 0.004). After the dose calculation with heterogeneity corrections, respectively for the low and high lung density patients, the mean V54Gy was 95.5 ± 5.7% (81.0% - 99.8%) and 99.9 ± 0.1%, p=0.01; the mean ITV V60Gy was 99.4 ± 1.1% (96.3 – 100.0%) and 100.0 ± 0.02% (99.9 -100.0%), p = 0.06. The decrease in PTV 60Gy for the low lung density patients correlated better with RingITV (r = 0.71). The results were not correlated with the lung density or HU. Conclusion: The dosimetric variations were significantly large for patients with very low lung density compared to high lung density. It may be beneficial to evaluate patient lung density for SBRT plans following protocols that require homogeneous dose calculation.

SSE22-05 A Non-Uniform and Non-Coplanar VMAT Dose Delivery Markedly Reduces Lung Dose in Lung SBRT

Monday, Nov. 27 3:40PM - 3:50PM Room: S403B

Participants
Jens Fleckenstein, Mannheim, Germany (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): In this retrospective treatment planning study, the effect of different formalisms of prescribing dose to a target volume (PTV)- a uniform and a non-uniform PTV coverage and volumetric modulated arc therapy (VMAT) dose delivery options – a coplanar and a non-coplanar delivery approach- for lung lesions treated with stereotactic body radiation therapy (SBRT) were compared.Materials/Methods: Treatment plans for 46 lesions in the peripheral lungs (VPTV 20.5±17.5cm³, VPTV,min 3.8 cm³, VPTV,max 85.4 cm³) were generated. The D95%(PTV) was 60Gy, delivered in 5 fractions. For each patient three different treatment plans were generated:First, a coplanar 360° VMAT treatment plan with a uniform dose prescription in the target. The planning objective was to cover all voxels in the PTV with 95%-107% of the prescription dose (in agreement with ICRU report 50). Second, a coplanar 360° VMAT treatment plan with a non-uniform dose distribution. The dose in the PTV was limited to a maximum of 150% of the prescription dose as proposed in RTOG trial 0915. Third, a non-coplanar VMAT dose delivery from four different couch angles (0°, ±35°, 90°) combined with a non-uniform PTV prescription as described above was used.All treatment plans were optimized with the described PTV coverage with as low as achievable dose to the lungs. Dose calculation was performed with a clinically commissioned, Monte Carlo based treatment planning system. The treatment sequences were delivered on a conventional medical linear accelerator with flattening-filter-free (FFF) dose delivery and 10MV nominal acceleration potential and the beam-on times were recorded.Results: For the three different scenarios (uniform coplanar, non-uniform coplanar, non-uniform non-coplanar) the delivered monitor units (MU) were (5141±117) MU, (4104±786) MU, and (3657±710) MU, and the corresponding beam-on times were (177±54)s, (143±29)s, and (148±26)s, respectively. This resulted in the following median dose-volume-histogram metrics for PTV, ipsilateral (ILL), and contralateral lung (CLL): uniformcoplanarnon-uniform coplanarnon-uniformnon-coplanarD99%(PTV) in (Gy)58.657.456.8D50%(PTV) in (Gy)62.769.568.4D1%(PTV) in (Gy)66.778.984.1V>5Gy(ILL) in (%)24.820.920.9V>10Gy(ILL) in (%)15.613.410.9V>20Gy(ILL) in (%)6.36.14.2V>30Gy(ILL) in (%)2.82.62.0V>40Gy(ILL) in (%)1.41.21.0V>5Gy(CLL) in (%)3.20.50.3All presented dosimetric results and dose to volume differences between (uniform, coplanar and non-uniform, non-coplanar treatment plans are significant (pConclusion: For SBRT treatments, a non-uniform dose prescription in the PTV, combined with a non-coplanar VMAT arc arrangement, significantly spares surrounding lung tissue while increasing the dose to the PTV.

SSE22-06 ZnS:Ag Scintillator as a Quality Assurance Tool for Scanned Carbon Ion Therapy

Monday, Nov. 27 3:50PM - 4:00PM Room: S403B

Participants

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CONCLUSION

We tested a ZnS:Ag scintillator as a QA tool for carbon ion therapy. The tool showed potential as a quick, precise way to measure the depth and lateral dose profiles of carbon pencil beams.

Background

Recently, quick and accurate measurement of dose distribution is essential for quality assurance (QA) of treatments with scanned carbon pencil beams. We developed an easy-to-use dose measurement tool that employed a ZnS:Ag scintillator and charge-coupled device (CCD) camera. One of the challenges in dose measurement of pencil beams for clinical use is the precise measurement of the lateral dose profile, including the low-dose envelope. We tested the tool's performance using pencil beams, comparing the depth and lateral brightness profiles with the dose profiles.

Evaluation

A sheet of the ZnS:Ag scintillator was placed perpendicular to the beam axis in a dark box to eliminate any background light. The water level of the tank above the dark box was controlled remotely to adjust the measurement depth. The scintillation light produced by irradiation with a carbon ion beam was reflected with a mirror and was recorded with a CCD camera; 290 MeV/nucleon mono-energetic carbon pencil beams were used. The depth and lateral brightness distributions from the scintillator were compared with the dose distribution, which was measured with an ionization chamber and a diode.The brightness of the ZnS:Ag scintillator was proportional to the dose (0.5-3 Gy). The depth brightness profile measured with the scintillator was underestimated by about 12% at the Bragg peak, compared with the depth dose profile measured with the chamber. Lateral brightness profiles at the entrance depth showed good agreement with the relative dose profiles measured with the diode. In contrast, there was a discrepancy of over 40% at the Bragg peak.

Discussion

In future, improvement of the signal-to-noise ratio of lateral brightness profiles at the Bragg peak, including the low-dose envelope will be necessary.

SSE23

Physics (Image Processing and Image Quality)

Monday, Nov. 27 3:00PM - 4:00PM Room: S404AB

PH

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 0

Participants
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Sub-Events

SSE23-02 Effect of Motion Compensation on the Image Quality of Cone Beam CT Scans in Musculoskeletal Setting

Monday, Nov. 27 3:10PM - 3:20PM Room: S404AB

Participants
Gaurav K. Thawait, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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Wojciech Zbijewski, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Carestream Health, Inc; Research Grant, Siemens AG

PURPOSE

To assess whether motion compensation (MC) applied to musculoskeletal cone beam CT (CBCT) images would demonstrate improved image quality and superior diagnostic value.

METHOD AND MATERIALS

18 study participants (13 male 5 female, average age 32 years) who underwent cone beam CT imaging and had motion artifacts in their scans were retrospectively selected. Image datasets were reconstructed using a recently developed motion compensation algorithm. The algorithm uses an "autofocus" approach that numerically estimates the motion trajectory by maximizing the sharpness of the reconstructed image. Image quality was graded using a 5-point Likert scale (1 and 2 non diagnostic, 5 excellent) by two experienced readers in consensus for cortical bone, trabecular bone, joint space, patellar tendon and severity of artifact. Data was analyzed using Visual Grading Characteristics (VGC) curve analysis. Artifact magnitude was quantified as the standard deviation in a soft-tissue region adjacent to bone and centered on the most prominent hyperattenuating streak artifact.

RESULTS

The amplitudes of patient motion, as estimated by the compensation algorithm, varied from 2.3 mm to 8 mm (mean=5.6 mm). All 18 datasets improved in image quality from non-diagnostic (ratings 1 and 2) in original CBCT images to diagnostic (ratings 4 and 5) in MC CBCT images for cortical and trabecular bones. All visualization tasks were significantly in favor of the MC CBCT (Area under curve 0.75 to 0.89, for all tasks). Quantitatively, the artifact magnitude was reduced from 230 HU (min=94 HU, max=334 HU) before compensation to 150 HU after MC.

CONCLUSION

MC improved the image quality of CBCT scans rendered non-diagnostic by motion artifact. The correction was more significant in bone as compared to soft tissue structures.

CLINICAL RELEVANCE/APPLICATION

As the scan times for CBCT examinations are usually longer than conventional CT (~30 sec. vs ~1 sec.), the likelihood of motion artifacts is increased in CBCT. This motion compensation algorithm has, therefore, the potential to be a valueble tool in growing use of dedicated musculoskeletal CBCT imaging.

SSE23-03 Algorithm and Parameter Optimization for Whole-Body Deformable Registration between MR T1-Weighted and Dixon Images (for PET/MR)

Monday, Nov. 27 3:20PM - 3:30PM Room: S404AB

Participants
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PURPOSE

While whole-body MR T1-weighted (T1W) and Dixon images can provide diagnostic and localization information at high spatial resolution for PET/MR interpretation and attenuation correction, the images may be misregistered in lung and upper abdomen due to respiration and patient motion which cannot be corrected using rigid-body registration. To address this, we developed a fully automatic deformable registration with algorithm optimization.

METHOD AND MATERIALS

Six whole-body MR Dixon and T1W data sets were collected (Philips Ingenuity TF PET/MR). Having the highest spatial resolution, the Dixon in-phase images were treated as reference for the registration. Rigid-body registration was first performed. Then, an open-source application, REGGUI, was used for non-gradient-based deformable registration. The optimal method was chosen among block-matching (BD), sum of square difference (SSD), BD-SSD with gradient, and local phase algorithms. In addition, a pre-regularization and a fluid regularization with different filters and parameters was applied and optimized for the best performance. SSD, mutual information (MI), normalized MI (norMI) and correlation coefficient (R) were recorded at the end of each iteration for performance evaluation.

RESULTS

The deformed whole-body T1W images were aligned with the Dixon images, especially in the areas of lung, liver, and upper abdomen. The local phase deformable algorithm shows the best result among the four methods. The pre- or fluid- regularization filters did not improve the registration. The majority of the mismatch between original T1W and Dixon images was from the deformation of lung and organs due to different breathing techniques and can be reduced with the deformable registration. This whole-body registration is insensitive to the change of the parameters and do not require filtering. The deformable registration currently takes 1 h but can be automated for clinical practice until computational optimizations are implemented.

CONCLUSION

The automatic registration with whole-body T1W and Dixon images are feasible using non-gradient-based deformation. The local phase without regularizations shows the best performance for this whole-body deformable registration.

CLINICAL RELEVANCE/APPLICATION

This study established a clinical practicable approach for an automatic deformable registration between whole-body T1W and Dixon images.

SSE23-04 A Viewer for Dynamic Whole-Body PET/CT Studies with Integrated Voxel-based Patlak Analysis

Monday, Nov. 27 3:30PM - 3:40PM Room: S404AB

Participants
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PURPOSE

The purpose of our project was to develop a software system for the display, quantitation and voxel-based Patlak analysis of dynamic whole-body PET/CT imaging studies.

METHOD AND MATERIALS

We developed a DICOM image viewer and analysis system in the Java programming language. The viewer can load dynamic (multi-timepoint) DICOM whole-body image sets as well as aggregating separately acquired whole body image series. In addition, the viewer can load any co-registered anatomical imaging (e.g. CT, MR) for fusion display and anatomical localization, employing multiple look-up tables and user control of image blending. We incorporated regions-of-interest (ROIs) which provide real-time display of Time-Activity-Curves (TACs) and corresponding image statistics. For the voxel-by-voxel Patlak analysis, ROIs are used to provide the necessary input function data, either providing the entire function if imaging captures the time of injection, or used to scale a population input function when only later imaging timepoints are available.

RESULTS

Integrated PET/CT display of dynamic whole-body PET was provided, allowing user navigation of study time points in a similar fashion to conventional clinical image review. In addition to providing simple navigation of fused datasets across all timepoints, the system provided for the generation of summed image datasets, as well as the generation and display of Patlak slope, intercept and correlation images resulting from a voxel-based Patlak analysis. ROIs drawn on any one dataset were dynamically applied to any other dataset, providing real-time TACs across both original and derived images. Tabular ROI statistics from any dataset are exportable for further analysis.

CONCLUSION

Modern PET/CT scanners are faster and more efficient than ever before, enabling dynamic whole-body acquisitions which previously were not feasible. The software presented here provides many of the required features to properly display and analyze these new datasets, and does so in an implementation which is easily navigable by the user and executable on the widest variety of computing platforms.

