

103rd Scientific Assembly and Annual Meeting

November 26 to December 1
McCormick Place, Chicago



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Tuesday

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SPDL30

Keeping Radiology Weird: Spot Diagnoses from the Pacific Northwest (Case-based Competition)

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

CA CH MK NR

AMA PRA Category 1 Credit™: 1.00

ARRT Category A+ Credit: 1.00

Participants

Fergus V. Coakley, MD, Portland, OR (*Moderator*) Founder, OmnEcoil Instruments, Inc; Shareholder, OmnEcoil Instruments, Inc

Bryan R. Foster, MD, Portland, OR (*Presenter*) Nothing to Disclose

Cristina Fuss, MD, Portland, OR (*Presenter*) Nothing to Disclose

David R. Pettersson, MD, Portland, OR (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

fussc@ohsu.edu

petterss@ohsu.edu

coakleyf@ohsu.edu

fosterbr@ohsu.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.*

SPSC30

Controversy Session: Combining Immunotherapy and Radiation: Is It All Hype?

Tuesday, Nov. 28 7:15AM - 8:15AM Room: E350

RO **SQ**

AMA PRA Category 1 Credit™: 1.00

ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Silvia C. Formenti, MD, New York, NY (*Moderator*) Nothing to Disclose

Silvia C. Formenti, MD, New York, NY (*Presenter*) Nothing to Disclose

Sandra DeMaria, MD, New York, NY (*Presenter*) Research Grant, Lytix Biopharma AS; Scientific Advisory Board, Lytix Biopharma AS; Consultant, Nanobiotix; Consultant, AstraZeneca PLC; Consultant, StemImmune, Inc

For information about this presentation, contact:

szd3005@med.cornell.edu

LEARNING OBJECTIVES

1) To understand how radiation affects the immune system, including the effect of dose fractionation and timing on immune activation. 2) To explain the rationale for combining specific regimens of radiation therapy with immunotherapy. 3) To determine the potential barriers that may need to be overcome for radiotherapy use as an adjuvant to immunotherapy treatment.

SPSH30

Hot Topic Session: Abbreviated Abdomen MRI Protocols

Tuesday, Nov. 28 7:15AM - 8:15AM Room: E450B

GI GU MR

AMA PRA Category 1 Credit™: 1.00

ARRT Category A+ Credit: 1.00

FDA

Discussions may include off-label uses.

Participants

Zhen J. Wang, MD, Hillsborough, CA (*Moderator*) Stockholder, Nextrast, Inc

For information about this presentation, contact:

Jane.Wang@ucsf.edu

LEARNING OBJECTIVES

1) Understand the workflow and finance issues related to implementing abbreviated MRI protocols in the clinics. 2) Describe the use of abbreviated MRI protocols for the evaluation of hepatocellular carcinoma, cystic pancreatic lesions, prostate cancer, and uterine cancer.

Sub-Events

SPSH30A Economic Rationale for Shorter MR Examinations

Participants

Sanjay Saini, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ssaini@mgh.harvard.edu

LEARNING OBJECTIVES

1) To understand long-term reimbursement trends for diagnostic imaging in general and MRI in particular. 2) To provide the clinical and economic rationale for shorter MR protocols made possible through recent technologic advances.

SPSH30B Abbreviated MRI for HCC Screening and Surveillance

Participants

Bachir Taouli, MD, New York, NY (*Presenter*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA

For information about this presentation, contact:

bachir.taouli@mountsinai.org

LEARNING OBJECTIVES

1) Review the current evidence on HCC screening and surveillance. 2) Introduce the concept of abbreviated MRI using gadoxetic acid for HCC screening. 3) Review early results of AMRI for HCC screening.

ABSTRACT

HCC is the fastest growing cause of cancer death in the United States. Practice guidelines recommend semi-annual HCC surveillance using ultrasound for high-risk patients to permit detection of HCC at an early stage, enabling effective treatment, and potentially improving survival. Due to known limitations of ultrasound, there is recent interest in developing fast MRI methods for HCC screening. In this presentation, we will discuss a novel abbreviated MRI (AMRI) exam designed to detect early-stage HCC in cirrhotic patients. AMRI is performed after gadoxetate disodium injection without the use of dynamic acquisitions, and combines only 3 sequences: T1 during the hepatobiliary phase, diffusion-weighted imaging and T2 SS FSE. The total exam time is ≤15 min, thus potentially decreasing costs. We will discuss pros and cons of AMRI, future directions and other alternatives.

SPSH30C A 10-min MRI Protocol for Follow Up Incidental Cystic Pancreatic Lesions

Participants

Ivan Pedrosa, MD, Dallas, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ivan.pedrosa@utsouthwestern.edu

LEARNING OBJECTIVES

1) To recognize the role of MRI in the follow up of incidental cystic pancreatic lesions. 2) To understand the potential advantages and disadvantages of a short MRCP protocol for the follow up of incidental cystic pancreatic lesions.

ABSTRACT

The diagnosis of incidental cystic pancreatic lesions has increased dramatically in the last decades due to widespread use of cross-sectional imaging and improvements in image quality. While the vast majority of these lesions exhibit a benign behavior a minority of them can evolve into invasive malignancies. This has led to the development and implementation of practice guidelines for the follow up of these lesions by several major medical organizations, all of which recognize serial imaging as the pillar of such strategies. Magnetic resonance cholangiopancreatography (MRCP) offers several advantages for the follow up of incidental pancreatic cystic lesions including excellent soft-tissue contrast and sensitivity to detect fluid and delineate ductal structures of the pancreaticobiliary system, and the lack of ionizing radiation. However, several qualities may challenge its broad implementation including long acquisition times, cost, and concerns about the repeated administration of gadolinium-based contrast agents during serial examinations. In this talk we will review the potential advantages and disadvantages of a short MRCP protocol for the follow up of incidental cystic pancreatic lesions.

Active Handout: Ivan Pedrosa

http://abstract.rsna.org/uploads/2017/17001338/Active_SPSH30C.pdf

SPSH30D **Abbreviated MRI of the Uterus and Cervix: When and How**

Participants

Evis Sala, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss patient preparation and specific MRI protocols for imaging of various uterine conditions. 2) Emphasize the role and indications for abbreviated MRI of the uterus and cervix. 3) Review specific MRI reporting tips for uterine and cervical pathologies.

ABSTRACT

URL

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/> Evis Sala, MD, PhD - 2013 Honored Educator Evis Sala, MD, PhD - 2017 Honored Educator

SPSH30E **Abbreviated Prostate MRI Protocols: Tips and Caution**

Participants

Andrew B. Rosenkrantz, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Andrew.Rosenkrantz@nyumc.org

LEARNING OBJECTIVES

1) Review the motivations for shortening standard protocols for prostate MRI. 2) Review various strategies for shortening prostate MRI protocols. 3) Consider pitfalls and published data relevant to shortened prostate MRI protocols.

RCB31

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

Tuesday, Nov. 28 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
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Rianne R. Engels, Cuijk, 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
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:

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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 be 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 last year's 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. Do 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 and take your tablet to view the coursebook during the course.

Active Handout: Renske Lian van Delft

http://abstract.rsna.org/uploads/2017/16002001/Active_RCB.pdf

MSAS31

The Developing Scope of Practice of the Radiographer/Radiological Technologist (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S105AB

OT

AMA PRA Category 1 Credits TM: 1.50

ARRT Category A+ Credit: 1.75

Participants

Charlotte Beardmore, MBA, London, United Kingdom (*Moderator*) Nothing to Disclose
Dimitrios Katsifarakis, MSc, Athens, Greece (*Moderator*) Nothing to Disclose

Sub-Events

MSAS31A Developing Scope of Practice of the Radiographer from the ISRRT Perspective

Participants

Donna E. Newman, BA, Fargo, ND (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn how Radiographers/ Radiologic technologist are a key part of the multi-disciplinary team and have an active role in justification and optimization of medical imaging and radio therapeutic within their scope of practice. 2) To learn how Radiographers/Radiologic Technologist play a key-role in radiation safety of patients in accordance with the "As Low as Reasonably Achievable (ALARA)" principle with in their scope of practice as they are the last person with the patient before exposure. 3) To learn how Radiographers/Radiologic Technologist are key role in patients' physical and psychosocial well-being, prior to, during and following examinations or therapy and are responsible to perform safe and accurate imaging examinations and post processing threw their scope of practice. 4) To learn how the advanced practitioner is an integral part of the imaging and radiotherapy treatment team in many countries globally and should be encouraged as a multi-disciplinary approach both at local departmental level and in the wider health care environment where scope of practice permits practice.

ABSTRACT

ISRRT represents more than 500,000 radiographers/Radiologic Technologists world-wide practicing in 92 countries. Their scope of practice can vary from country to country depending on national legislation and education curriculum provided within each of these countries. With work force shortages within health care and emerging technologies, Radiographers/Radiologic Technologists roles and scope of practice are continuing to develop to meet these needs of patients and to help ensure that Universal Health Care coverage happens globally. As a global stakeholder ISRRT contributes to these changes in basic role development as well as advanced practice development which will help play an integral part in imaging and treatment to improve service and delivery of health care universally. The evolving change will aid in the sustainable development goals which includes Universal Health Care by 2025 which has been part of the World Health Assembly's strategic goal.