CLINICAL RELEVANCE/APPLICATION

Dynamic whole-body PET/CT imaging is possible and, when provided with the right toolset, clinicians can begin to exploit the additional dimension of information which this imaging strategy provides.

SSE23-05 Novel Approach to Estimate Source-Detector Alignment of Cone-Beam X-Ray Systems Using Collimator Edge Tracking

Monday, Nov. 27 3:40PM - 3:50PM Room: S404AB

Participants
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Andreas Fieselmann, PhD, Erlangen, Germany (*Abstract Co-Author*) Employee, Siemens Healthcare GmbH
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Ludwig Ritschl, Nurnberg, Germany (*Abstract Co-Author*) Employee, Siemens Healthcare GmbH

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PURPOSE

Due to upcoming applications for clinically well-established digital X-ray systems, like workflow automation or high-quality free exposures with mobile detectors, knowing and reproducing the exact source-detector alignment is a crucial factor. Hence, it is important to determine their exact alignment without complicating the clinical routine or adding any additional hardware. Furthermore, novel X-ray systems with independently moveable source and detector might benefit from this method.

METHOD AND MATERIALS

The presented method utilizes the fact that the position of the collimator relative to the source is known, and determines the intrinsic parameters of a projection matrix using a two-staged algorithm.1. Detect the corners of the collimator in the projection image and find a preliminary set of intrinsics such that the difference between the projection of the known 3-D collimator coordinates and the detected corners is minimal in a least-squares sense.2. Use these intrinsic parameters as initial values for an optimization, to find the optimal set of intrinsics (f, u0, v0) which maps the 3-D coordinates best to the 2-D ones on the detector, by maximizing the sum along the line integral between the projections of two collimator corner points using a precomputed gradient magnitude image.For validation, a simulation study was carried out, simulating the projection of the collimator, taking the introduced blurring due to the focal spot size into account. In total, 27 data sets (2880x2880 px á 0.15 mm, f = 1200 mm) with various detector rotations and translations were simulated and used for evaluation. Each variable was then compared to the ground truth separately.

RESULTS

It was shown that the presented method is able to estimate the detector offset (u0, v0) with an accuracy of ±1.35 px and the focal length f with an accuracy of ±5 mm.

CONCLUSION

The presented algorithm is capable of estimating the source-detector alignment of cone-beam X-ray systems, utilizing only already existing information of the X-ray system. Thus, this method might enable new clinical applications which could lead to a benefit in the clinical routine.

CLINICAL RELEVANCE/APPLICATION

The proposed method might open up the possibility of further workflow automation and image quality improvement in well-established digital X-ray systems. Additionally, emerging technologies like CBCT using robotic devices might profit.

SSE23-06 Feasibility Study of the NPWE Model Observer for Objective Image Quality Assessment of Processed Digital Mammography Images

Monday, Nov. 27 3:50PM - 4:00PM Room: S404AB

Participants
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PURPOSE

To investigate how image processing algorithms in digital mammography affect the detectability of calcification-like discs embedded in an anthropomorphic breast phantom for both human and model observers.

METHOD AND MATERIALS

A 3D printed phantom was constructed from a patient breast CT image, and cut into two transverse slabs. Between the slabs, aluminum squares with gold discs of 0.1 mm and 0.25 mm diameter (1.80 µm and 0.50 µm thick) were inserted. Images were acquired at four dose levels using two mammography systems, and images with and without processing were used to create 200 signal-present and 200 signal-absent regions of interests (ROIs) per system type, image type, dose level and disc size. The ROIs were scored by a non-prewhitening with eye-filter (NPWE) model observer and by three human observers in two-alternative-forced-choice experiments. As a measure of performance, the proportion of correct (PC) responses was obtained.

RESULTS

For system A, for the 0.1 mm discs, PCNPWE increased with dose and ranged from 0.74-0.89 and 0.75-0.92 (p=0.12); PCH varied 0.73-0.93 and 0.71-0.95 (p=1), in case of ROIs with and without processing respectively. Similar results were obtained for the 0.25 mm discs and for both disc sizes on system B. The correlation between humans and model observer was high and resulted in R2=0.77 for the 0.1 mm and R2=0.85 for the 0.25 mm disc. As expected, all PC values increased with dose and trends were similar for both systems and unprocessed/processed images.

CONCLUSION

For the task of detecting a specific disc size, model and human observers have a consistent correlation in PC in images with and without processing under different conditions (dose levels, type of system). Therefore, an NPWE model observer and real acquired images of a realistic breast phantom could be used in the assessment of detection of calcification-like discs in images including image processing

CLINICAL RELEVANCE/APPLICATION

Model observers and anthropomorphic phantoms could be used to assess the impact of image processing algorithms on lesion detectability, allowing for task-based testing of this important post-acquisition stage.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
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SSE24

Radiation Oncology (Breast)

Monday, Nov. 27 3:00PM - 4:00PM Room: S104A

BR RO OI

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

Participants
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Kathleen Horst, MD, Stanford, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSE24-01 Effectiveness and Accuracy of Novel 3-D Surgical Markers in Identifying Post-Surgical Boost Cavities in Women with Early Stage Breast Cancer for Adjuvant Radiation Therapy

Monday, Nov. 27 3:00PM - 3:10PM Room: S104A

Participants
Mustafa Abugideiri, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
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ABSTRACT

Purpose/Objective(s): For patients undergoing breast conserving surgery (BCS), adjuvant radiation therapy (RT) is the standard of care. A lumpectomy cavity boost (LCB) is typically added for patients with high risk features such as young age, lymph node positivity, positive margins, and the use of neoadjuvant or adjuvant chemotherapy. Defining the boost volume is traditionally guided by the post-operative seroma, anatomical landmarks, and surgical clips; however, there can be much discrepancy in defining these cavities. This ambiguity may result in over or underestimation of the cavity's true size, especially in the setting of oncoplastic reduction (OR) or a delay between surgery and adjuvant RT. The accurate delineation of the cavity volume will determine the high dose RT boost volume, which can in turn impact breast toxicity. This study seeks to evaluate whether the use of a novel 3-D implantable tissue markers (TM) will decrease ambiguity in the delineation of the surgical cavity and result in more accurate LCB volumes. Materials/Methods: The records of 10 consecutive patients (range: 50-71 years) who underwent BCS followed by adjuvant RT with a LCB at our institution between January 2015 and July 2015 were reviewed. Nine (90%) of the LCB were treated using mini-tangents and one (10%) was treated using enface electrons. Five of the patients underwent BCS alone and 5 underwent BCS and OR. All patients had 3-D TM placed at the time of surgery. Two independent radiation oncologists determined the LCB volumes, one using the traditional indicators such as seroma size and surgical clips, while the other defined the cavity using 3-D TM. Results: The mean LCB volume using traditional methods was 32.15cc (SD=21.97 and SEM=6.9) and 19.14cc (SD=8.0 and SEM=2.5) using 3-D TM (P=0.072). In the BCS arm, 4 patients (80%) had a reduction in the LCB volume with the use of 3-D TM (range, 8.7%-66.2%). One patient had an increase in their LCB volume with the use of 3-D TM by 25.0%. In the BCS+OR arm, 3 patients (60%), had a reduction in their LCB volume with the use of 3-D TM (range, 50.1%-68.7%) and 2 patients (40%), had an increase in their boost volume (47.6% and 154.8%). Conclusion: On average, LCB volumes were smaller using 3-D TM for planning as compared with conventional methods and locating the lumpectomy cavity was more precise. Although this value did not reach statistical significance with a p=0.072, the trend towards statistical significance, especially with a small sample size, should be noted. In the BCS+OR arm, the use of 3-D TM resulted in significant reductions in treatment volumes in 3 cases, while also helping to increase the necessary LCB volume in 2 patients that would have otherwise been undertreated. The 3-D TM appeared to be more effective at identifying and maintaining the cavity for boost determination, especially in those with OR. This study is hypothesis generating and will serve as a report to initiate future studies examining the local control and toxicity rates of patients receiving LCB with 3-D TM versus conventional methods.

SSE24-03 Bolus Technique in Post-Mastectomy Radiotherapy: Practice Patterns and Acute Toxicity Outcomes

Monday, Nov. 27 3:20PM - 3:30PM Room: S104A

Participants
Adam C. Ferro, MD, MS, Baltimore, MD (*Presenter*) Nothing to Disclose
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Fariba Asrari, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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Todd R. McNutt, PhD, Baltimore, MD (*Abstract Co-Author*) Research collaboration, Koninklijke Philips NV Research collaboration, Toshiba Corporation Research collaboration, Elekta AB

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ABSTRACT

Purpose/Objective(s): While bolus is commonly used to enhance dose to superficial tissues in post-mastectomy radiotherapy (PMRT), there is little consensus regarding its specific indications or optimal use. We review practices patterns of bolus application following mastectomy across four facilities with expertise in breast radiotherapy.Materials/Methods: Medical records were reviewed for all patients who were managed with PMRT between 9/11/2007 and 12/31/2016. Treatment fields and bolus factors were recorded, and the association between bolus type by reconstruction status of the chest wall (unreconstructed vs. reconstructed) was assessed by Chi2 analysis. Acute radiation-related toxicities were evaluated by the treating physician during the course of PMRT; scores at baseline and at the final assessment were compared. Logistic regression assessed for the odds of acute toxicity outcomes by bolus status. We additionally evaluated the odds of completing scar/surgical bed boost by bolus status. Results: A total of 316 patients received PMRT during the study period. The chest wall was unreconstructed in 38%, reconstructed including with tissue expander in 51%, and unspecified in 11% of cases. Additional fields included dedicated supraclavicular coverage in 85% and scar/surgical bed boost in 41% of treatments. A total of 270 patients had adequate bolus details to analyze. Bolus was used for at least part of the treatment in 75% of unreconstructed chest wall and 61% of reconstructed chest wall PMRT cases, most commonly with brass mesh and 1-cm oil gel sheets, respectively. Use of bolus was significantly higher for the unreconstructed group (p=0.012). Surgical bed boost fields employed bolus in 71% of treatments, and 0.5-1.0 cm oil gel sheet bolus were used 84% of the time. Acute toxicity assessments were available for 151 patients. When controlling for reconstruction status of the chest wall, use of bolus was not significantly associated with worsening odds of acute toxicity outcomes including radiation-related pain, burning, or hyperpigmentation. Also adjust for reconstruction status, the use of bolus did not significantly affect the odds of receiving a scar/surgical boost (OR 1.63, CI 0.95-2.83).Conclusion: These data confirm that bolus is commonly employed in the delivery of post-mastectomy radiotherapy, particularly among patients with unreconstructed chest walls. Although bolus type and duration of use varied, when controlling for reconstruction status of the chest wall, neither acute toxicities nor completion of scar/surgical bed boost were worse with the use of bolus.

SSE24-04 Four Year Follow-Up of Patients Treated With either Accelerated Partial Breast Irradiation or Whole Breast Irradiation in a Community Hospital: Possible Implications for PR Negative Patients

Monday, Nov. 27 3:30PM - 3:40PM Room: S104A

Participants
Imraan Jan, Newark, DE (*Presenter*) Nothing to Disclose
Christopher Koprowski, Newark, DE (*Abstract Co-Author*) Nothing to Disclose
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ABSTRACT

Purpose/Objective(s): This study sought to evaluate the comparative safety of partial breast irradiation vs whole breast radiation in a community hospital setting. The primary endpoint of the study was local control. Secondary endpoints included: toxicities, complications and regional and distant failure rates.Materials/Methods: All patients were selected from the breast surgeons employed by the institution and from the contracted radiation oncology practice. Treatment options were discussed at a multidisciplinary conference and consensus decisions guided by national criteria. Accelerated partial breast irradiation (APBI) patients had their tumor cavity treated with a strut assisted volume implant in 10 fractions of 3.4 Gy administered bid. Contemporary early stage patients (Tis-T2, N0) treated with whole breast (WB) radiation were randomly selected from the same practice. During the period 2008-2014, 219 patients were treated with APBI and 143 were randomly selected from the whole breast patients. As appropriate, Chi Square , Fisher's exact and Log-Rank tests were used to compare categorical data.Results: Ninety-two percent of the patients were seen within a year of review. Mean length of follow up was 3.7 years in WB patients and 3.8 years in APBI. Actuarial local recurrence-free survival was 95% in the WB group at 5 years and 96% in the APBI cohort (NS).The whole breast group had four local failures (LF)-two distant and LFs and two LFs. All LFs were in breast true recurrences (IBTR). Significantly more patients within the WB group had T2, grade 3, or ER negative disease, were likelier to have chemo and less likely to have antiestrogen therapy (p).Only 3 of 219 patients treated with APBI were ER negative. Three of seven LFs were IBTRs, the others elsewhere in the breast. Among all recurrences in the APBI group 7 of11 were ER +, PR - vs 37 of 208 in the patients without recurrence (p=.0015).The APBI group had significantly lower rates of fatigue, dermatitis, and breast pain (5.94%, 26.5%, and 26.5% respectively) compared to the whole breast group (57.6%, 99.3%, and 54.2% respectively) (p).Conclusion: Both APBI and WB patients had comparable and low LF rates, but the pattern of recurrence (NS) and prognostic factors (p) differed, suggesting a possible effect on outcomes of the radiation mode employed.The equality of local control, given the different covariates in these two cohorts, underscores the importance of patient selection and adherence to national guidelines.Acute toxicity was less with APBI.There is a strong suggestion that PR -patients have a worse prognosis for local and distant recurrence than PR + in APBI, despite being ER +. This needs to be confirmed with prospective data.

SSE24-05 Intensity Modulated Proton Therapy For Re-irradiation of Recurrent Cancer in the Breast and Chest Wall: A Single Institution Experience

Monday, Nov. 27 3:40PM - 3:50PM Room: S104A

Participants
Fantine Giap, Dallas, TX (*Presenter*) Nothing to Disclose
Lei Dong, PhD, San Diego, CA (*Abstract Co-Author*) License agreement, Varian Medical Systems, Inc
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ABSTRACT

Purpose/Objective(s): This retrospective study describes a single institution's technique and early experience with Intensity Modulated Proton Therapy (IMPT) for re-irradiation of recurrent malignancies in the breast and chest wall over the past 3 years. Materials/Methods: We identified 10 patients in this category, all of whom had previous radiation to the breast or chest wall. Two patients needed chest wall radiation after resection of recurrent cancer due to positive margins; seven patients had

gross nodal and chest wall recurrence; one patient had post-lumpectomy radiation in previously irradiated area from another malignancy. All patients except one (23.4 Gy) had previous full dose radiation to 50 Gy or higher. Patients, immobilized with either a breast board or Vac-Q-Fix cushion, were set up in the supine position with their arms over their head. One to two beams using IMPT with MFO technique was used. Dose was prescribed at 1.8-2 Gy to 50 to 66 Gy daily treatment. Weekly adaptive simulation was done with CT. Photographs were obtained during and after treatment. All cases were reviewed and approved by our weekly physicist and physician treatment planning conference.Results: All patients had grade 1-2 skin toxicity. There were no Grade 3 or greater acute or late toxicity. One patient developed grade 2 lymphedema. No patients have local failure, and all are still alive.Conclusion: IMPT is feasible and a safe modality for re-treatment of recurrent cancer in the breast and chest wall. Further validation with more patients and longer follow-up is needed.

SSE24-06 Clinical Risk Factors Associated with Improved Relative Survival Among Metastatic Breast Cancer Patients Receiving Palliative Radiation Therapy

Monday, Nov. 27 3:50PM - 4:00PM Room: S104A

Participants
Rahul Kumar, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Sanjay Aneja, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Dennis Chan, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Arun Goel, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Andrew Huang, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Nima Harandi, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
John Lee, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Predicting survival of patients with metastatic breast cancer remains difficult. Identifying breast cancer patients with improved relative survival can help identify patients who may benefit from palliative radiation therapy. The aim of this study was to determine clinical factors associated with improved relative survival in metastatic breast cancer patients treated with palliative radiation therapy. Materials/Methods: We identified a cohort of metastatic breast cancer patients in the Surveillance, Epidemiology, and End Results (SEER) dataset from the years 1973-2013. A survival analysis was performed using SEER*Stat software to determine the 5-year expected survival in this cohort of patients using the Ederer II method. Expected survival was based on a non-cancer cohort matched on age, sex, and race. Relative survival was determined as the ratio of observed survival to expected survival. Multivariate logistic regression was performed to identify risk factors associated with improved relative survival. Risk factors analyzed were age at diagnosis, grade, histologic type, presence of metastasis to bone at diagnosis, and status of estrogen receptor (ER), progesterone receptor (PR), and HER-2 receptor.Results: We analyzed 3,356 patients from the SEER database who were diagnosed with metastatic breast cancer and received palliative radiation therapy between 1973-2013. Median survival of the entire cohort was 14 months. Median expected survival was 59 months, and median relative survival was 24.1%. Multivariate logistic regression found younger patients [OR 1.81; 95% CI(1.10, 2.97); p=0.02] with metastatic bone lesions [OR 1.5; 95% CI(1.29, 1.83); p=0.01] to be associated with improved relative survival. Conversely, patients with poorly differentiated [OR 0.68; 95 CI (0.48, 0.96); p=0.03], HER-2 positive tumors [OR 0.70; 95% CI(0.50, 0.97); p=0.03) were found to have decreased relative survival. Histologic type as well as ER and PR receptor positivity did not have statistically significant impact on relative survival.Conclusion: Younger age and the presence of osseous metastatic disease at diagnosis were associated with improved relative survival in patients with metastatic breast cancer who received palliative radiation therapy. Our findings may help physicians identify patients who are mostly likely to benefit from palliative radiation therapy and help inform shared decision making for patients considering multiple palliative treatment options.

SSE25

Vascular Interventional (Vascular and Dialysis Access)

Monday, Nov. 27 3:00PM - 4:00PM Room: N226

VA IR

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

FDA Discussions may include off-label uses.

Participants
Himanshu Shah, MD, Zionsville, IN (*Moderator*) Consultant, IMARC Research Inc
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Sub-Events

SSE25-01 Poor Man's Thrombectomy for the Treatment of Thrombosed Arteriovenous Grafts: 5-Year Results of 241 Cases

Monday, Nov. 27 3:00PM - 3:10PM Room: N226

Participants
Panagiotis Kitrou, Patras, Greece (*Presenter*) Nothing to Disclose
Panagiotis Papadimatos, MD, Rio, Greece (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

This was a retrospective analysis investigating the results of a hybrid thrombolysis-thrombectomy method performed in our department for the treatment of thrombosed dialysis arteriovenous grafts (AVG).

METHOD AND MATERIALS

Within 5 years (January 2012-Decmber 2016), 291 declotting procedures were performed in our department for the treatment of thrombosed dialysis arteriovenous fistulas or grafts. Data were available for 129 patients (75 men, 58.1%) with an AVG undergoing 241 procedures [1.87procedures/patient (1-10)]. Procedure includes initial thrombolysis with 5mg rTPA followed by thrombectomy with high pressure balloons for thrombus maceration using "facing sheaths" technique. 61 patients had >=2 declotting procedures. In 80 cases (80/241; 33.2%) a stent graft (SG) was used for thrombus apposition or treatment of persistent stenosis. Primary outcome measure was circuit survival. Secondary outcome measures included procedural complications and investigation of independent factors that could influence survival.

RESULTS

Median survival was 434 days according to Kaplan Meier survival analysis. In 6 cases (6/241, 2.49%) declotting failed and a catheter was placed. There were 16 minor (16/241, 6.64%) and no major complications. There was no significant difference regarding circuit survival when a SG was placed (No SG 406 days vs. SG 349 days; p=0.24). There was a significant difference in favor of the 2nd declotting compared to the 1st in 61 patients (1st: 162 days vs. 2nd: 447 days; p<0.0001).

CONCLUSION

Hybrid declotting method performed in our department has high survival rates with increased technical success and minimum complications without the use of thrombectomy devices.

CLINICAL RELEVANCE/APPLICATION

A hybrid thrombectomy - thrombolysis method for the treatment of thrombosed AVGs

SSE25-02 Is Preprocedural Bloodwork Necessary in Children Undergoing Elective Removal of Tunneled Central Venous Access Devices (cVLs)?

Monday, Nov. 27 3:10PM - 3:20PM Room: N226

Participants
John P. Donnellan, MBChB,FFR(RCSI), Toronto, ON (*Presenter*) Nothing to Disclose
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Bairbre L. Connolly, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Joao G. Amaral, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

Philip R. John, MBBCh, FRCR, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Obtaining pre-procedural bloodwork in paediatric patients is often a traumatic and stressful experience for the patient as well as adding extra cost and time penalties to a busy interventional procedural list. We assessed the utility of preprocedural complete blood counts (CBC's) and coagulation screens with respect to intraoperative and postoperative bleeding complications for all patients undergoing elective removal of CVL's to see if the preoperative blood work could safely be eliminated without affecting patient safety.

RESULTS

A total of 1112 cases were identified. 865 devices were removed electively of which 843 had pre-procedural bloodwork. The average patient age was 8.47years and the average patient weight was 16.6kg. 35 patients were under 10kg. 116 cases had a personal history of a bleeding disorder. The average Hb, PT, INR and PTT were 126.7, 270.6, 1.07 and 32.1 respectively. 102 cases had documented abnormal pre-procedural bloodwork. Of these 14 cases had pre-procedural treatment initiated on the basis of the blood results. 5 cases had Factors given, 6 had platelets and 3 had FFP. 96% of cases were documented as uneventful. The 4% of cases described as eventful required a second dissection site to release an adherent cuff. 5.9% with abnormal preprocedural bloodwork were noted to have some degree of bleeding at a pre-discharge review, however, no cases required further treatment, observation or intervention. Of the cases with normal preprocedural bloodwork, 93% were uneventful. 45 cases were noted to have documented evidence of bleeding upon review (6%). 2 were kept under extended observation without any further treatment necessary before being discharged. No intra-operative events were due to bleeding-related issues. When analysed using chi-square test, there is no statistical significance between pre-procedural bloodwork result and bleeding related complications (p-value 0.9397).

CONCLUSION

We have evaluated the use of blood testing before elective central venous device removal in a large cohort of patients at a tertiary referral center and shown that there is no significant benefit to the patient or to the performing service. This work will support the reduction in utilization of needless blood tests on pediatric patients, minimizing the stress and trauma these tests often cause our patients as well as reducing overall institutional cost and increasing efficiency.

METHODS

IRB approval was granted. Patients who underwent CVL removal (port-a-cath or central venous line) by Interventional Radiology between Jan 1st 2009 and Dec 31st 2013 were identified. Cases of device infection or malfunction were excluded. Patient records were reviewed and the data collected included patient demographics, underlying diagnosis, reason for device removal, history of bleeding disorder, device type, pre-and post-procedural bloodwork results, if any treatments were needed and what was given, as well as peri-operative bleeding complications (during or within 24hours of procedure). Data was collected by a single researcher and interval random data validity checks were performed. All data was recorded and analysed in Microsoft Excel.

PDF UPLOAD

https://abstract.rsna.org/uploads/2017/17018252/17018252_i6g4.pdf

SSE25-03 Predictors of Migration of Implantable Central Venous Port Devices

Monday, Nov. 27 3:20PM - 3:30PM Room: N226

Participants
Ingo Steffen, Berlin, Germany (*Presenter*) Nothing to Disclose
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Thomas Elgeti, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Catheter migration is one of the most common complications of central venous port devices. The aim of this study is identification of early risk factors for catheter migration which may be helpful in clinical maintenance of long term central venous ports.