MSAS31B The Developing Scope of Practice of the Radiographer/Radiological Technologist in Breast Imaging Services

Participants

Anne-Marie Culpan, PhD, Leeds, United Kingdom (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

anne-marie.culpan@hee.nhs.uk

LEARNING OBJECTIVES

1) Describe innovations in the scope of practice of radiographers in diagnostic breast services in the United Kingdom. 2) Critically appraise new theories which explain why practice varies between individuals and across institutions. 3) Improve their knowledge of Realist Evaluation research methodology and their understanding of how this is used to identify (and test) causal relationships between triggering 'contexts', resource and reasoning 'mechanisms' and resultant 'outcomes.' 4) Assess the potential of the role innovations presented to enhance clinical practice at micro (personal), meso (local) and macro (national) levels.

Active Handout: Anne-Marie Culpan

http://abstract.rsna.org/uploads/2017/17000225/AM_Culpan_RSNA_2017_-_handout.pdf

MSCC31

Case-based Review of Nuclear Medicine: PET/CT Workshop-Lymphoma and Pediatric PET/CT (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S406A

CT NM PD

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

Participants

Katherine A. Zukotynski, MD, Hamilton, ON (*Director*) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Hamilton, ON (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Apply basic anatomic, pathologic, and physiologic principles to the interpretation of PET/CT with emphasis on pediatrics and lymphoma. 2) Identify blind spots that can influence interpretation of PET/CT studies. 3) Analyze factors that can improve image quality while minimizing patient risk. 4) Learn available treatment response criteria that can be applied in the interpretation of clinical scans for lymphoma.

Sub-Events

MSCC31A Lymphoma

Participants
Delphine L. Chen, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

chend@wustl.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

Active Handout: Delphine L. Chen

http://abstract.rsna.org/uploads/2017/17001667/RSNA_lymphoma_11-2017_handouts.pdf

MSCC31B Pediatrics

Participants
Helen R. Nadel, MD, Vancouver, BC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

hnadel@cw.bc.ca

LEARNING OBJECTIVES

View Learning Objectives under main course title

MSES31

Essentials of Non-interpretative Skills

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S100AB

HP PR

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

Sub-Events

MSES31A Price Transparency in Radiology

Participants

Mark D. Hiatt, MD, MBA, Salt Lake City, UT (*Presenter*) Medical Director, Regence BlueCross BlueShield; Board Member, RadSite

For information about this presentation, contact:

mark.hiatt@regence.com

LEARNING OBJECTIVES

1) To explain why greater price transparency is needed for services provided by radiologists. 2) To identify how greater price transparency for radiological services may be achieved. 3) To examine what greater price transparency in radiology may look like in the future.

ABSTRACT

Rising health care costs, mounting patient demand, and the growing popularity of high-deductible insurance plans are driving the need for greater transparency in the prices charged for services provided by radiologists. This need is being met by new transparency tools and programs. As a result, the field of radiology will be increasingly consumer-centric in the future.

MSES31B Structured Reporting

Participants

Eduardo J. Mortani Barbosa, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To present different reporting strategies in Radiology, from narrative to fully structured reports, discussing their advantages and disadvantages. 2) To emphasize the key principles that should guide Radiology reporting: accuracy, clarity, consistency, and efficiency. 3) To highlight why and how structured reporting can improve the quality of Radiology reports via optimized internal organization, streamlined communication, reduced errors and potential for increase in efficiency, if designed and utilized thoughtfully. 4) To offer practical examples of how to construct efficient structured report templates for a variety of situations and examinations. 5) To discuss how to surmount the challenges involved in implementing structured reports and discuss future perspectives.

ABSTRACT

Traditional training in Radiology has focused on what to say when dictating reports, but not on how to construct better reports. The objective of this lecture is to demonstrate why and how structured reports can increase the value of Radiology reports, via discussion of the advantages and disadvantages of different Radiology reporting strategies, with emphasis on the principles and the evidence supporting implementation of structured reports. Finally, a practical framework will be offered with a recipe of how to design and implement structured reports with the following goals: reducing errors, improving accuracy, offering consistent internal organization, fostering better communication and potentially increasing efficiency.

MSES31C Radiology for Poor and Developing Countries: Past, Present and Future

Participants

Michael P. Yannes, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

michael.yannes@gmail.com

LEARNING OBJECTIVES

1) To convey the gravity of radiological disparity as it relates to medical health equity. 2) Introduce the RAD-AID organization and its global footprint. 3) Encourage RSNA members to engage in international radiology outreach.

ABSTRACT

Global health inequity is manifested in Radiology by a severe lack of access to radiological services. This lack of access includes lack of education, staff, capital, and resources. RAD-AID is a non-profit organization formed nearly a decade ago whose mission is to improve and optimize access to medical imaging and radiology in poor and developing regions of the world for increasing radiology's contribution to global public health initiatives and patient care. In this brief lecture, many of RAD-AID's efforts will be highlighted, with a focus on the country of Haiti.

MSES31D How Culture of Compliance Can Promote Burnout

Participants

Richard B. Gunderman, MD, PhD, Indianapolis, IN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rbgunder@iu.edu

LEARNING OBJECTIVES

1) Discuss factors that promote burnout. 2) Describe a culture of compliance. 3) Outline strategies for reducing the burnout associated with a compliance culture.

ABSTRACT

A culture of compliance values adherence to policies over the discretion of health professionals. Diminished professional autonomy and discretion are important contributors to burnout. Radiology personnel can take steps to diminish the adverse effects of compliance on morale.

MSQI31

Quality Improvement Symposium: The IOM Report on Improving Diagnosis

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S406B

SQ

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

FDA

Discussions may include off-label uses.

Participants

Lane F. Donnelly, MD, Houston, TX (*Moderator*) Nothing to Disclose

Sub-Events

MSQI31A The IOM Report: A Call to Action

Participants

Hedvig Hricak, MD, PhD, New York, NY (*Presenter*) Board of Directors, Ion Beam Applications, SA

LEARNING OBJECTIVES

1) Understand the key points from the IOM report, "Improving Diagnosis in Healthcare." 2) Become aware of areas in which radiology and radiologists can help in reducing diagnostic errors. 3) Understand the importance of engaging and communicating with patients for decreasing diagnostic errors. 4) Understand the importance of interdisciplinary teamwork for facilitating accurate and timely diagnosis.

MSQI31B Overview: Scale & Scope of Error in Diagnosis

Participants

James R. Duncan, MD, PhD, Saint Louis, MO (*Presenter*) Stock options, Proteon Therapeutics, Inc; Scientific Advisory Board, Metactive Medical Inc; Scientific Advisory Board, Flow Forward Medical Inc

For information about this presentation, contact:

jrduncan@wustl.edu

LEARNING OBJECTIVES

1) Describe the steps in the diagnostic process. 2) Estimate the frequency of diagnostic errors in medicine. 3) List failure modes for radiology's diagnostic process. 4) Identify the high priority failure modes for radiology.

ABSTRACT

This session will use the Institute of Medicine's 2015 report on Improving Diagnosis in Health Care as a starting point to review the steps in the diagnostic process. Radiology's failure modes at each step will be discussed and a method for identifying the highest priority failure modes will be presented.

MSQI31C The Diagnostic Process - More than Just Interpretation of Images

Participants

Matthew S. Davenport, MD, Cincinnati, OH (*Presenter*) Royalties, Wolters Kluwer nv; ;

For information about this presentation, contact:

matdaven@med.umich.edu

LEARNING OBJECTIVES

1) Understand that the job of a radiologist is to advance diagnosis and treatment, not simply to interpret individual image sets. 2) Recognize the benefits of multidisciplinary collaboration. 3) Learn the effect of language on effective radiology report communication.

MSRO31

BOOST: Genitourinary-Oncology Anatomy (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S103AB

GU **OI** **RO**

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

Participants

Daniel A. Hamstra, MD, PhD, Dearborn, MI (*Moderator*) Advisory Board, Myriad Genetics, Inc; Consultant, Augmenix, Inc
Jonathan M. Willatt, MBChB, Ann Arbor, MI (*Moderator*) Nothing to Disclose
Tristan Barrett, MBBS, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Rohit Mehra, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Brian J. Davis, MD, PhD, Rochester, MN (*Presenter*) Stockholder, Pfizer Inc; Speaker, Augenix Inc

For information about this presentation, contact:

tristan.barrett@addenbrookes.nhs.uk

LEARNING OBJECTIVES

1) To describe the role, challenges, and advantages of MRI in the planning of definitive radiotherapy for prostate cancer. 2) To describe the role, challenges, and advantages of MRI in the planning of post-operative radiotherapy for prostate cancer. 3) To assess the growing role of new PET imaging technologies for radiation planning in both the definitive and the adjuvant/salvage settings. 4) To assess the role of imaging in the diagnosis of prostate cancer through case examples. 5) To examine the implications of the Gleason grading system in prostate cancer in the context of imaging diagnosis and treatment pathways. 6) To assess the impact of MRI on staging prostate cancer in a multidisciplinary setting. 7) To identify the radiological anatomy of the prostate and isolate prostate cancer, including local involvement of extracapsular disease and lymph nodes. 8) To complete contouring of prostate cancer with a view to facilitating radiation treatment. 9) To define residual disease in the context of post treatment imaging, and delineate further treatment zones.