METHOD AND MATERIALS

Retrospectively, 202 patients (98f; median age, 63 years; range, 19-83 years), with implanted central venous access port-systems via the right jugular vein placed in the interventional suite of the radiology department were included. Radio fluoroscopy (RF) was used for catheter placement, subsequently all patients underwent standard chest X-ray for assessment of port capsule migration. Location of catheter in RF was described using extra- (EX) and intravasal (IV) projection of catheter, ratio of EX/IV, length of catheter projection (CPL), normalized distance of the catheter tip from the carina (nCTCD) and projection of the port capsule relative to intercostal space (PCP). Associations of dislocation and possible risk factors (catheter characteristics as described above, age, gender, body weight, body height, BMI and thickness of presternal fat (PF) were analyzed using receiver operating characteristics (ROC) curves and logistic regression model.

RESULTS

Catheter migration was observed in 12 of 202 patients (5.9%). In univariate logistic regression catheter dislocation was significantly associated with body weight (OR, 1.04; p=0.009), BMI (OR, 1.15; p=0.002), presternal fat (OR, 1.15; p<0.001), EX (OR, 1.07; p=0.001), IV (OR, 1.03; p<0.001), EX/IV (OR, 1.10; p<0.001), CPL (OR, 1.02; p=0.001) and nCTCD (OR, 1.03; p<0.001) but not with age, gender, body height and PCP. The highest AUC in ROC analysis of females was observed for BMI (AUC, 0.91; p=0.006), EX/IV ratio (AUC, 0.88; p<0.001) and PF (AUC, 0.86; p=0.014). ROC analysis of males revealed the highest AUC for length of catheter (AUC, 1; p<0.001) and presternal fat (AUC, 0.85; p=0.004).

CONCLUSION

This explorative analysis identified length of catheter projection, BMI, thickness of presternal fat and ratio of extravasal/intravasal projecting catheter at time of radio fluoroscopy as significant risk factors for catheter dislocation.

CLINICAL RELEVANCE/APPLICATION

Length of catheter projection as well as ratio of extravasal/intravasal projecting catheter at time of radio fluoroscopy, body mass index and thickness of presternal fat in the lateral chest radiograph are risk factors for port catheter dislocation.

SSE25-04 Tunneled Central Venous and Dialysis Catheters in ICU Patients: Evaluation of CLABSI Rates

Monday, Nov. 27 3:30PM - 3:40PM Room: N226

Participants
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Amit D. Kalaria, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Alex Kim, MD, Washington, DC (*Abstract Co-Author*) Research Grant, Surefire Medical, Inc; Speakers Bureau, Surefire Medical, Inc; Advisory Board, Surefire Medical, Inc; Stockholder, Surefire Medical, Inc; Speakers Bureau, Sirtex Medical Ltd; Proctor, Sirtex Medical Ltd; Advisory Board, Bayer AG; Stockholder, Pfizer Inc; ;

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PURPOSE

Tunneled catheter placement in ICU patients is often deferred due to infection concerns despite lower infection rates than non-tunneled lines. The purpose of this study is to compare the incidence of Central Line Associated Bloodstream Infections (CLABSI) with tunneled central venous and dialysis catheters placed by Interventional Radiology in MICU or SICU patients versus historical overall CLABSI rates in the ICU setting.

METHOD AND MATERIALS

A retrospective single institution evaluation was performed. The database of procedural dictations was queried for reports with procedure codes for tunneled central venous and dialysis catheter placement originating from the MICU or SICU over a 12 month period. Reports were reviewed to ensure a tunneled central catheter was placed. The EHR was reviewed and the CLABSI rates were calculated based upon NHSN criteria and compared to publically available CLABSI rates for this institution. Patients still hospitalized with catheters were credited for catheter days until the day of final data analysis. Rates of line replacement and/or removal for reasons other than CLABSI were also evaluated.

RESULTS

A total of 981 catheter placements were performed with 53 in ICU patients. 25 were tunneled catheters, 13 in MICU and 10 in SICU patients (2 patients received both tunneled central venous and dialysis catheters). 23 internal jugular and 2 femoral catheters were placed. There were a total of 709 central line days, with 1 CLABSI in a SICU patient with a femoral tunneled line for TPN. CLABSI rate was 1.41 per 1000 catheter days. Publically available CLABSI rates for the MICU from 2013-2010 were 1.23, 1.54, 2.23, 1.59, respectively, and 0.27 in the SICU in 2013. 6 catheters were removed prior to discharge for reasons other than lack of need: 2 for malfunction, 2 for non-CLABSI infection, 1 for non-TPN use of TPN catheter in a code, and 1 for CLABSI.

CONCLUSION

The CLABSI rate of tunneled catheters in the ICU is comparable to overall ICU CLABSI rates from prior years. Additionally, 24% of catheters needed to be removed or replaced for other reasons requiring transport and IR sedation.

CLINICAL RELEVANCE/APPLICATION

The policy of deferring tunneled line placement in ICU patients is not justified based upon infection risk; however, it is warranted based upon rate of repeat procedures needed to replace/remove catheters. Patient specific considerations should guide the decision.

SSE25-05 An Analysis of Potential Predictors of Tunneled Central Venous Catheter Infection or Malfunction

Monday, Nov. 27 3:40PM - 3:50PM Room: N226

Participants
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Jeffrey R. Black, BS, Birmingham, AL (*Presenter*) Nothing to Disclose
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Sherif M. Moawad, MD,MSc, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose
Joseph B. Eason, MD, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Ahmed K. Abdel Aal, MD, PhD, Birmingham, AL (*Abstract Co-Author*) Consultant, St. Jude Medical, Inc; Consultant, Baxter International Inc; Consultant, C. R. Bard, Inc; Consultant, Boston Scientific Corporation; Consultant, W. L. Gore & Associates, Inc;

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PURPOSE

To assess the ability of various clinical factors to predict infection or malfunction of tunneled central venous catheters (tCVCs).

METHOD AND MATERIALS

A retrospective review of all adult patients who had a tCVC placed by interventional radiology between 1/1/2012 and 12/31/2015

was performed. From this cohort, patients with a known indication for tCVC removal were included, while patients with femoral, trans-hepatic, or trans-lumbar tCVCs were excluded. tCVCs were considered infected based on clinical suspicion or culture-positive bacteremia. Malfunction was defined as all other non-infectious causes for line failure. Time to removal or exchange was recorded. Data was analyzed with univariate and multivariate models to assess for potential predictors of tCVC infection or malfunction, such as: age, sex, indication for tCVC placement, site of tCVC placement, inpatient versus outpatient status at time of placement, body mass index (BMI), platelet count, white blood cell count (WBC), international normalized ratio, and partial thromboplastin time. Positive blood cultures, sepsis, or fever within 30 days of placement were also analyzed as potential predictors.

RESULTS

441 patients (229F; 212M; mean age: 52.1 years) qualified for inclusion. The most common reasons for tCVC placement included: dialysis (175), long-term antibiotics (111), and malignancy (92). 98.4% were placed via the internal jugular vein. One minor complication occurred during tCVC placement. 13.8% of tCVCs were removed due to infection at a mean of 88.8 days (range: 0-217 days). 17.5% of catheters were removed or exchanged due to malfunction at a mean of 94.9 days (range: 1-684 days). The remainder of the tCVCs were removed due to completion of therapy at a mean of 89.9 days (range: 1-797). No differences in time to removal or exchange of tCVCs was seen between the groups. Leukopenia (WBC <4.5x103/mm3) was associated with tCVC removal for infection (p=0.03). Both female sex (p=0.02) and BMI >30 (p=0.04) were associated with tCVC removal or exchange for malfunction. None of the other evaluated factors were predictive of line removal or exchange.

CONCLUSION

Leukopenia was associated with tCVC removal for infection while female sex and BMI >30 were associated with tCVC malfunction. The other evaluated factors were largely poor predictors of tCVC removal or exchange.

CLINICAL RELEVANCE/APPLICATION

Improved models for patient selection prior to tCVC placement are needed.

SSE25-06 3D Bioprinted Veins-on-a-Chip Model

Monday, Nov. 27 3:50PM - 4:00PM Room: N226

Participants
Rahmi Oklu, MD, PhD, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose
Shrike Y. Zhang, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Hassan Albadawi, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose
Ali Khademhosseini, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

oklu.rahmi@mayo.edu

PURPOSE

In this study, 3D bioprinting technology was used for the construction of a highly biomimetic venous thrombosis-on-a-chip model.

METHOD AND MATERIALS

Thrombosis-on-a-chip model consisted of microchannels coated with a layer of confluent human endothelium embedded in a gelatin methacryloyl (GelMA) hydrogel, where human whole blood was infused and induced to form thrombi. Three groups of hydrogel micro channels were fabricated using sacrificial bioprinting approach: i) microchannels covered by HUVECs without fibroblasts (control), ii) non-endothelialized microchannels with encapsulated fibroblasts in the hydrogel, and iii) endothelialized microchannels with simultaneously encapsulated fibroblasts inside the matrix. Mechanical tests, cell viability, morphology analysis, perfusion assays with and without tPA treatment, immunohistochemistry (CD-31, f-actin, collagen-1) and histology were performed; changes over 14 days was documented using video fluorescent microscopy.

RESULTS

A biomimetic thrombosis-on-a-chip model was successfully created. Encapsulation with fibroblasts in the GelMA matrix demonstrated the migration of these cells into the clot and subsequent deposition of collagen type I over time, facilitating fibrosis remodeling resembling human thrombus organization. Continuous perfusion with tPA led to dissolution of non-fibrotic clots, further revealing clinical relevance of the model.

CONCLUSION

3D bioprinted models can be used to study the pathology of venous fibrosis and test therapeutics.

CLINICAL RELEVANCE/APPLICATION

Biomimetic human tissue on a chip models can lead to rapid in vitro testing of therapeutics and medical devices.

MSAS24

Planning Effective and Efficient Imaging Services (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Monday, Nov. 27 3:30PM - 5:00PM Room: S105AB

HP LM

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

Participants
Morris A. Stein, BArch, Phoenix, AZ (*Moderator*) Nothing to Disclose
William A. Undie, PhD, RT, Houston, TX (*Moderator*) Nothing to Disclose

Sub-Events

MSAS24A Regulatory Updates on Clinical Support Systems and the Implication for Financial and Operational Considerations

Participants
Melody W. Mulaik, Powder Springs, GA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn the current status of the governmental requirement for the implementation of Clinical Decision Support for radiology services. 2) Gain an understanding of key operational challenges and concerns associated with the industry implementation of this key initiative.

MSAS24B Delivery of Imaging Master Planning and Design of Physical Space through Data, Modeling and Research

Participants
Carlos L. Amato, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

camato@cannondesign.com

LEARNING OBJECTIVES

1) Learn how new planning and design tools such as parametric software can be used to efficiently master plan and design imaging departments. 2) Learn how 3D and 4D space modeling is used to implement evidence based knowledge in architectural design. 3) Gain an understanding of how to bridge the gap between advanced research data and design considerations affecting clinical operations.

MSCT22

Case-based Review of Thoracic Radiology (An Interactive Session)

Monday, Nov. 27 3:30PM - 5:00PM Room: S100AB

CH VA

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

Participants
Diana Litmanovich, MD, Haifa, Israel (*Director*) Nothing to Disclose

Sub-Events

MSCT22A Vascular Mediastinal Disorders

Participants
Patrick M. Colletti, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize common vascular mediastinal abnormalities, including aneurysm, dissection, and thrombosis. 2) Adjust timing to avoid biopsy or similar interventions in vascular lesions in the future.

ABSTRACT

The largest structures in the mediastinum are vascular, including the aorta, IVC, and pulmonary arteries and veins. Potential abnormalities include dilated, obstructed,and annomalous or collateral vessels. Thus, anuerysms, thrombosis, and occlusions and collateral vssels are occasionally noted. It is most important to identify vascular abnormalities in order to avoid inappropriate biopsies.

Active Handout:Patrick M. Colletti

http://abstract.rsna.org/uploads/2017/17000466/Active MSCT22A.pdf

MSCT22B Neoplastic Disorders

Participants
Jeremy J. Erasmus, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jerasmus@mdanderson.org

LEARNING OBJECTIVES

1) Better understand thoracic neoplastic disorders including lung cancer, esophageal cancer and malignant mesothelioma. 2) Be able to discuss the common and uncommon manifestations of intrathoracic malignancies. 3) Be able to advise colleagues on the use of CT, PET/CT and MR imaging in the evaluation and TNM staging of patients with intrathoracic malignancies. 4) Be conversant with the common dilemmas and pitfalls in staging.