MSRO35

BOOST: Lung—Oncology Anatomy (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S103CD

CH **OI** **RO**

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

Participants

Meng X. Welliver, MD, Columbus, OH (*Moderator*) Nothing to Disclose
Subba R. Digumarthy, MD, Boston, MA (*Presenter*) Nothing to Disclose
Henning Willers, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

sdigumarthy@partners.org

hwillers@partners.org

LEARNING OBJECTIVES

1) Teach radiological and cross sectional anatomy for planning radiation therapy. 2) Develop strategies to avoid radiation to sensitive organs. *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

Common primary thoracic malignancies will be selected and important clinical aspects, anatomical aspects that influence management and treatment protocols will be highlighted

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.

Honored Educators

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RC301

Lung Cancer Screening

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E353C

CH

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

Participants

Caroline Chiles, MD, Winston-Salem, NC (*Moderator*) Advisory Board, ImBio, LLC

For information about this presentation, contact:

jerasmus@mdanderson.org

Sub-Events

RC301A Shared Decision Making and Smoking Cessation

Participants

Debra S. Dyer, MD, Denver, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

DyerD@NJHealth.org

LEARNING OBJECTIVES

1) Identify who can provide Shared Decision Making and what documentation is required. 2) Identify options for Smoking Cessation services and what documentation is required. 3) Recognize optimal strategies for incorporating Shared Decision Making and Smoking Cessation services into a Lung Cancer Screening Program. 4) Identify current reimbursement for Shared Decision Making and Smoking Cessation Counseling.

RC301B Nodule Risk Predication and Stratification

Participants

James G. Ravenel, MD, Charleston, SC (*Presenter*) Consultant, Imbio, LLC

For information about this presentation, contact:

ravenejg@musc.edu

LEARNING OBJECTIVES

1) To understand various nodule prediction models as they pertain to lung cancer screening. 2) To describe how these prediction models can be utilized to help tailor patient follow up.

RC301C Nodule Management

Participants

Mylene T. Truong, MD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review nodule management strategies. 2) To understand risks and benefits of various management strategies. 3) To select management with incorporation of risk assessment. 4) To apply lung-RADs guidelines for nodule management. 5) To compare Lung-RADs with volume based model of NELSON. 6) To evaluate how nodules that do not fit into Lung-RADs are managed.

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RC301D Atypical Screen-detected Lung Cancers

Participants

Caroline Chiles, MD, Winston-Salem, NC (*Presenter*) Advisory Board, ImBio, LLC

LEARNING OBJECTIVES

1) Recognize atypical presentations of screen-detected lung cancers.

RC301E Update on International Screening Trials

Participants

Mathias Prokop, PhD, Nijmegen, Netherlands (*Presenter*) Speakers Bureau, Bayer AG; Speakers Bureau, Bracco Group; Speakers Bureau, Toshiba Medical Systems Corporation; Research Grant, Toshiba Medical Systems Corporation;

RC302

TRaD Talks: Teaching Radiology Educators

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S405AB

ED

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

Participants

Petra J. Lewis, MD, Lebanon, NH (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1. List 2 reasons why drawings/medical comics are an effective means of teaching/learning medicine. 2. Draw at least 2 crude (but effective!) anatomic illustrations and use them to teach basic anatomy. 3. Explain why spaced interval testing results in better learning than repeated review. 4. Develop a learning or a teaching exercise that exploits spaced interval testing. 5. Discuss the importance of intrinsic versus extrinsic motivation for a learner. 6. Assess the motivational structure of a learning environment. 7. Summarize basic theory on technology and education. 8. Describe ways to incorporate technology in radiology education. 9. Discuss the potential inherent in one-to-many communication for advocacy and education. 10. Recognize the inherent scarcity of an individual's attention and the increasing demands on one's attention created in the age of "push" technology. 11. Describe approaches to teach professionalism amidst these increasing distractions in the reading room.

Sub-Events

RC302A TEST TEST TEST - How We Learn Best: The Science of Spaced Repetition

Participants

Petra J. Lewis, MD, Lebanon, NH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain why spaced interval testing results in better learning than repeated review. 2) Develop a learning or a teaching exercise that exploits spaced interval testing.

RC302B The Attention Economy in the Reading Room: Teaching Professionalism in the Era of Distraction

Participants

Jonathan O. Swanson, MD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jonathan.swanson@seattlechildrens.org

LEARNING OBJECTIVES

1) Recognize the inherent scarcity of an individual's attention and the increasing demands on one's attention created in the age of "push" technology. 2) Describe approaches to teach professionalism amidst these increasing distractions in the reading room.

RC302C Using Social Media for Education in Medicine

Participants

Wendy Sue Swanson, MD, Seattle, WA (*Presenter*) Stockholder, Doximity, Inc; Stockholder, Before Brands, Inc; Chief Medical Officer, Before Brands, Inc

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Radiologists will be able to identify opportunities of using social and traditional media, as well as digital technology, to enhance public understanding and increase potency of their advocacy. 2) Attendees will understand the value of one-to-many communication in advancing their impact, serving the population, and augmenting their academic work. 3) Attendees will know 3 social tools they can use to develop not only an online 'digital footprint' but an online 'digital fingerprint' to bolster their reputation and hone their effectiveness as leaders. 4) Attendees will be exposed to novel examples in digital innovation that will illustrate how new communication tools can bring efficiency to their patient care and potentially improve quality for their patients.

RC302D How to Foster Learner Self-Motivation

Participants

Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the importance of intrinsic versus extrinsic motivation for a learner. 2) Assess the motivational structure of a learning environment.

RC302E The 'ART' of Teaching: Teaching Medicine through Drawing

Participants

Stefan Tigges, MD, Atlanta, GA (*Presenter*) Stockholder, Microsoft Corporation; Stockholder, General Electric Company

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LEARNING OBJECTIVES

1) List two reasons why drawing is a powerful educational tool. 2) Discuss two scientific studies that support using simple drawings and comics to teach medicine. 3) Be able to draw two simplified pictures of important anatomic structures.

URL

<https://xraycomix.com/>

RC302F Educational Technology Theory

Participants

Harprit S. Bedi, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Summarize basic theory on technology and education. 2) Describe ways to incorporate technology in radiology education.

RC303

Cardiac Series: Emerging Cardiovascular MR and CT Imaging Techniques

Tuesday, Nov. 28 8:30AM - 12:00PM Room: S502AB

CA BQ CT MR

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

FDA Discussions may include off-label uses.

Participants

Suhny Abbbara, MD, Dallas, TX (*Moderator*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Bernd J. Wintersperger, MD, Toronto, ON (*Moderator*) Speakers Bureau, Siemens AG; Research support, Siemens AG; Speaker, Bayer AG

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Sub-Events

RC303-01 Spectral Detector CT

Tuesday, Nov. 28 8:30AM - 8:55AM Room: S502AB

Participants

Suhny Abbbara, MD, Dallas, TX (*Presenter*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

Honored Educators

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

RC303-02 Accuracy of Calcium Scoring (CACS) Calculated From Contrast Enhanced Coronary Computed Tomography Angiography (CCTA) Using Single Source Dual Layer Spectral Imaging CT

Tuesday, Nov. 28 8:55AM - 9:05AM Room: S502AB

Participants

Jonathan Nadjiri, MD, Munich, Germany (*Presenter*) Nothing to Disclose
Michael Rasper, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Georgios Kaissis, MD, PhD, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose
Felix Meurer, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexandra S. Straeter, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Ernst J. Rummeny, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Armin M. Huber, MD, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Standard evaluation of Coronary Artery Disease (CAD) requires non-contrast imaging for determination of (CASC) and contrast-enhanced imaging for evaluation of vascular stenosis. Several methods of calculating (CASC) from contrast-enhanced images have been proposed with good results. The principle for that has been spectral imaging to generate virtual non-contrast images allowing a specific subtraction of iodine from the image. However, the so far proposed techniques have some limitations: Dual Source imaging can lead to increased radiation exposure and switching the voltage of the tube (KV-switching) results in slower rotation speed of the gantry and is prone to motion artefacts which is especially critical in cardiac imaging. Spectral imaging with a dual layer detector might overcome these difficulties. Through absorption in the first layer, the second layer detects a harder spectrum of the emitted radiation from the same tube resulting in detection of two different radiation spectra. Our objective was to evaluate the accuracy of CACS from the virtual non-contrast imaging computed from spectral data in comparison to standard non-contrast imaging.

METHOD AND MATERIALS

We consecutively investigated 17 patients referred to CCTA with suspicion of CAD. The used scanner was a Philips IQon Spectral CT. CACS was calculated from both, real- and virtual non-contrast image by certified software for medical use.

RESULTS

Mean age was 59±12 years. 9 patients (53%) were male. Inter-quartile-range of clinical CACS was 0-461. Correlation of measured CACS from real- and virtual non-contrast images was very high (0.99); $p < 0.0001$. The slope was 2.1 indicating that values from virtual non-contrast are approximately half of the results from real-non contrast image. Visual analysis of Bland-Altman-Plot of

CACS shows good accordance of both methods when results from virtual non-contrast data are multiplied by the slope of the logistic regression model (2.1). The acquired power of the results is 0.99.

CONCLUSION

Determination of Calcium Score from contrast enhanced CCTA using spectral imaging with a dual layer detector is possible and shows good agreement with the standard technique when multiplied with a correction factor.

CLINICAL RELEVANCE/APPLICATION

In the future radiation exposure can be reduced through omitting native scans for patients referred to CCTA by using dual layer spectral imaging without the usual limitations of dual energy analysis.