ABSTRACT

Neoplastic disease in the thorax including primary malignancies (non-small cell lung cancer, esophageal cancer, malignant pleural mesothelioma) and metastasis are commonly encountered in clinical practice and can have a wide range of imaging manifestations. CT is almost typically used to diagnose, stage and assess treatment response in patients with intrathoracic malignancies. FDG-PET and MR imaging compliment conventional CT assessment and improve the accuracy of staging. This talk will review cases that elucidate the appropriate use of imaging in patients with intrathoracic malignancies as well as pitfalls in assessment and staging issues and dilemmas encountered in clinical practice.

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/ Jeremy J. Erasmus, MD - 2015 Honored Educator

MSCT22C Large Airway Disorders

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ellakaz@umich.edu

LEARNING OBJECTIVES

1) To better understand the spectrum of abnormalities that involve the large airways. 2) To learn advanced imaging techniques used to evaluate the large airways. 3) To learn the radiologic manifestations of the most common large airway lesions.

ABSTRACT

Diseases of the central tracheobronchial tree are uncommon, challenging to detect radiographically and occur in a structure that is generally less well interrogated when interpreting chest radiographic images. Advanced imaging techniques on modern multidetector CT scanners with multiplanar and 3D renderings, dynamic and multiphasic examinations (inspiratory/expiratory) and virtual endoscopy, have advanced our ability to both detect and characterize large airway abnormalities. The 'large' airways are defined as the trachea through segmental bronchi, the larger structures residing within the mediastinum may be referred to as 'intramediastinal,' and the smaller structures are located within the lungs, referred to as 'intraparenchymal'. Congenital abnormalities are uncommon and often incidentally detected, including a tracheal bronchus and the rare accessory cardiac bronchus, bronchial atresia and rare congenital tracheal stenosis. Among aquired abnormalities, post intubation stenosis, tracheomegaly and the saber trachea are the most common centrally, and foreign body aspiration is the most common within the larger intraparenchymal airways. Less common acquired disease include primary malignancy and metastases, chronic inflammatory and granulomatous diseases such as tracheobronchomalacia, amyloidoisis, polychondritis, granulomamatosis with polyangitis and sarcoidosis and infection, such as tuberculosis. Once abnormalities are identified, careful demonstration and measurement of the extent of abnormality is important when considering surgical and / or endobronchial interventional therapeutic approaches.

Honored Educators

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MSCT22D MRI of the Mediastinum, Pleura, and Lungs

Participants
Jeanne B. Ackman, MD, Boston, MA (*Presenter*) Spouse, Stockholder, Everest Digital Medicine; Spouse, Consultant, Everest Digital Medicine; Spouse, Stockholder, Cynvenio Biosystems, Inc; Scientific Advisory Board, Cynvenio Biosystems, Inc; Consultant, PAREXEL International Corporation

LEARNING OBJECTIVES

1) Become more aware of thoracic MR's value as a problem solver in the thorax. 2) Understand how MR assists with tissue diagnosis. 3) Learn how MR can add diagnostic specificity beyond that of CT, assisting clinical management, guiding the thoracic surgeon, and preventing unnecessary diagnostic intervention/surgery.

ABSTRACT

This case review will highlight the value of MRI as a problem-solving tool in the thorax. It will demonstrate how MR's tissue diagnostic capability can yield diagnostic specificity beyond that of CT. When used appropriately and performed well, MR can increase diagnostic certainty, guide the thoracic surgeon with regard to clinical management and surgical approach, and prevent unnecessary diagnostic intervention and follow-up for mediastinal, pleural, and lung masses.

MSMC24

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

Monday, Nov. 27 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*) Nothing to Disclose

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.

ABSTRACT

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

Sub-Events

MSMC24A Coronary Atherosclerosis and Bypass Grafts

Participants
Gautham P. Reddy, MD, Seattle, WA (*Presenter*) Researcher, Koninklijke Philips NV

LEARNING OBJECTIVES

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

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

MSMC24B Congenital Heart Disease

Participants
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

dececco@musc.edu

LEARNING OBJECTIVES

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

ABSTRACT

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

MSMC24C Coronary Artery Disease and Incidental Non-cardiac Findings

Participants
Diana Litmanovich, MD, Haifa, Israel (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title

View learning objectives under the main course title.

ABSTRACT

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

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MSMI24

Molecular Imaging Symposium: Cardiovascular MI Applications

Monday, Nov. 27 3:30PM - 5:00PM Room: S405AB

CA MR MI NM

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

FDA Discussions may include off-label uses.

Participants
Markus Schwaiger, MD, Munich, Germany (*Moderator*) Research Grant, Siemens AG; Speaker, Siemens AG
Robert J. Gropler, MD, Saint Louis, MO (*Moderator*) Grants, Bayer AG; Consultant, Biomedical Systems; Scientific Adivsor, Amgen Inc; Scientific Advisor, sanofi-aventis Group

For information about this presentation, contact:

rgropler@wustl.edu

Sub-Events

MSMI24A PET/MR Perfect Imaging Tool for MI?

Participants
Markus Schwaiger, MD, Munich, Germany (*Presenter*) Research Grant, Siemens AG; Speaker, Siemens AG

LEARNING OBJECTIVES

1) Get an overview of recent publications and set this into perspective based on a seven year long experience. 2) Identify potential clinical targets with a reasonable cost benefit ratio based on a weakness/strength analysis of the individual modalities. 3) Understand technical opportunities and limitations for hybrid PET/MRI cardiac imaging.

ABSTRACT

Since their introduction around 15 years ago, PET/CT and SPECT/CT hybrid imaging devices saw high clinical utilization, which was driven clearly by oncology. Fortunately, the basic availability in a clinical setting enabled the investigation of the cardiac imaging perspective and facilitated numerous research activities. Given the fact that cardiac MRI is a very attractive research field with an increasing clinical utilization, PET/MR raised the expectation of potential imaging scenarios with synergistic applications. Integrating molecular imaging with a multitude of PET agents and the high temporal and spatial resolution of MRI are ideally suited for novel applications having especially a reduced burden of ionizing radiation and lack of contrast media in mind. This presentation aims to provide insights into current and future applications but also the logistical issues one should consider when implementing a cardiac PET/MRI program.

MSMI24B Metabolic Characterization of Heart Disease

Participants
Robert J. Gropler, MD, Saint Louis, MO (*Presenter*) Grants, Bayer AG; Consultant, Biomedical Systems; Scientific Adivsor, Amgen Inc; Scientific Advisor, sanofi-aventis Group

LEARNING OBJECTIVES

1) To become more familar with the central role of myocardial metabolism in CV health and disease; 2) Understand how prolonged abnormalities can lead to impaired LV function; 3) Become more familar with how metabolic imaging can advance CV invesitgation and ehnace clinical care of cardiac patient.

ABSTRACT

The metabolism of exogenous and endogenous substrates, under baseline conditions and in response to metabolic and physiological stimuli, is necessary to maintain cardiac myocyte health. The increasing evidence demonstrating the primacy of perturbations in intermediary metabolism in the pathogenesis of common cardiovascular diseases such as ischemic heart disease, heart failure, and diabetic cardiomyopathy, further supports this contention. Of note, it is becoming increasingly apparent that chronic adaptations in cellular metabolism initiates a host of pleiotropic actions detrimental to cellular health such as impaired energetics, increases in inflammation, oxidative stress, and apoptosis.Moreover, our understanding of metabolic pathways continues to evolve with the acquisition of vast quantities of information from metabolomics, proteomics, and transcriptomics that are integrated from "big-data" sets such as the Kyoto Encyclopedia of Genes and Genomes. Indeed, the importance of myocardial metabolism was highlighted in a recent Scientific Statement from the American Heart Association. Finally, interest in modifying myocardial metabolism underlying human cardiovascular disease is exemplified by the robust drug discovery and development efforts to identify new metabolic modulators. Positron emission tomography (PET) is the most widely used methods to perform in vivo assessments of myocardial metabolism in pre-clinical model of disease and humans. Its high sensitivity, resulting in the administration of nano- to pico-molar concentrations of various radiotracers, and inherent quantitative capability permits the measurement of fluxes in absolute rates through key metabolic processes without perturbing the biochemical system. Moreover, PET benefits from the availability of an extensive portfolio of metabolic radiotracers. More recently, carbon-13 hyperolarized MR has been emplyed to provide detailed assessments of various metabolic pathways, albeit primarily in pre-clinical disease models. In this talk the fundamentals of these technologies in measuring myocardial metabolism will be disccused and their contribution to cardiovascular research highlighted and potential new clinical applications are reviewed.

MSMI24C PET Imaging of Infective Endocarditis and Cardiac Device Infection

Participants
Daniel Juneau, MD, Montreal, QC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

daniel.juneau@umontreal.ca

LEARNING OBJECTIVES

1) Review the available literature and discuss the accuracy of PET imaging for the diagnosis of infective endocarditis and cardiac device infection. 2) Review the advantages and limitations of PET versus other molecular imaging modalities and tests for these indications. 3) Discuss proper patient preparation and imaging protocols for these indications. 4) Discuss the role and appropriateness of PET for these indications, and how it should be integrated into current medical practice.

ABSTRACT

The indications for and use of cardiac implantable electronic device (CIED) and valve replacement have increased over the last decades. This increase in use has been accompanied by an increase in infectious complications. Despite efforts towards prevention, incidence of CIED infection and infective endocarditis (IE) have not declined. Both conditions are serious and life-threatening and are associated with a significant cost and burden on health systems. Their diagnosis relies on a mix of clinical, microbiological and echocardiographic findings, but due to the highly variable and nonspecific presentation of these processes, it remains challenging. Early and accurate diagnosis helps to lower morbidity and mortality. This situation has led to an increased interest in using advanced cardiac imaging, including PET/CT, to help complement the current investigative approach. This presentation will explore the value of molecular imaging in the diagnosis of CIED infection and IE, and explore how it can be properly integrated in the current diagnostic approach.

MSMI24D Myocardial Inflammation and Heart Failure

Participants
Marcelo F. Di Carli, MD, Boston, MA (*Presenter*) Research Grant, Spectrum Dynamics Medical, Inc; Research Consultant, General Electric Company; Research Consultant, sanofi-aventis Group; ;

MSMI24E Molecular Imaging of Atherosclerotic Plaques

Participants
Zahi A. Fayad, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

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

ABSTRACT

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

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RCA25

Introduction to Machine Learning and Texture Analysis for Lesion Characterization (Hands-on)

Monday, Nov. 27 4:30PM - 6:00PM Room: S401AB

IN

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

Participants
Kevin Mader, DPhil,MSc, Zuerich, Switzerland (*Moderator*) Employee, 4Quant Ltd; Shareholder, 4Quant Ltd
Kevin Mader, DPhil,MSc, Zuerich, Switzerland (*Presenter*) Employee, 4Quant Ltd; Shareholder, 4Quant Ltd
Joshy Cyriac, Basel, Switzerland (*Presenter*) Nothing to Disclose
Bram Stieltjes, MD,PhD, Basel, Switzerland (*Presenter*) Nothing to Disclose
Barbaros S. Erdal, PhD, Columbus, OH (*Presenter*) Nothing to Disclose
Luciano M. Prevedello, MD, MPH, Columbus, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

bram.stieltjes@usb.ch

kevin.mader@4quant.com

LEARNING OBJECTIVES

1) Review the basic principles of machine learning. 2) Learn what texture analysis is and how to apply it to medical imaging. 3) Understand how to combine texture analysis and machine learning for lesion classification tasks. 4) Learn the how to visualize and analyze results. 5) Understand how to avoid common mistakes like overfitting and incorrect model selection.

ABSTRACT

During this course, an introduction to machine learning and image texture analysis will be provided through hands on examples. Participants will use with open source as well as freely available commercial platforms in order to achieve tasks such as image feature extraction, statistical analysis, building models, and validating them. Imaging samples will include both 2D and 3D datasets from a variety of modalities (CT, PET, MR). The course will begin with a brief overview of important concepts and links to more detailed references. The concepts will then be directly applied in visual, easily understood workflows where the participants will see how the images are processed, features and textures are extracted and how publication ready statistics and models can be built and tested.

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RCB25

Making the Most of Google Docs: Docs, Slides, Forms, and Sheets (Hands-on)

Monday, Nov. 27 4:30PM - 6:00PM Room: S401CD

IN

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

Participants
Marc D. Kohli, MD, San Francisco, CA (*Moderator*) Nothing to Disclose
Thomas W. Loehfelm, MD, PhD, Atlanta, GA (*Presenter*) Nothing to Disclose
Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Ross W. Filice, MD, Chevy Chase, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of using Google tools for collaborative editing. 2) Explain issues related to storing protected health information in Google Drive. 3) Demonstrate the ability to use the Google productivity applications for collaboration on document, spreadsheet, online form and presentation creation.

ABSTRACT

Note: Attendees should have or create a Google account prior to coming to the session.In today's busy environment, we need tools to work smarter, not harder. Google's suite of productivity applications provides a platform for collaboration that can be used across and within institutions to produce documents and presentations and to obtain and work-up data with ease. However, with increased sharing, security concerns need to be addressed. At the end of the session, learners should be able to demonstrate creating, sharing, and editing a document as a group.

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RCC25

Patient-Centric Radiology

Monday, Nov. 27 4:30PM - 6:00PM Room: S501ABC

IN

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

Participants
Olga R. Brook, MD, Boston, MA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

obrook@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To learn about strategies and initiatives for patient-centric radiology.

Sub-Events

RCC25A Direct Patient Access to Radiologists: A Patient's Perspective

Participants
Dana Habers, MPH, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dhabers@med.umich.edu

LEARNING OBJECTIVES

1) Review a patient's perspective on direct access to the Radiologist & Radiology Reports. 2) Debate the impact of technology and patient portals on direct interaction between the Radiologist and patient. 3) Assess whether this insight may modify practice style or systems in place in your own practice.

ABSTRACT

The interaction between patients and Radiologists is changing - as patients improve awareness of their conditions through online references, connect with others who have a similar diagnosis through social media and other networking tools, or gain direct access to their own health records through online patient portals, the level of interaction patients expect from their providers (Radiologists included) is evolving. In this session we will explore the patient's perspective - peeling apart patient stories that lead us through the challenges and questions that arise from this phenomenon. We will explore it from both angles - the patient and the Radiologist - landing on a list of potential considerations for your own practice.

RCC25B How to Translate Radiology Reports to the Language that Patients Understand

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

tessa.cook@uphs.upenn.edu

LEARNING OBJECTIVES

1) Informatics can be used to develop methods to augment radiologists' current workflow to make it more patient-centric, by providing multimedia, annotated radiology reports that can help patients to better understand an interpretation typically written for consumption by one of their physicians.

RCC25C Multimedia Radiology Reports

Participants
Seth J. Berkowitz, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how multimedia reports can add value to patients and referring physicians.

RCC25D Electronic Kiosks for Patient's Satisfaction Surveys—Measuring and Improving Patient Experience in Radiology

Participants
Olga R. Brook, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

obrook@bidmc.harvard.edu

LEARNING OBJECTIVES

1) Although many different ways to obtain patient satisfaction data can be used, electronic kiosks offer an easy-to-use solution to obtain patient feedback immediately. 2) Benefits and limitations of the electronic kiosks for obtaining patient satisfaction data will be discussed.

ABSTRACT

Survey kiosks lead to a higher response rate than online surveys in our experience. Cleanliness, wait time, patient-staff communication, and especially courtesy of the receptionist were found to be important factors for patient satisfaction.

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SPDL21

Chest and Abdomen (Case-based Competition)

Monday, Nov. 27 4:30PM - 6:00PM Room: E451B

CH GI

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

Participants
Paul J. Chang, MD, Chicago, IL (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Advisory Board, Bayer AG; Advisory Board, Aidoc Ltd; Advisory Board, McCoy
Neety Panu, MD, FRCPC, Thunder Bay, ON (*Presenter*) Nothing to Disclose
Ashley Altman, MD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

pchang@radiology.bsd.uchicago.edu

ashley.altman@uchospitals.edu

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.*

ABSTRACT

The extremely popular audience participation educational experience, Diagnosis Live!, is an expert-moderated session featuring a series of interactive case studies that will challenge radiologists' diagnostic skills and knowledge. The session features a lively, fast-paced game format: participants will be automatically assigned to teams who will then use their personal mobile devices to test their knowledge in a fast-paced session that will be both educational and entertaining. After the session, attendees will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance.

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SPSI21

Special Interest Session: Experiencing Radiology: Patients' Perspectives

Monday, Nov. 27 4:30PM - 6:00PM Room: S402AB

OT

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

Participants
Mary C. Mahoney, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose
Christine Zars, MS, Saint Charles, IL (*Presenter*) Nothing to Disclose
Jennifer L. Kemp, MD, Denver, CO (*Presenter*) Advisory Board, Koninklijke Philips NV
James V. Rawson, MD, Augusta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jkemp@divrad.com

LEARNING OBJECTIVES

1) To understand the mission and goals of RSNA's Radiology Cares: The Art of Patient-centered Practice and ACR's Imaging 3.0 campaigns. 2) To assess your radiology practice model and realign it to focus on value over volume. 3) To learn tactics to put the concepts of patient-centeredness and value vs. volume into practice. 4) To understand your patients' perspectives as they navigate through the healthcare continuum, especially as it relates to radiology.

Honored Educators

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SPSI22

Special Interest Session: The Imaging Cognition—Dementia

Monday, Nov. 27 4:30PM - 6:00PM Room: E353C

BQ NR

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

Participants
David B. Hackney, MD, Boston, MA (*Moderator*) Nothing to Disclose
Jeffrey R. Petrella, MD, Durham, NC (*Moderator*) Nothing to Disclose

Sub-Events

SPSI22A Integrating Structural and Functional Biomarkers in Dementia Imaging

Participants
Tammie S. Benzinger, MD, PhD, Saint Louis, MO (*Presenter*) Research Grant, Eli Lilly and Company; Investigator, Eli Lilly and Company; Investigator, F. Hoffmann-La Roche Ltd;

SPSI22B The IDEAS Study: Goals and Update

Participants
Barry A. Siegel, MD, Saint Louis, MO (*Presenter*) Advisory Board, Blue Earth Diagnostics Ltd; Advisory Board, General Electric Company; Spouse, Speaker, Siemens AG

For information about this presentation, contact:

siegelb@wustl.edu

LEARNING OBJECTIVES

1) Identify appropriate and inappropriate uses of amyloid PET in clinical practice. 2) Recognize the design and goals of the IDEAS Study as a coverage with evidence development program underway to address the utility of amyloid PET in clinical populations. 3) Appreciate the impact of amyloid PET on patient management based on ealy reswults of the IDEAS Study.

SPSI22C Role of Imaging in Clinical Evaluation and Management of Dementia

Participants
Jeffrey R. Petrella, MD, Durham, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Envision the evolving role of MR and PET imaging in the personalized care of patients with dementia and those at risk.

SPSI22D Imaging Research in Dementia—The Foreseeable Near Future

Participants
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Presenter*) Research Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

SPSI22E Panel Discussion: Translation of Imaging Research to Clinical Care in Dementia

SPSI23

Special Interest Session: Translation of Quantitative Imaging from Clinical Research to Clinical Practice: Why and How?

Monday, Nov. 27 4:30PM - 6:00PM Room: E353B

BQ CT NM

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

Participants
Edward F. Jackson, PhD, Madison, WI (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

efjackson@wisc.edu

LEARNING OBJECTIVES

1) Appreciate the opportunities and advantages of quantitative imaging biomarkers in clinical practice, particularly in the era of precision medicine. 2) Understand the role of the RSNA Quantitative Imaging Biomarkers Alliance (QIBA) in the translation of quantitative imaging applications from academia to clinical practice. 3) Understand, by specific examples of FDG PET/CT SUV measurements in oncology and CT volumetry, QIBA processes that aid in the translation of quantitative imaging biomarkers. 4) Appreciate some of the key opportunities and challenges of the implementation of quantitative imaging biomarkers in radiology practice.

Sub-Events

SPSI23A The Added Value of Quantitative Imaging in Clinical Practice

Participants
Richard L. Wahl, MD, Saint Louis, MO (*Presenter*) Consultant, Nihon Medi-Physics Co, Ltd; Contract, WhiteRabbit.AI Inc; ;

Honored Educators

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SPSI23B The Quantitative Imaging Biomarker Alliance (QIBA) Approach to 'Industrializing Quantitative Imaging Biomarkers'

Participants
Kevin O'Donnell, Pacifica, CA (*Presenter*) Employee, Toshiba Medical Systems Corporation;

LEARNING OBJECTIVES

1) Understand the process by which QIBA selects and develops specifications including opportunities for participation and the different stages of maturity at which sites can choose to adopt those specifications.

URL

https://qibawiki.rsna.org/index.php/Main_Page

SPSI23C Practical Example: FDG-PET/CT SUV Measurements in Oncology

Participants
Paul E. Kinahan, PhD, Seattle, WA (*Presenter*) Research Grant, General Electric Company; Co-founder, PET/X LLC

SPSI23D Practical Example: CT Volumetry

Participants
Gregory V. Goldmacher, MD,PhD, West Point, PA (*Presenter*) Employee, Merck & Co, Inc; Stockholder, Merck & Co, Inc

LEARNING OBJECTIVES

1) Learners will be able to apply the process for standardization of tumor volume measurements by CT, as described in the QIBA profile.

SPSI23E Implementing Quantitative Imaging Biomarker Processes in a Radiology Department—A Chair's Perspective

Participants
Lawrence H. Schwartz, MD, New York, NY (*Presenter*) Committee member, Celgene Corporation Committee member, Novartis AG Committee member, ICON plc Committee member, BioClinica, Inc

SPSI24

Special Interest Session: How are Focal and Local Our Interventions? Systemic and Immunologic Effects of Interventional Oncology

Monday, Nov. 27 4:30PM - 6:00PM Room: N226

IR RO

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

FDA Discussions may include off-label uses.

Participants
S. Nahum Goldberg, MD, Ein Kerem, Israel (*Moderator*) Consultant, AngioDynamics, Inc; Research support, AngioDynamics, Inc; Consultant, Cosman Medical, Inc;
Muneeb Ahmed, MD, Wellesley, MA (*Moderator*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Gain awareness of the rationale and current clinical results of the cutting edge discipline of immuno-oncology. 2) Appreciate the extent of potentially beneficial and harmful systemic effects of "focal" interventional oncologic therapy. 3) Learn how immuno-oncologic techniques can be combined with both percutaneous and transcatheter interventional oncologic therapies to potentially achieve better clinical outcomes.

Sub-Events

SPSI24A Practical Primer of Immuno-oncology for the Radiologic Community

Participants
Lei Zheng, MD, Baltimore, MD (*Presenter*) Research Grant, Bristol-Myers Squibb Company; Research Grant, Merck & Co, Inc; Research Grant, iTeos Therapeutics SA; Research Grant, Gradalis, Inc; Research Grant, Amgen Inc; Research Grant, Halozyme Therapeutics, Inc; Royalties, Aduro BioTech, Inc; Advisory Board, Merrimack Pharmaceuticals, Inc; Consultant, Percan; Consultant, Biosynergics Inc; Shareholder, Z&L Medical International

LEARNING OBJECTIVES

View Learning Objectives under main course title

SPSI24B Combining Immuno-oncology with Ablation

Participants
Muneeb Ahmed, MD, Wellesley, MA (*Presenter*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc

For information about this presentation, contact:

mahmed@bidmc.harvard.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

SPSI24C Immuno-oncology and Transcatheter Techniques

Participants
Jens Ricke, MD,PhD, Munich, Germany (*Presenter*) Research Grant, Sirtex Medical Ltd; Research Grant, Bayer AG

LEARNING OBJECTIVES

1) Mechanisms of in-vivo vaccination by interventional techniques. 2) Potential synergies of chemoembolization or radiation techniques with checkpoint inhibition. 3) Future clinical implications of combined interventional oncology and checkpoint-inhibition.