RC303-03 Optimized Energy of Spectral Coronary CT Angiography for Coronary Plaque Detection and Quantification

Tuesday, Nov. 28 9:05AM - 9:15AM Room: S502AB

Participants

Rolf Symons, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Younhee Choi, BS, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Mark A. Ahlman, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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Amir Pourmorteza, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Jan G. Bogaert, MD, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
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
Veit Sandfort, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Optimal reconstruction methods for dual energy (DE) reconstruction of coronary plaque are unknown. The purpose of this study was to evaluate conventional mixed, conventional virtual monoenergetic (VM), and frequency spectrum noise-optimized virtual monoenergetic (VMO) reconstructions of coronary plaque with the goal of reducing image noise and improving signal- and contrast-to-noise ratio for coronary CT angiography (CCTA).

METHOD AND MATERIALS

DE CCTA was performed in 50 prospectively enrolled subjects eligible for high-intensity statin therapy using a dual-source CT scanner (90/Sn150 kVp, IRB approved: NCT02740699). Images were reconstructed with linear mixed blending, VM, and VMO with photon energies of 40-150 keV at 10-keV intervals. Image noise, iodine signal-to-noise-ratio (SNR), and contrast-to-noise ratio (CNR) for calcified (CP) and non-calcified plaque (NCP) were measured. Semi-automated software (QAngioCT, Medis) was used to quantify coronary plaque volumes using mixed and VMO images with photon energies of 40, 70, 100, and 130 keV. Linear mixed-models that account for within-subject correlation of plaques were used to compare the results.

CONCLUSION

Spectral DE CCTA with low energy (40-70 keV) virtual optimized post-processing can improve the CNR of coronary plaque detection by 25-28%. However, the lowest energy (40 keV) images may be prone to errors in plaque quantification likely due to lack of software optimization.

CLINICAL RELEVANCE/APPLICATION

Dual energy spectral CT using highly optimized, low keV images can substantially improve image quality for evaluation of coronary artery plaque compared to conventional CT images.

RC303-04 Quantifying Regional Myocardial Function-Strain, Torsion and Twist

Tuesday, Nov. 28 9:15AM - 9:40AM Room: S502AB

Participants

Bernd J. Wintersperger, MD, Toronto, ON (*Presenter*) Speakers Bureau, Siemens AG; Research support, Siemens AG; Speaker, Bayer AG

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Active Handout: Bernd J. Wintersperger

http://abstract.rsna.org/uploads/2017/16001381/Active_RC303-04.pdf

LEARNING OBJECTIVES

1) Describe the principle architecture of the LV related to cardiac function. 2) Describe the principles of regional myocardial function assessment. 3) Compare different imaging approaches for quantification of regional myocardial function. 4) Identify possible applications of regional function analysis in clinical cardiac imaging.

ABSTRACT

A complex joint effort of the entire heart muscle is required to provide normal ventricular output. While the evaluation of global cardiac function and volumes aims at assessment of the gross ventricular status, measures of regional myocardial function provide a more detailed analysis of the myocardial function and its individual components. Parameters of regional myocardial function

generally describe the relationship between force and resulting deformation of finite elements. Furthermore, such regional parameters are used to describe these relationships along various directions of the cardiac axis and coordinate system. The complex composition of myocardial layers including the change of fiber orientation with location may also allow more insight into the effect of pathologies on function. Different modalities (Echo, MRI, CT) have been proposed for the assessment of such parameters. While in MRI regional parameters have predominately been used for research purposes, the development of speckle-tracking echocardiography (STE) and its evaluation has pushed towards clinical applications of regional myocardial functional parameters. The clinical use of such techniques may allow for earlier identification of subclinical pathology and as such may trigger therapy decisions at earlier time points.

RC303-05 MR-based Assessment of Myocardial 2D Strain using Feature Tracking: Association to Cardiovascular Risk Factors in a Population based Cohort free of Cardiovascular Disease

Tuesday, Nov. 28 9:40AM - 9:50AM Room: S502AB

Participants

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Christopher L. Schlett, MD, MPH, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Myocardial strain analysis is a promising tool for the detection of subtle but relevant alterations of left ventricular function, also in asymptomatic subjects. Thus, we determined the feasibility of cardiac MR-based 2D global strain analysis using feature tracking and its association with cardiovascular risk factors in a sample from the general population.

METHOD AND MATERIALS

Subjects without history of cardiocerebrovascular disease were enrolled in a sub-study of the population-based KORA (Cooperative Health Research in the Region of Augsburg) cohort. In all participants with absence of late gadolinium enhancement, longitudinal and circumferential global strain were measured on Cine SSFP imaging (TR: 29.97ms, TE: 1.46ms, ST: 8mm), using a semiautomatic segmentation algorithm (CVI42, Circle, Canada). Differences in strain values according to age, gender, BMI, hypertension, diabetes mellitus and hyperlipidemia were derived using linear regression analysis.

RESULTS

Among 360 subjects (mean age, 56.2±9.2 years, 57% male), average global systolic radial strain was 40.1±8.2%, circumferential 19.9±2.7% and longitudinal 19.8±3.2%. Male gender was associated with decreased global strain values, independent of the strain direction (all $p < 0.001$). While many cardiovascular risk factors were correlated with strain in univariate analysis, mainly waist-to-hip ratio and HbA1c remained associated with decreased radial and circumferential strain in fully adjusted models. Similarly, higher radial and circumferential strain was observed in older subjects ($\beta = 0.14$, $p = 0.01$ and $\beta = 0.11$, $p = 0.04$, respectively).

CONCLUSION

Strain analysis using MR feature tracking is feasible in population-based cohort studies and shows differences with respect to age and gender as well as an independent association with markers of metabolic syndrome.

CLINICAL RELEVANCE/APPLICATION

MR-based strain analysis is a very useful tool for detection of early cardiac dysfunction, but several influencing factors need to be considered.

RC303-06 Sparse CINE SSFPs for Left Ventricular Functional Analysis in Cardiac MRI: Accuracy in Patients with Structural Myocardial Inhomogeneities

Tuesday, Nov. 28 9:50AM - 10:00AM Room: S502AB

Participants

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Christina Doesch, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Johannes Budjan, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To investigate in a sparse 2D real-time CINE TrueFISP sequence featuring iterative reconstruction (SSIR) possible influence of structural myocardial inhomogeneity indicated by presence of late-gadolinium enhancement (LGE+) with regard to accuracy of left ventricular (LV) functional analysis.

METHOD AND MATERIALS

In patients undergoing cardiac MRI on a 3 Tesla system the SSIR sequence was once acquired in a single-breath-hold (sBH) and once during free breathing (non-BH), as well as the fully-sampled multi-breath-hold reference standard sequence (RS) for LV functional analysis. LV-assessment was performed with dedicated software (Argus, Siemens Healthcare Sector). Agreement of SSIR and RS for the LV functional parameters ejection fraction, end-diastolic and end-systolic volume and stroke volume was determined with Bland-Altman-analysis and linear regression analysis.

RESULTS

51 patients (25 LGE+; 26 LGE-) who underwent LGE-imaging and LV analysis with the RS and the SSIR sequence were investigated. Linear regression analysis revealed with sBH-SSIR in comparison to RS excellent correlation coefficients r from 0.85-0.98 in LGE+ patients, from 0.92-0.99 in LGE- patients and with non-BH-SSIR r from 0.83-0.97 in LGE+ and 0.91-0.98 in LGE- patients, respectively (All p -values <0.0001). No significant bias was found in Bland-Altman-analysis when SSIR LV functional results in both LGE+ and LGE- patients were compared to RS results (all p -values > 0.05).

CONCLUSION

LV functional parameters can be accurately assessed using SSIR datasets acquired with a single breath-hold or during free breathing in patients with circumscribed cardiac structural inhomogeneities indicated by presence of LGE. Data acquisition is accelerated on average by factor 12.

CLINICAL RELEVANCE/APPLICATION

Accurate MR LV functional analysis can be accelerated by factor 12 using sparse sampling featuring iterative reconstruction (SSIR) imaging even in patients with structural myocardial inhomogeneities.

RC303-07 Valvular Flow Quantification with Phase Contrast Imaging (2D, 4D)

Tuesday, Nov. 28 10:20AM - 10:45AM Room: S502AB

Participants

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

LEARNING OBJECTIVES

1) Understand principles and techniques for cardiovascular flow quantification using 2D phase contrast MRI and 4D flow MRI. 2) Describe advantages of 4D flow MRI for the comprehensive assessment of valvular flow characteristics. 3) Identify possible applications of 2D and 4D flow MRI in clinical cardiovascular imaging.

RC303-08 Optimized Aortic 4D Flow MRI in Under 3 Minutes: Impact of Resolution and Respiratory Navigator Gating On the Quantification of 3D Wall Shear Stress

Tuesday, Nov. 28 10:45AM - 10:55AM Room: S502AB

Participants

Emilie Bollache, Chicago, IL (*Presenter*) Nothing to Disclose

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Ryan S. Dolan, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

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

PURPOSE

Wall shear stress (WSS) plays an important role in the regulation of cellular function and remodeling. We evaluated the performance of aortic WSS estimates using a newly developed k-t accelerated non-navigator gated 4D flow MRI sequence, which was shown to provide consistent velocity and flow indices with total scan times under 3 minutes.