SPSI24D Is All This Activation Beneficial? IO and Tumorigenesis

Participants
S. Nahum Goldberg, MD, Ein Kerem, Israel (*Presenter*) Consultant, AngioDynamics, Inc; Research support, AngioDynamics, Inc; Consultant, Cosman Medical, Inc;

LEARNING OBJECTIVES

View Learning Objectives under main course title

View Learning Objectives under main course title

SPSI25

Special Interest Session: Integration of CEUS into Radiology Practice

Monday, Nov. 27 4:30PM - 6:00PM Room: N228

US

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

FDA Discussions may include off-label uses.

Participants
Andrej Lyshchik, MD, PhD, Philadelphia, PA (*Moderator*) Research support, Bracco Group; Advisory Board, Bracco Group; Research support, General Electric Company; Research support, Siemens AG; Research support, Toshiba Medical Systems Corporation; Speaker, SonoScape Co, Ltd; ;

For information about this presentation, contact:

Andrej.Lyshchik@jefferson.edu

LEARNING OBJECTIVES

1) To provide the participants with overview of contrast-enhanced ultrasound applications and discuss integration of CEUS into clinical radiology practice.

Sub-Events

SPSI25A How to Integrate CEUS into Your Radiology Practice

Participants
Richard G. Barr, MD, PhD, Campbell, OH (*Presenter*) Consultant, Siemens AG; Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, SuperSonic Imagine; Speakers Bureau, Koninklijke Philips NV; Research Grant, Bracco Group; Speakers Bureau, Siemens AG; Consultant, Toshiba Medical Systems Corporation; Research Grant, Esaote SpA; Research Grant, BK Ultrasound; Research Grant, Hitachi, Ltd

LEARNING OBJECTIVES

1) To review current approaches of CEUS integration in clinical radiology practice including which patients are appropriate for CEUS, brief review of how to develop a CEUS program, and discussion of on label and off label uses of CEUS based on the literature.

ABSTRACT

This lecture will review current approaches of CEUS integration in clinical radiology practice including which patients are appropriate for CEUS, brief review of how to develop a CEUS program, and discussion of on label and off label uses of CEUS based on the literature.

Honored Educators

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SPSI25B CEUS: Technique, Protocols and Lexicon

Participants
Andrej Lyshchik, MD, PhD, Philadelphia, PA (*Presenter*) Research support, Bracco Group; Advisory Board, Bracco Group; Research support, General Electric Company; Research support, Siemens AG; Research support, Toshiba Medical Systems Corporation; Speaker, SonoScape Co, Ltd; ;

For information about this presentation, contact:

Andrej.Lyshchik@jefferson.edu

LEARNING OBJECTIVES

1) To review basics of CEUS image acquisition including available contrast agents, scanner settings, image acquisition protocols and lexicon of imaging findings.

SPSI25C CEUS in Multi-Modality Assessment of Benign and Malignant Liver Disease in the Non-cirrhotic Liver

Participants
Stephanie R. Wilson, MD, Calgary, AB (*Presenter*) Equipment support, Koninklijke Philips NV; Equipment support, Siemens AG; Equipment support, Samsung Electronics Co, Ltd; Speaker, General Electric Company; Speaker, Koninklijke Philips NV; Speaker, Saumsung

For information about this presentation, contact:

stephanie.wilson@ahs.ca

LEARNING OBJECTIVES

1) To review CEUS characteristics of focal liver lesions in non-cirrhotic liver and discuss value of CEUS in multimodality liver tumor assessment.

SPSI25D CEUS in Multi-Modality Assessment of the Liver at Risk for HCC

Participants
Hyun-Jung Jang, MD, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

hyun-jung.jang@uhn.ca

LEARNING OBJECTIVES

1) To describe use of CEUS in patients at risk for HCC including. 2) To understand recently proposed CEUS LI-RADS and CEUS integration with CT and MRI LI-RADS.

SPSI25E Multimodality Assessment of Renal Masses: Combination of CEUS and CT/MRI

Participants
Wui K. Chong, MD, Houston, TX (*Presenter*) Advisory Board, Bracco Group;

For information about this presentation, contact:

wkchong@mdanderson.org

LEARNING OBJECTIVES

1) To provide overview of CEUS imaging characteristics of benign and malignant renal masses and describe value of CEUS in multimodality renal mass imaging.

SPSI25F Molecular Imaging with CEUS

Participants
Juergen K. Willmann, MD, Stanford, CA (*Presenter*) Research Consultant, Bracco Group Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Advisory Board, Lantheus Medical Imaging, Inc Advisory Board, Bracco Group

For information about this presentation, contact:

Willmann@stanford.edu

LEARNING OBJECTIVES

1) To learn the principle of molecular imaging with CEUS. 2) To understand clinical indications of molecular imaging with CEUS. 3) To learn about the first feasibility, safety and efficacy data of molecular imaging with CEUS in patients.

ABSTRACT

Molecular imaging with ultrasound has recently moved into first-in-human clinical trials. This talk focuses on clinical indications and early clinical data in patients with prostate, ovarian, and breast cancer using ultrasound molecular imaging.

SPSI26

Special Interest Session: Preparing Imaging Investigators to Dive into the 'Shark Tank'

Monday, Nov. 27 4:30PM - 6:00PM Room: S404AB

OT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

LEARNING OBJECTIVES

1) Identify strategies for bringing a research idea to the marketplace. 2) Present a proposal in a way that elicits interest from potential investors. 3) Take steps to secure investor funding while developing and protecting the intellectual property. 4) Identify ways to generate business value through licensing and collaborations.

Sub-Events

SPSI26A Creating a Form for Venture Funding Pitches

Participants
Renee L. Cruea, Washington, DC (*Presenter*) Nothing to Disclose
Ronald L. Arenson, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify strategies for bringing a research idea to themarketplace.2) Present a proposal in a way that elicits interest frompotential investors.3) Take steps to secure investor funding while developing andprotecting the intellectual property.4) Identify ways to generate business value through licensing and collaborations.

ABSTRACT

If you are an imaging researcher and looking for alternatives to federal funding, Preparing Radiologists to Jump Into the 'Shark Tank' is an educational session for you! Learn about your options and the process to obtaining venture capital funding and the legal ramifications of this exciting funding alternative.The Plan:The Academy is providing an ongoing initiative with the primary goal of educating imaging investigators about how best to present translational research and technology development ideas to industry and other non-governmental funding sources. Today we explore an opportunity to educate and bring together investigators with venture capitalists and industry

SPSI26B The Pitch Teams

Participants
Patrick Baird, BS, Nashville, TN (*Presenter*) Nothing to Disclose
Andrew D. Smith, MD,PhD, Jackson, MS (*Presenter*) President, Radiostics LLC; President, eRadioMetrics LLC; Patent holder, eRadioMetrics LLC; President, Liver Nodularity LLC; Patent holder, Liver Nodularity LLC; President, Color Enhanced Detection LLC; Patent holder, Color Enhanced Detection LLC
Steven W. Hetts, MD, San Francisco, CA (*Presenter*) Royalties, Penumbra, Inc; Stockholder, ThrombX Inc; Researcher, Stryker Corporation; Researcher, Terumo Corporation; Researcher, Siemens AG
Michael Hanley, MD, Charlottesville, VA (*Presenter*) Nothing to Disclose
Vandiver Chaplin, MS, Nashville, TN (*Presenter*) Nothing to Disclose
Josh Chriscoe, Charlotte, NC (*Presenter*) Employee, Shertech Laboratories

For information about this presentation, contact:

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andrewdennissmith@uabmc.edu

LEARNING OBJECTIVES

1. Identify strategies for bringing a research idea to the marketplace. 2. Present a proposal in a way that elicits interest from potential investors. 3. Take steps to secure investor fundsing while developing and protecting intellectual property. 4. Identify ways to generate business value through licensing and collaborations.

ABSTRACT

eMASS is transforming evaluation of metastatic disease and lymphoma response to therapy with cutting-edge imaging software for the radiologist that eliminates errors, enhances efficiency, and imrpoves reporting and data visualization for oncologists and patients. eMASS software guides the radiologist through the tumor response process, making sure to capture all essential elements. Multiple steps are automated to improve efficiency. In a multi-institutional trial with 11 readers, eMASS software cut errors in tumor response assessment from 30% to 0% and was twice as fast as the manual (standard-of-care) method. The software is intuitive like and iPhone, requires only 1 hour of trianing to use, and is relevant to all therapies for all metastatic tumors and lymphoma. eMASS moves us away from freeform, ustructured reporting and transforms the radiology report into objective data with enhanced visualization (e.g. graphical display) for rapid interpretation by the oncologist and patient. eMASS LLC is an Alabama company with 100% ownership by its founder, Andrew Smith MD PhD, an oncologic radiologist who is president of a commercial core lab and Vice Chair of Radiology Research and Director of the Tumor Metrics Lab at the Unviersity of Alabama Medical Center. eMASS LLC has one U.S. patent accepted and several pending worldwide for its proprietary methods. eMASS is currently negotiating a licensing deal with a large clinical research organization, and eMASS software is separately being integrated into a commonly used PACS viewer

for further validation and FDA 510(k) clearance of a rapid and simple-to-use clinical practice version. Our customers are radiology practices, and we are seeking $1.5M to fully launch our start-up company.

URL

http://www.emass.co

SPSI26C Shark Tank Panel

Participants
Scott A. Penner, JD, San Diego, CA (*Presenter*) Nothing to Disclose
Ari Nowacek, MD,PhD, Chicago, IL (*Presenter*) Nothing to Disclose
Micheal Haimour, Pewaukee, WI (*Presenter*) Employee, Boston Scientific Corporation

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SPenner@foley.com

LEARNING OBJECTIVES

**View learning objectives in main course title

SPSI26D Discussion

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SPSI27

Special Interest Session: High Impact Clinical Trials

Monday, Nov. 27 4:30PM - 6:00PM Room: S404CD

OT

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

FDA Discussions may include off-label uses.

Participants
Udo Hoffmann, MD, Boston, MA (*Moderator*) Research Grant, HeartFlow, Inc

Sub-Events

SPSI27A Decision Quality and Quality of Life After Treatment for DCIS: A Trial of the ECOG-Acrin Cancer

Participants
Ruth C. Carlos, MD, MS, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Janie M. Lee, MD, Bellevue, WA (*Presenter*) Research Grant, General Electric Company
Justin Romanoff, MA, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Constantine Gatsonis, PhD, Providence, RI (*Abstract Co-Author*) Consultant, MedyMatch Technology, Ltd;
Ilana F. Gareen, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Habib Rahbar, MD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company
Kathy D. Miller, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Christopher E. Comstock, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Constance D. Lehman, MD, PhD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company
Seema A. Khan, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Derrick W. Spell, MD, Baton Rouge, LA (*Abstract Co-Author*) Nothing to Disclose
John R. Bumberry, MD, Springfield, MO (*Abstract Co-Author*) Nothing to Disclose
Bradley S. Snyder, MS, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Joseph A. Sparano, MD, Bronx, NY (*Abstract Co-Author*) Consultant, F. Hoffmann-La Roche Ltd; Consultant, Eli Lilly and Company; Consultant, Juno Therapeutics, Inc; Consultant, Celldex Therapeutics, Inc; Consultant, Seattle Genetics, Inc; Consultant, AstraZeneca PLC; Research Grant, Novartis AG; Research Grant, Deciphera Pharmaceuticals, LLC; Research Grant, Prescient Therapeutics Pty Ltd; Stockholder, MetaStat, Inc
Lynne I. Wagner, MD, Winston Salem, NC (*Abstract Co-Author*) Member, Scientific Steering Committee, Connect MM Registry, Celgene Inc.; Research Consultant, QMedic, Inc
Linda K. Han, Fort Wayne, IN (*Abstract Co-Author*) Consultant, Cardinal Health, Inc
Jennifer L. Sabol, MD, Wynnewood, PA (*Abstract Co-Author*) Nothing to Disclose
Kenneth B. Blankstein, MD, Flemington, NJ (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