METHOD AND MATERIALS

k-t accelerated free breathing 4D flow MRI (PEAK GRAPPA acceleration factor $R=5$, spatial resolution $SRes=3.4\pm0.1\times2.3\times2.8\pm0.2mm^3$, temporal resolution $TRes=65.6-67.2ms$, scan time=1:21-2:40min) combined with a custom k-space reordering was compared to conventional navigator-gated 4D flow MRI acquired according to consensus recommendations (GRAPPA $R=2$, $SRes=3.2\pm0.1\times2.2\pm0.1\times2.7\pm0.3mm^3$, $TRes=38.4-39.2ms$, scan time=8:58-17:37min). Acquisitions were performed *in-vitro* using a patient-specific 3D-printed descending aortic (DA) coarctation model and a pulsatile pump, in 10 healthy volunteers (6 men, 61 ± 16 years) and in 10 patients with aortic disease (7 men, 60 ± 10 years). Data analysis included calculation of 3D systolic aortic WSS and quantification of maximal WSS (2% highest values) throughout the cardiac cycle in the ascending aorta (AA), aortic arch and DA.

RESULTS

3D aortic systolic WSS distributions and regional maximal WSS waveforms are illustrated in Figure A and B for conventional and the k-t accelerated 4D flow MRI. Figure C provides Bland-Altman diagrams combining all time frames and aortic regions. Absolute differences between k-t accelerated and conventional WSS were as follows for the AA, arch and DA, respectively: 6.9 ± 5.6 , 9.2 ± 5.7 and $7.9\pm3.9\%$ (*in-vitro*); 15 ± 16 , 19 ± 23 and $19\pm20\%$ (volunteers); 11 ± 8.0 , -11 ± 11 and $14\pm15\%$ (patients). While peak systolic WSS was similar between the 2 techniques in healthy subjects at all locations, it was significantly underestimated (by $19\pm22\%$, $p=0.04$) in the DA in patients when using k-t accelerated 4D flow.

CONCLUSION

Aortic WSS calculation is sensitive to respiration gating and/or reduced resolution in patients with complex flow due to stenosis or

aneurysm. Larger studies are warranted to define the best compromise between short 4D flow MRI scan time, resolution, respiratory motion and accuracy in calculating WSS.

CLINICAL RELEVANCE/APPLICATION

Highly accelerated 4D flow MRI will help enhancing the clinical usefulness of its 3D time-resolved wall shear stress quantification in cardiovascular disease.

RC303-09 First Results of CT-Derived Cardiac 4D Blood Flow: Comparison with 4D Flow MRI

Tuesday, Nov. 28 10:55AM - 11:05AM Room: S502AB

Participants

Jonas Lantz, Linköping, Sweden (*Presenter*) Nothing to Disclose
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PURPOSE

Current computed tomography (CT) technology can provide high-resolution time-resolved cardiac anatomy images, but unlike 4D Flow MRI or ultrasound, blood flow data cannot be assessed directly with CT. However, with modelling approaches, fractional flow reserve can now be estimated using CT. The aim of this study was to extend the use of clinical CT applications to assessment of intracardiac blood flow. This was done by utilizing our recently developed 4D Flow CT framework that can compute the resulting cardiac blood flow using conventional retrospectively gated coronary CT angiography (cCTA) images.

METHOD AND MATERIALS

cCTA and 4D Flow MRI measurements were acquired in a cohort of 9 patients who all had a cCTA referral. Our 4D Flow CT framework is based on computational fluid dynamics with wall motion extracted from CT data. Using this framework, intracardiac flow fields were obtained for all patients. Results could then be compared to 4D Flow MRI measurements.

RESULTS

Characteristic cardiac blood flow patterns, like vortices and jets, were seen in atriums and ventricles in both techniques. The 4D Flow CT derived flow field agreed visually very well with 4D Flow MRI. Linear regression showed that peak flow rate derived from 4D Flow CT had an excellent agreement with 4D Flow MRI measurements ($R^2=0.96$, Pearson correlation coeff. $p=0.98$) as well as for stroke volume ($R^2=0.80$, $p=0.89$).

CONCLUSION

We demonstrate the feasibility of a novel patient specific CT method to obtain intracardiac blood flow. Nine patients were evaluated with 4D Flow CT, and both qualitative and quantitative results agreed well with in vivo MRI measurements. This provides the ability to obtain new functional information without affecting the cCTA examination. Additionally, the method gives the potential to simulate "what if" scenarios. Larger prospective studies are required to further establish its diagnostic performance and incremental value compared with MRI or cCTAs.

CLINICAL RELEVANCE/APPLICATION

The method can add new functional information to cCTA and has great potential to increase the moderate positive predictive value of clinical cCTA while keeping the high negative predictive value.

RC303-10 Multiparametric Myocardial MR Mapping (T1, T2 and T2*)

Tuesday, Nov. 28 11:05AM - 11:30AM Room: S502AB

Participants

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

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LEARNING OBJECTIVES

1) Describe the basic techniques of myocardial MR mapping. 2) Explain the role of myocardial MR mapping. 3) Identify findings of common diseases on T1, T2, and T2* maps.

Honored Educators

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

RC303-11 Quantitative Comparison of T1 Shortening by Three Different Macrocyclic Gadolinium-Based Contrast Agents in Cardiac MRI of the Myocardium and Left Ventricle

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S502AB

Participants

Takahito Nakajima, MD, Maebashi, Japan (*Presenter*) Nothing to Disclose

Ayako Shimazaki, Maebashi, Japan (*Abstract Co-Author*) Nothing to Disclose

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Yoshito Tsushima, MD, Maebashi, Japan (*Abstract Co-Author*) Institutional Research Grant, Bayer AG ; Institutional Research Grant, DAIICHI SANKYO Group; Institutional Research Grant, Eisai Co, Ltd; Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, FUJIFILM Holdings Corporation ; Institutional Research Grant, Fuji Pharma Co, Ltd; Institutional Research Grant, Siemens AG ; Institutional Research Grant, OncoTherapy Science, Inc; Institutional Research Grant, Becton, Dickinson and Company; Speaker, Bayer AG ; Speaker, DAIICHI SANKYO Group; Speaker, Eisai Co, Ltd; Speaker, Fuji Pharma Co, Ltd; Speaker, Guerbet SA; .;

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PURPOSE

The aim of this study is to investigate the effect of three different macrocyclic gadolinium-based contrast agents (mGBCA) on T1 shortening in the myocardium and left ventricle (LV).

METHOD AND MATERIALS

This retrospective study included 40 patients (20 women) who underwent CMR with T1 mapping before and after administration of the following mGBCAs: gadoterate meglumine (MagneScope®; Terumo Co. Ltd., Japan; n = 10); gadteridol (ProHance®; Eisai Co. Ltd., Japan; n = 13); and gadobutrol (Gadovist®; Bayer Co. Ltd., Japan; n = 17). Gadoterate meglumine and gadoteridol were administered for patients from May 2015 to March 2016, and gadobutrol was administered from April 2016 to September 2016. Gadoterate meglumine was used for patients weighing less than 55 kg, and gadoteridol was used for patients over 55 kg. Gadobutrol was used for patients of any body weight. MRI was performed using a 3T system (MAGNETOM Skyra, Siemens Healthcare, Germany). T1 mapping was conducted using modified look-locker inversion recovery (MOLLI) sequences to measure the T1 relaxation time values of the myocardium and LV. Regions of Interest were drawn on the short axis images of areas of the myocardium without lesion involvement, at the LV septal/inferior walls, and in the LV cavity. Statistical analyses were conducted using Kruskal-Wallis test with Bonferroni correction for multiple comparison of imaging parameters. $P < 0.05$ was considered statistically significant.

RESULTS

Native T1 relaxation times were not significantly different across the three groups for either the myocardium, ranging from $1220 \text{ ms} \pm 267$ to $1265 \text{ ms} \pm 52$, or the LV, ranging from $1740 \text{ ms} \pm 550$ to $1957 \text{ ms} \pm 86$. T1 relaxation times for the myocardium were significantly lower in the group administered gadobutrol ($594 \text{ ms} \pm 53$, $P < 0.0001$) compared to the groups administered gadoterate meglumine ($691 \text{ ms} \pm 31$) or gadoteridol ($645 \text{ ms} \pm 53$). T1 relaxation times for the LV were also significantly lower in the gadobutrol group ($415 \text{ ms} \pm 51$, $P < 0.0001$) compared with the groups administered gadoterate meglumine ($555 \text{ ms} \pm 46$) or gadoteridol ($493 \text{ ms} \pm 55$).

CONCLUSION

Gadobutrol showed the most effective shortening of T1 relaxation times in the myocardium and LV cavity.

CLINICAL RELEVANCE/APPLICATION

The T1-shortening abilities of gadobutrol would contribute to depict myocardial lesions even at the concentration of 0.1 mmol/kg .

RC303-12 Myocardial Edema Detecting By Cardiovascular Magnetic Resonance T2 Mapping in Patients with End Stage Renal Disease: Comparing with Conventional T2-Weighted Imaging

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S502AB

Participants

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PURPOSE

To explore the effectiveness of T2 mapping and conventional T2-weighted imaging (T2WI) in the detection of myocardial edema in patients with end stage renal disease (ESRD), and further compare the reproducibility of these two technique.

METHOD AND MATERIALS

Forty-six ESRD patients and 12 age/gender matched healthy volunteers were recruited and underwent cardiac magnetic resonance (CMR) examination. The ESRD patients were divided into patient's with impaired left ventricular (LV) function (LV ejection fraction [EF] $< 50\%$, $n=31$) and those with preserved LV function (LVEF $> 50\%$, $n=15$). T2 values and T2 SI ratios for myocardial edema in basal, middle and apex segments were assessed from T2 mapping and T2WI images respectively by offline post-processing software and statistically compared. By Intra-class correlation coefficient (ICC) analysis, inter- and intra- observer agreement representing the reproducibility of T2 mapping and T2WI were obtained.

RESULTS

The global T2 values of ESRD patients with impaired LV function and with preserved LV function were high than normal controls ($46.2 \pm 4.58\text{ms}$, $43.2 \pm 4.65\text{ms}$, $39.0 \pm 3.33\text{ms}$, respectively, all $P < 0.05$). For the segmental heterogeneity, T2 values of basal, middle and apical segments in ESRD with impaired LV function were the highest comparing with those with preserved LV function and normal ones (all $P < 0.05$). However, for the T2 SI ratios, ESRD with impaired LV function was highest among the three group, but no statistical difference were found ($P = 0.86$). T2 values were negatively related with LVEF ($r = -0.46$, $p < 0.001$). By the analyzing of reproducibility, inter- and intra-observer agreement of T2 value were both improved and excellent high comparing with T2 SI ratio (Inter-observer: ICC=0.994 vs. 0.980; Intra-observer: ICC=0.988 vs. 0.960).

CONCLUSION

Quantitative T2 mapping is a higher reproducible tool replacing conventional T2WI imaging to evaluate the myocardial edema of ESRD patients. The myocardial edema was existed in ESRD patients and had a negative effect on cardiac dysfunction.

CLINICAL RELEVANCE/APPLICATION

(dealing with cardiovascular disease) 'Cardiac MR studies can demonstrate existing impaired myocardium in end stage renal disease patients and this exam will contribute to early detection of cardiac function impairment.

RC303-13 Diagnostic Value of Tissue Characteristic Parameters in Acute Myocarditis: A Double-Center Study

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S502AB

Participants

Mu Zeng, Changsha, China (*Presenter*) Nothing to Disclose
Zhaoying Wen, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Gang Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Xiaolei Zhu I, PhD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Jing An, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the diagnostic value of cardiac magnetic resonance imaging in patients with suspected acute myocarditis using multi-parameter cardiac magnetic resonance imaging with T1 mapping and T2 mapping as a tool for tissue characterization.

METHOD AND MATERIALS

A total of 50 patients with acute myocarditis and 100 controls from 2 centers were included in this study. Cardiac magnetic resonance imaging methods included black blood T2-weighted short tau inversion recovery, early gadolinium enhancement, delayed gadolinium enhancement, native T1 relaxation time, native T2 relaxation time and extracellular volume fraction. Diagnostic performance was compared using the receiver operating characteristic curve with clinical evidence of acute myocarditis as a reference standard.

RESULTS

The area under the curve of Lake Louise criteria was 0.865, with sensitivity of 92% and specificity of 81%. The area under the diagnostic curve of native T1 was 0.909, with sensitivity of 88% and specificity of 85% (cutoff, 1256 ms). The area under the diagnostic curve of native T2 was 0.679, with sensitivity of 78% and specificity of 65% (cutoff, 44.2 ms). The area under the diagnostic curve of ECV was 0.817, with sensitivity of 72% and specificity of 81% (cutoff, 28.1%).

CONCLUSION

Diagnostic performance of native T1 is superior to native T2 and ECV, and its specificity is also higher than the Lake Louise criteria. Native T1 relaxation time, as a supplement to existing cardiac magnetic resonance techniques, is of high value in the diagnosis of suspected acute myocarditis.

CLINICAL RELEVANCE/APPLICATION

(dealing with acute myocarditis) Native T1 relaxation time is of high value in the diagnosis of suspected acute myocarditis.

RC304

Musculoskeletal Series: Ultrasound

Tuesday, Nov. 28 8:30AM - 12:00PM Room: E450A

MK US

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

FDA Discussions may include off-label uses.

Participants

Marnix T. van Holsbeeck, MD, Detroit, MI (*Moderator*) Consultant, General Electric Company; Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder MedEd3D; Grant, Siemens AG; Grant, General Electric Company;
Ogonna K. Nwawka, MD, New York, NY (*Moderator*) Research Grant, General Electric Company
Jon A. Jacobson, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose
Kambiz Motamedi, MD, Los Angeles, CA (*Moderator*) Nothing to Disclose
Arvin Kheterpal, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Access the results of new research and access their potential applications to clinical practice. 2) Research will be integrated with the hands-on practice of established techniques of musculoskeletal ultrasound.

Sub-Events

RC304-01 Elbow Ultrasound (Demonstration)

Tuesday, Nov. 28 8:30AM - 9:05AM Room: E450A

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;

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC304-02 Shear Wave Ultrasound Evaluation of the Supraspinatus Muscle: Anisotropy and Age Considerations

Tuesday, Nov. 28 9:05AM - 9:15AM Room: E450A

Participants

Alexander N. Merkle, MD, New York, NY (*Presenter*) Nothing to Disclose
Benjamin Abiri, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Dana Lin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
James S. Babb, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ronald S. Adler, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Evaluation of muscle atrophy in the rotator cuff is integral to preoperative evaluation, with implications for repair outcomes. Preliminary work suggests that shear wave elastography (SWE) provides a more robust quantitative assessment of muscle status. The effects of age and transducer orientation in this cohort have not yet been fully evaluated. Anisotropy may be of substantial importance, yet recent literature describing SWE application to muscle has varied in probe orientation, with uncertain effect. Age has also been shown to affect muscle SWE measurements, likely independent of visible atrophy. We hypothesize that probe orientation affects measurement and that changes in stiffness occur in aging.

METHOD AND MATERIALS

IRB approval and informed consent were obtained. 11 asymptomatic subjects with SWE of one or both shoulders resulted in 19 eligible studies. Exams were performed with a 9MHz linear transducer on a Siemens S3000 scanner with VTIQ software (Siemens). Absence of supraspinatus (SSM) fatty degeneration was confirmed in subjects under 40 by US evaluation. Concurrent MRI confirmation was required in subjects over 40 (N = 6). SWE measurements of the SSM in the longitudinal (parallel to fibers) and transverse orientations were obtained at the midpoint of the muscle belly under mild preload positioning.

RESULTS

A highly significant difference was seen between mean velocities measured in long and trans in the SSM ($p < 0.001$). A highly significant difference in velocity variance was also seen between trans and long orientations ($p=0.002$), with increased variance in trans. A weakly significant increase in mean velocity was seen in an over 40 subgroup in long orientation (3.95 vs 4.00 cm/s; $p = 0.048$), with a paradoxical decrease in mean velocity in trans position in the same subgroup (6.75 vs 5.00 cm/s; $p < 0.001$).

CONCLUSION

Effects of anisotropy in SWE measurement may be substantial in vivo. Longitudinal probe orientation appears to provide less

variance. Mildly increased stiffness seen in normal older subjects in the longitudinal orientation more closely corresponds to prior histologic and other findings, which may support using the longitudinal position for muscle elastography.

CLINICAL RELEVANCE/APPLICATION

Interpretation of shear wave ultrasound elastography in muscle.

RC304-03 Rotator Cuff Calcific tendinitis: Ultrasound-Guided Needling and Lavage vs Subacromial Corticosteroids - Five-Year Outcomes of a Randomized Controlled Trial

Tuesday, Nov. 28 9:15AM - 9:25AM Room: E450A

Participants

Pieter Bas de Witte, MD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Arjen Kolk, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ferdinand Overes, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Rob G. Nelissen, MD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Monique Reijnen, MD, Leiden, Netherlands (*Presenter*) Nothing to Disclose

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PURPOSE

To compare the long-term results of two regularly applied treatments in patients with RCCT: ultrasound (US)-guided barbotage combined with US-guided corticosteroids injection in the subacromial bursa (SAIO (Group I) vs. US-guided SAI alone (Group II)

METHOD AND MATERIALS

Patients were randomly assigned to Group I (barbotage and SAI) or II (SAI) and evaluated before and after treatment at regular time-points until 12 months and in addition at 5 years, using the Constant Score (CS, primary outcome), the Western Ontario Rotator Cuff Index (WORC) and the Disabilities of the Arm, Shoulder and Hand score (DASH). Calcifications' location, size and Gartner classification were assessed on radiographs. Rotator cuff condition was evaluated with US. Results were analyzed using t-tests, linear regression and a mixed model for repeated measures.

RESULTS

48 patients were included (mean age 52 (SD=7.3), 25 (52%) females) with an average baseline CS of 69 (SD=11.9). After a mean follow-up of 5.1 years (SD=0.5), mean CS was 90 points (95%-CI:83.0-95.9) in Group I vs 87 (95%-CI:80.5-93.5) in Group II (p=0.58). Average CS improvement in Group I was 18 points (95%-CI:12.3-23.0) vs 21 (95%-CI: 16.2-26.2) in Group II (p=0.32). There was a total resorption of all calcifications in 62% of Group I and 73% in Group II (p=0.45). Rotator cuff status with ultrasound was not significantly different between the groups. With the mixed model the repeated measurements, taking into account baseline CS and Gartner classification, average additional treatment effect was 6 points (95%-CI: -8.9-21.5) in favor of barbotage, but without statistical significance. Follow-up scores were significantly associated with baseline scores and duration of follow-up. Results for DASH and WORC were similar.