Purpose: The choice of treatment for patients with DCIS is a complex process which must take into account patient preference, knowledge of surgery options, and preferred medical decision---making style. We hypothesize that the patient satisfaction with the decision process influences quality of life (QOL) following treatment. In this study, we 1)assessed quality of treatment decision---making among women with DCIS and 2)evaluated the impact of decision quality on QOL after treatment among women participating in a single arm multicenter preoperative MRI trial. Methods: In this trial of the ECOG---ACRIN Cancer Research Group (E4112), the study population included women with DCIS who were considered candidates for wide local excision (WLE) based on standard imaging (mammogram±sonography) and clinical exam without prior breast MRI. Patient---reported outcomes were collected prior to breast MRI(T0), 2---5 days after pre---surgical consult(T1) and post--- surgery(T2). We assessed quality of decision process by knowledge score (computed as % of questions correctly answered using a 5---item survey at T2), by decision process score (computed from a 7---item survey at T1, where higher scores represent higher levels of shared decision---making) and by decision confidence and perception of being informed (both derived from a respective single item at T1 with a 0--- 10 scale). Participants reported 1)preferred medical decision---making style at T0 using a 5---category scale reduced to three preference categories: surgeon---led decision, shared decision, patient---led decision and 2)perceived level of decision involvement at T1 using a 5---category scale reduced to three perception categories: surgeon---led decision, shared decision, patient---led decision. QOL was measured using PROMIS--- 10 Physical and Mental T---scores. Correlation was assessed using the Spearman rank correlation; comparisons were conducted using either a t---test or ANOVA model as appropriate. Results: 352 eligible women completed the study MRI (Figure 1). Median knowledge score was 80% (range 20---100%), median PROMIS---10 Physical and Mental T---scores were 50.8(range 26.7---67.7) and 50.8 (range 25.1---67.6). As knowledge score increased, post---surgery QOL significantly increased (p=0.007, Physical; p<0.001, Mental). Median decision process score was 71.4 (range 14.3---100). However, higher decision process scores were observed with the patient's perception that the treatment decision was shared or patient---led compared to surgeon---led(p<0.001). Decision process scores were significantly higher for mastectomy compared to WLE(p=0.04). No difference in post---surgery QOL was observed by varying decision process score (p=0.64, Physical; p=0.93, Mental). Knowledge score did not correlate with the perception of being informed (Spearman=---0.01, p=0.87) or decision confidence (Spearman=--- 0.05, p=0.45). In the 335 women with known final surgery, 270 received WLE, 54 received mastectomy, and 11 with attempted WLE ultimately received mastectomy. 86%(222/258) of women who initially preferred WLE at T0 received WLE; 64% (7/11) of women who initially preferred mastectomy received mastectomy. There was no significant difference in type of surgery received by knowledge score (p=0.85). Conclusion: Objective measures of decision quality such as knowledge score and decision process score were high. Only knowledge score predicted post---treatment physical and mental well---being. Although there was

no significant difference in knowledge score by surgery type, decision process scores were significantly higher, indicating more shared decision---making, for mastectomy compared to WLE.

SPSI27B Core Laboratory Versus Local Site Interpretation of Coronary CT Angiography (CTA): Association with Cardiovascular Events in the PROMISE (PROspective Multicenter Imaging Study for Evaluation of Chest Pain)

Participants
Michael T. Lu, MD, Boston, MA (*Presenter*) Nothing to Disclose
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;
Nandini M. Meyersohn, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Stephan Achenbach, MD, Erlangen, Germany (*Abstract Co-Author*) Research Grant, Siemens AG Research Grant, Bayer AG Research Grant, Abbott Laboratories Speaker, Guerbet SA Speaker, Siemens AG Speaker, Bayer AG Speaker, AstraZeneca PLC Speaker, Berlin-Chemie AG Speaker, Abbott Laboratories Speaker, Edwards Lifesciences Corporation
Brian B. Ghoshhajra, MD, Waban, MA (*Abstract Co-Author*) Consultant, Siemens AG; Consultant, Medtronic plc
Udo Hoffmann, MD, Boston, MA (*Abstract Co-Author*) Research Grant, HeartFlow, Inc
Pamela Douglas, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Maros Ferencik, MD, Boston, MA (*Abstract Co-Author*) Research Grant, American Heart Association
Stefan Puchner, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Hamed Emami, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Thomas Mayrhofer, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Daniel O. Bittner, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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ABSTRACT

Purpose: Detection of significant coronary artery disease (CAD) on coronary CT angiography (CTA) yields important prognostic information that may trigger downstream testing and coronary revascularization. However, the concordance and relative prognostic value of central core laboratory versus local site interpretation for significant CAD are not known. Methods: In PROMISE (PROspective Multicenter Imaging Study for Evaluation of chest pain), 193 North American sites interpreted coronary CTA as part of the clinical evaluation of stable chest pain. CTA was also interpreted retrospectively by a central core lab blinded to clinical data, site interpretation, and outcomes. Concordance between core lab and site interpretation for significant CAD (>=50% luminal stenosis) was assessed. Receiver operator characteristic analysis compared the area under the curve (AUC) of core lab versus site CTA findings of significant CAD for prediction of cardiovascular events (cardiovascular death or myocardial infarction). Results: 4347 subjects (51.8% women, mean age 60.4 } 8.2 yrs) had coronary CTA and were eligible. The core lab assigned 39% fewer patients as having significant CAD compared to sites (Table 1: 14%, 595/4347 vs 23%, 1000/4347, p<0.001). Core lab and site interpretations were discordant in 16% (683/4347). Discordance was most commonly due to significant CAD by site but not by core lab read (80%, 544/683). Overall, 1.3% (57/4347) suffered a cardiovascular event during median followup of 25 months. The event rate was 0.8% (27/3208) in patients with concordance for no significant CAD, 3.5% (16/456) with concordance for significant CAD, and 2% (14/683) in patients with discordance (p<0.001). Core lab and site findings of significant CAD had similar discrimination for cardiovascular events (c-statistic: 0.67 vs 0.68, p=0.71). Conclusions: Core lab interpretation of coronary CTA classified significantly fewer patients as having significant CAD compared to site interpretation, without a loss of predictive power for cardiovascular events.

SPSI27C A Pivotal Study of Opto-Acoustic Imaging to Diagnose Benign and Malignant Breast Masses: A New Evaluation Tool for Radiologists

Participants
Erin I. Neuschler, MD, Chicago, IL (*Presenter*) Research Grant, Seno Medical Instruments, Inc; Speaker, Northwest Imaging Forums, Inc; Faculty, ABC Medical Education, LLC; Speakers Bureau, General Electric Company; Speakers Bureau, Anderson Publishing, Ltd;
Constance D. Lehman, MD, PhD, Boston, MA (*Presenter*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company
Philip T. Lavin, PhD, Framingham, MA (*Abstract Co-Author*) Research Consultant, Seno Medical Instruments, Inc
F. L. Tucker, MD, Wirtza, VA (*Abstract Co-Author*) Nothing to Disclose
Lora D. Barke, DO, Greenwood Village, CO (*Abstract Co-Author*) Nothing to Disclose
Margaret L. Bertrand, MD, Greensboro, NC (*Abstract Co-Author*) Nothing to Disclose
Marcela Bohm-Velez, MD, Pittsburgh, PA (*Abstract Co-Author*) Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, Seno Medical Instruments Inc.; Research Grant, Delphinus Medical Technologies, Inc.;
Stamatia V. Destounis, MD, Scottsville, NY (*Abstract Co-Author*) Hologic, Inc. Scientific Advisory Board
Basak E. Dogan, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Pamela M. Donlan, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Stephen Grobmyer, MD, Cleveland, OH (*Abstract Co-Author*) Travel support, Seno Medical Instruments, Inc; Research support, Mitaka USA, Inc; Research support, Provista Diagnostics, Inc
Janine T. Katzen, MD, New York, NY (*Abstract Co-Author*) Travel support, Seno Medical Instruments, Inc
Kenneth Kist, MD, San Antonio, TX (*Abstract Co-Author*) Research Grant, Bayer AG ; Research Grant, Konica Minolta Group; Research Grant, Toshiba Medical Systems Corporation; Research Grant, Seno Medical Instruments, Inc
Erini V. Makariou, MD, Washington, DC, DC (*Abstract Co-Author*) Nothing to Disclose
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ABSTRACT

Purpose: The need to improve breast imaging specificity has led to interest in functional modalities that might better reveal non-anatomic differences in benign and malignant tumor biology. Optoacoustics (OA/US) functional imaging fuses the high contrast resolution of optical imaging with the good spatial resolution of US. This study compares the specificity of an investigational OA/US breast imaging device with that of gray-scale ultrasound (US) in evaluating breast masses. Methods: A prospective, HIPAA-compliant, IRB-approved 16-site study was undertaken to compare the BI-RADS classifications of breast masses assigned by independent readers (IR) using US alone to those assigned using OA/US images. The study is a FDA premarket approval (PMA) study of the OA/US device. The OA/US signal is color-coded and co-registered with the US image, and Temporarily interleaved with US images in real time, yielding a real time co-registered blood map of relative oxygenation-deoxygenation on the US image background. Masses assessed as BIRADS (BR) 3, 4 or 5 by US with histologic results from biopsy-proven histology and BR-3 masses stable at 12-month follow-up (per the FDA), were eligible for the study. 7 blinded independent readers (IRs) first assessed the masses and assigned a BR category using US images obtained on the OA/US device, and locked the results. Then they reviewed the OA images taken with the OA/US device, scored 3 internal and 2 external OA features, and finally assigned an OA Probability of Malignancy (POM) and an OA BR category. An OA POM of 1 or 2% allowed a mass to be classified as BR-3, while OA POM of 0% allowed a mass to be classified as BR-2. Specificity was calculated for biopsied benign masses and stable BR-3 masses with 12-month follow-up. Sensitivity was calculated for biopsied malignant masses. Results: 1765 masses were evaluated in 1698 subjects (678 malignant, 889 benign, 190 with 12-month follow-up). There were 12,283 reads by the 7 IRs. 8 masses did not meet follow-up criteria. OA sensitivity and specificity were 96.0% (99% CI:94.5%, 97.0%) and 43.0% (40.4, 45.7%), respectively, US sensitivity was 98.6% (97.8, 99.1%) and US specificity was 28.1% (25.8, 30.5%). OA had an absolute specificity advantage of 14.9% over US ($p < 0.0001$; 99% CI:12.9, 16.9%). In benign masses, OA downgraded 48.6% of BR-3 mass reads to BR-2, and 29.1% of BR-4A+ mass reads to a BR-2 or 3 when compared to US. OA correctly upgraded 47.0 % (31/66) of malignant mass reads classified as BR-3 by US. OA's negative likelihood ratio (NLR) was 0.094, which can reduce a maximum US-assigned pre-test probability of 17.8% (low BR- 4B) to a post-test probability of 2% (BR-3). Conclusions: OA/US had better specificity than US in assessing breast masses and has an excellent NLR. Using OA, blinded IRs downgraded the BR scores of some benign masses and upgraded those of some BR-3 malignant masses. These results suggest that OA/US offers the potential to reduce false positive diagnoses and to further enhance gray scale US accuracy in breast mass assessment.

RSNA 2017 Explore. Invent. Transform.
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MSRO29

BOOST: Head and Neck—eContouring

Monday, Nov. 27 4:45PM - 6:00PM Room: S104B

HN NR OI RO

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Suresh K. Mukherji, MD, Northville, MI (*Presenter*) Nothing to Disclose
Sung Kim, MD, New Brunswick, NJ (*Presenter*) Nothing to Disclose
Allen M. Chen, MD, Kansas City, KS (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Expose the audience to head and neck radiation therapy contouring. 2) Describe the concepts of CTV, GTV and PTV. 3) Demonstrate the complementary nature of different imaging techniques for tumor contouring.

ABSTRACT

The goal of this session is to expose the audience to head and neck radiation therapy contouring. The session will introduce the audience to concepts such as CTV, GTV and PTV. We will also demonstrate the important complementary nature of different imaging techniques for tumor contouring