CONCLUSION

Whereas results were significantly superior for barbotage after 1 year of follow-up, no more significant differences were found in clinical and radiological outcomes between both treatment groups after 5 years.

CLINICAL RELEVANCE/APPLICATION

Our results show that both treatments lead to short-term clinical improvement, with superior outcome after 6 and 12 months. However, on the longer term (>5 years), mean results are good in both groups. This suggests that barbotage mainly seems to accelerate the natural course. This is in concordance with several retrospective and descriptive follow-up studies, showing good long-term outcomes of barbotage and more conservative methods.

RC304-04 Value of Real-time Sonoelastography for Evaluation of Medial Epicondylitis

Tuesday, Nov. 28 9:25AM - 9:35AM Room: E450A

Participants

Minwoo Shin, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seok Hahn, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jisook Yi, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic ability of real-time sonoelastography for medial epicondylitis by the investigation and comparison in clinically suspected patients and asymptomatic patients

METHOD AND MATERIALS

Our study was retrospective. From July 2016 to March 2017, forty-seven elbows of 41 patients (17 males and 24 females; mean 54.4 years +/- 11.6 years) consecutively were performed gray-scale sonography and compression-based real-time color-coded sonoelastography. The two regions of interest; the lesion of common flexor tendon (R1) for the target area and the adjacent normal tendon (R2) for a reference area were obtained to calculate. These patients were divided into two groups consisted of patients who clinically suspected medial epicondylitis and asymptomatic patients based on the patient's symptoms and signs in a physical examination performed by a 12-year experienced orthopedic surgeon. A 10-year experienced radiologist evaluated gray-scale sonography finding (swelling, hypoechogenicity, calcification, and tear) and elastographic grade with 3-point visual scale. There sonographic finding, elastographic grade, and strain ratio were compared between two groups by Mann-Whitney test and diagnostic performance was by receiver operating characteristic curves for elastographic grade and strain ratio.

RESULTS

SONOELASTOGRAPHY FINDING, ELASTOGRAPHIC GRADE, AND STRAIN RATIO WERE COMPARED BETWEEN TWO GROUPS BY MANN-WHITNEY TEST AND DIAGNOSTIC PERFORMANCE WAS BY RECEIVER OPERATING CHARACTERISTIC CURVES FOR ELASTOGRAPHIC GRADE AND STRAIN RATIO.

Of the 41 patients, 13 patients with 16 elbows were diagnosed clinically and 28 patients with 31 elbows had no symptom. Swelling ($p=0.551$), calcification ($p=0.365$), and tear ($p=0.365$) on gray-scale sonography finding showed no significant difference between two groups. However, hypoechogenicity, elastographic grade, and strain ratio showed significant difference ($p<0.001$), respectively. The areas under the receiver operating characteristic curve were 0.852 (95% confidence interval, 0.689-0.950) for elastographic grade and 0.983 (95% confidence interval, 0.886-1.000) for strain ratio, respectively.

CONCLUSION

Elastographic grade and strain ratio from real-time sonoelastography are valuable and can be sufficient supplementary diagnostic tools in the diagnosis of medial epicondylitis.

CLINICAL RELEVANCE/APPLICATION

When evaluating clinically suspected medial epicondylitis and gray-scale ultrasound finding is not satisfy to diagnose, real-time sonoelastography will be helpful.

RC304-05 Shoulder Ultrasound (Demonstration)

Tuesday, Nov. 28 9:35AM - 10:10AM Room: E450A

Participants

Ogonna K. Nwawka, MD, New York, NY (*Presenter*) Research Grant, General Electric Company

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC304-06 Ankle Ultrasound (Demonstration)

Tuesday, Nov. 28 10:20AM - 10:55AM Room: E450A

Participants

Jon A. Jacobson, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

Honored Educators

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RC304-07 Diagnostic Performance of Ultrasound Examination for the Diagnosis of Ulnar Neuropathy at the Elbow: A Systematic Review and Meta-Analysis of 1349 Examinations

Tuesday, Nov. 28 10:55AM - 11:05AM Room: E450A

Participants

Nima Hafezi Nejad, MD, MPH, Baltimore, MD (*Presenter*) Nothing to Disclose

Ogonna K. Nwawka, MD, New York, NY (*Abstract Co-Author*) Research Grant, General Electric Company

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Theodore T. Miller, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Ulnar Neuropathy at the Elbow (UNE) is one of the most common entrapment neuropathies. Diagnostic accuracy of Ultrasound (US) examination for the diagnosis of UNE has been explored in numerous studies with limited sample sizes for more than a decade. The purpose of our study was to investigate the current state of literature and to pool the results of smaller studies and quantify the accuracy of US examination for the diagnosis of UNE.

METHOD AND MATERIALS

We performed a systematic literature search of PubMed, EMBASE, Scopus and Web of Science for studies evaluating the diagnostic accuracy of US examination in the setting of UNE. From 774 retrieved records, 24 studies were eligible for inclusion, 13 of which were included in the final analysis. Details of the study designs, US examinations and Nerve Conduction Studies (NCS) were extracted and compared. High between-study heterogeneity was detected ($I^2 > 0.40$), and Random Effect Modeling (DerSimonian-Laird) was utilized throughout the study. Sensitivity analysis was performed to confirm the pooled results' robustness considering differences in study designs, reported ulnar nerve Cross Sectional Areas (CSAs) and CSA cut-offs, use of NCS in confirming the UNE diagnosis, and the departments where the study was conducted. Effect of age, gender, CSA mean (among patients and controls) and CSA cut-off on the Diagnostic Odds Ratio (DOR) was evaluated in the meta-regression analysis.

RESULTS

Pooling the results from 1349 examinations, US examination had a sensitivity of 79.6%(76.4-82.6), specificity of 84.2%(81.2-86.9), DOR of 32.00(16.16-63.36), positive and negative likelihood ratios of 4.54(3.28-6.27) and 0.19(0.12-0.29), respectively. A CSA value of greater 10 cm² was the most commonly used cut-off. The results were consistent in the sensitivity analysis. Mean/median value of CSA in patients (but not in controls) was a significant predictor of the DOR (beta:0.34±0.11; P:0.02). Every 1 cm² higher

CSA was associated with 41% increase in the DOR (Relative DOR: 1.41(1.09-1.83)). Receiver Operating Characteristics (ROC) curve analysis demonstrated an excellent performance with the Area Under the Curve (AUC) of 0.917±0.020 (P<0.05).

CONCLUSION

US examination has an acceptable sensitivity (~80%) and specificity (~84%) for the diagnosis of UNE.

CLINICAL RELEVANCE/APPLICATION

We quantified the accuracy of US examination for the diagnosis of UNE in a large meta-analysis by pooling examination level data.

RC304-08 **Ultrasound Evaluation of Radial Nerve Palsy Associated with Humeral Shaft Fracture to Guide Operative Versus Conservative Treatment**

Tuesday, Nov. 28 11:05AM - 11:15AM Room: E450A

Participants

Mihra S. Taljanovic, MD, Tucson, AZ (*Presenter*) Nothing to Disclose
Melissa Esparza, MD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose
Lana H. Gimber, MD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose
Tyson S. Chadaz, MD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose
Lisa Truchan, MD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Krupinski, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Kurt Mohty, BS, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose
Jason Wild, MD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Radial nerve palsies are commonly associated with humeral shaft fractures. Ultrasound (US) evaluation of the radial nerve allows for differentiation of nerve injury secondary to contusion or stretch injuries which are managed conservatively versus laceration or entrapment which require surgical treatment. The purpose of this study is to determine the effectiveness of US at evaluating the condition of the radial nerve in the setting of humeral shaft fractures and determine if surgical management is needed.

METHOD AND MATERIALS

A retrospective review of US studies in patients with radial nerve palsy associated with humeral shaft fractures was conducted. Seventeen patients were identified who met inclusion criteria. Five patients with US diagnosis of radial nerve laceration and/or entrapment underwent prompt ORIF of their humeral shaft fracture. One patient with US diagnosis of complete radial nerve laceration underwent surgery 6 weeks after injury with tendon transfer. Others were initially treated conservatively with 5 patients undergoing subsequent surgical treatment for other reasons unrelated to radial nerve palsy. Clinical, operative and US results were compared.

RESULTS

Of 17 patients, 11 (64.7%) were male and 6 (35.3%) female. Average age was 48.9. Ground level fall and motor vehicle accidents were the most common mechanisms of injury. In 6 patients who underwent initial ORIF of their humeral shaft fracture, US correctly diagnosed 1 partial radial nerve laceration with entrapment, and 4 radial nerve entrapments which were operatively confirmed. In one patient US failed to see the radial nerve at the fracture site which was proven to be complete transection at surgery. In 5 surgically treated patients without radial nerve entrapment or laceration, US diagnosis was concordant with surgical findings. In 5 patients who were treated conservatively, clinical follow-up showed radial nerve recovery. US findings were 100% concordant with surgical findings.

CONCLUSION

US provides accurate diagnosis of radial nerve injuries in patients with humeral shaft fractures and helps in treatment guidance.

CLINICAL RELEVANCE/APPLICATION

US is effective in evaluating radial nerve palsy in humeral shaft fractures by separating patients with laceration/entrapment requiring surgery from those with neurapraxia managed nonoperatively.

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/> Mihra S. Taljanovic, MD - 2016 Honored Educator Lana H. Gimber, MD - 2016 Honored Educator Elizabeth A. Krupinski, PhD - 2017 Honored Educator

RC304-09 **Improving Operator Dependence in Shear Wave Elastography of the Median Nerve and Carpal Tunnel Flexor Tendons with a Probe Scaffold: Reducing Barriers to Clinical Adoption**

Tuesday, Nov. 28 11:15AM - 11:25AM Room: E450A

Participants

Matthew B. O'Brien, MD, Detroit, MI (*Presenter*) Nothing to Disclose
Marnix T. van Holsbeeck, MD, Detroit, MI (*Abstract Co-Author*) Consultant, General Electric Company; Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder MedEd3D; Grant, Siemens AG; Grant, General Electric Company;
Nickolas Nahm, MD, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose
Lisa M. Walker, MD, Berkley, MI (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Ultrasound elastography (EUS) of the median nerve is of increasing interest in diagnostic Carpal Tunnel Syndrome (CTS). Shear Wave Elastography (SWE) is an EUS subtype less well studied with CTS, but offers promise in quantitative measurement. We evaluated the reproducibility and inter-observer agreement of median nerve SWE across varying experience levels using a simple probe scaffold for acquisition.

METHOD AND MATERIALS

15 cadaver wrists were evaluated with B-mode and SWE. Cross sectional area (CSA) of the nerve was measured at the level of the pronator quadratus (CSAp) and at the carpal tunnel (CSAc). Multiple SWE measurements of the nerve in the carpal tunnel and the adjacent third flexor tendon were obtained. Three observers ranged from 1.5 years to no experience. Velocity readings were made based on a region of interest on a GE Logiq E9 with a 9 MHz transducer, (GE, Milwaukee, WI, USA.)

RESULTS

No wrists were excluded. Intra-class correlation coefficients demonstrated excellent to good agreement between all three observers except for a single moderate agreement, (ICCs ranged from 0.836-0.996, 95% CI ranging from 0.592-0.999; exception 0.746, 95% CI 0.412-0.903.) Median nerve velocities ranged from 2.49 - 5.65 m/s. No significant correlation between CSAp and CSAc was found.

CONCLUSION

Using the scaffold, SWE velocities were highly reliable across multiple observers of variable experience. This is particularly relevant given known challenges of SWE in narrow, bone-enclosed areas such as the carpal tunnel. The scaffolding reduces the highly operator dependent characteristics of EUS and in particular SWE. The lack of correlation between CSA and nerve velocities was likely due to multiple freeze-thaw cycles and the effects on the cadaveric tissue.

CLINICAL RELEVANCE/APPLICATION

A scaffold reduces SWE operator dependence even in untrained observers, a current limitation of clinical EUS, and could facilitate clinical adoption of SWE in CTS and other diagnoses.

RC304-10 Peripheral Nerves Ultrasound (Demonstration)

Tuesday, Nov. 28 11:25AM - 12:00PM Room: E450A

Participants

Kambiz Motamedi, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

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Active Handout:Kambiz Motamedi

[http://abstract.rsna.org/uploads/2017/17000346/Active RC304-10.pdf](http://abstract.rsna.org/uploads/2017/17000346/Active_RC304-10.pdf)

LEARNING OBJECTIVES

1) To optimize the ultrasound equipment and choice of probes for proper nerve sonography. 2) To identify the nerves and recognize the proper anatomic landmarks for their precise localization. 3) To understand the value of cine imaging throughout the course of the affected nerve. 4) To understand the morphology and location of the nerves depending on patient positioning. 5) To become familiar with common locations of nerve entrapment syndromes, such as fibroosseus and fibromuscular tunnels.

RC305

Neuroradiology Series: Stroke

Tuesday, Nov. 28 8:30AM - 12:00PM Room: N228

MR **NR**

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

FDA Discussions may include off-label uses.

Participants

Howard A. Rowley, MD, Madison, WI (*Moderator*) Research Consultant, Bracco Group; Research Consultant, Guerbet SA; Research Consultant, General Electric Company; Consultant, F. Hoffmann-La Roche Ltd; Consultant, W.L. Gore & Associates, Inc; ; ; ; ;
Jeffrey L. Sunshine, MD, PhD, Pepper Pike, OH (*Moderator*) Research support, Siemens AG; Travel support, Siemens AG; Travel support, General Electric Company; Travel support, Sectra AB; Travel support, Allscripts Healthcare Solutions, Inc; Travel support, Imprivata, Inc; Travel support, KLAS Enterprises LLC

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LEARNING OBJECTIVES

1) To review latest developments and directions in stroke imaging and intervention relevant to practice.

Sub-Events

RC30501 Imaging for Stroke Triage: What I Look For and What I Wish I Had

Tuesday, Nov. 28 8:30AM - 9:00AM Room: N228

Participants

Gregory W. Albers, MD, Palo Alto, CA (*Presenter*) Stockholder, iSchemaView, Inc ; Consultant, iSchemaView, Inc; Consultant, Medtronic plc

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LEARNING OBJECTIVES

1) Understand the role of advanced imaging for patient selection in recent endovascular stroke trials. 2) Understand the rationale for obtaining data on both cerebral hemodynamics, collateral circulation and vascular anatomy with a single contrast injection. 3) Know the pros and cons of obtaining initial brain imaging data on stroke patients in the angiography suite.

RC305-02 Prediction of IV Thrombolysis Effect Using CT Perfusion-Post-Processed Detection of Vessel Occlusions

Tuesday, Nov. 28 9:00AM - 9:10AM Room: N228

Participants

Wolfgang G. Kunz, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Matthias P. Fabritius, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Lukas Havla, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Pierre Scheffler, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Maximilian F. Reiser, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Kolja M. Thierfelder, MD,MSc, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Wieland H. Sommer, MD, Munich, Germany (*Presenter*) Founder, Smart Reporting GmbH

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PURPOSE

To determine the predictive value of CTA-occult vessel occlusions detected using CT perfusion-post-processed wavelet-transformed angiography (waveletCTA) on the morphologic and functional outcome after IV thrombolysis (IVT) in acute ischemic stroke.

METHOD AND MATERIALS

Patients were selected from a cohort of 1,851 consecutive patients who had undergone multiparametric CT including whole-brain CT perfusion. Inclusion criteria were: (1) significant cerebral blood flow (CBF) deficit, (2) no evidence of occlusion on standard CTA, and (3) follow-up-confirmed infarction. waveletCTA defines angiographic signal by best fitting of time-attenuation curves to a generic contrast bolus curve in each voxel, and was analyzed by two blinded readers with respect to vessel occlusions. Morphologic outcome was defined as relative infarction growth using the ratio [final infarction volume] / [initial CBF deficit volume], of which

smaller values were considered favorable. Significant functional improvement was defined as a decrease in modified Rankin Scale score from admission to discharge (ΔmRS) of ≥ 1 or a decrease of National Institutes of Health Stroke Scale score from admission to 24 hours ($\Delta NIHSS$) of ≥ 3 . Linear and logistic regression analyses were performed to identify independent associations between predictors and outcomes.

RESULTS

Among all included patients (N=107) with unremarkable standard CTA, 58 (54%) showed an occlusion on waveletCTA. There was no significant difference between patients receiving IVT (n=57) vs. patients receiving only supportive care (SC, n=50) regarding age, sex, time from symptom onset, early infarction signs, perfusion mismatch, waveletCTA-detected occlusions or NIHSS on admission (all with $p > 0.05$). In patients treated with IVT, regression analyses showed that the presence of a waveletCTA-detected occlusion was an independent predictor of a favorable morphologic ($\beta = -1.044$, $p = 0.001$) and functional outcome (ΔmRS : OR=7.868, $p = 0.041$; $\Delta NIHSS$: OR=9.810, $p = 0.013$), while it failed to predict outcome in patients who received SC (all with $p > 0.05$).

CONCLUSION

The presence of CTA-occult vessel occlusions detected using waveletCTA independently predicts a higher effectiveness of IVT in stroke.

CLINICAL RELEVANCE/APPLICATION

waveletCTA has the potential to contribute to decision making in acute ischemic stroke, as CTA-occult occlusions that are detected with this technique predict a better response to IVT.

RC305-03 Importance of CT-Perfusion in Diagnosis of Stroke Mimic Perfusion Patterns Related by Seizures in Daily Clinical Practice

Tuesday, Nov. 28 9:10AM - 9:20AM Room: N228

Participants

Friederike Austein, MD, Kiel, Germany (*Presenter*) Nothing to Disclose
Monika Huhndorf, Kiel, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Lindner, Kiel, Germany (*Abstract Co-Author*) Nothing to Disclose
Olav Jansen, MD, PhD, Kiel, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Stroke mimics (SM) constitute 5%-30% of clinically diagnosed strokes. CT perfusion (CTP) is the standard assessment in stroke diagnostics to rule out hemorrhage, a potential contraindication for thrombolysis, but fails to identify SM. Our aim was therefore to evaluate the diagnostic value and characteristics of seizure related perfusion alterations with CTP in the differential diagnosis of ictal or postictal state in acute neurological deterioration.

METHOD AND MATERIALS

We identified 37 patients over a 22-month period presented to our stroke center with acute stroke-like symptoms and a multimodal CT examination. Patients were included who underwent electroencephalography (EEG) within 5 days of symptom onset and had seizure as final diagnosis. Analysis of the perfusion maps was performed and was correlated with clinical symptoms and EEG.

RESULTS

The most common perfusion abnormality, seen in 22/37 (59.5%) patients, was regional hyperperfusion in a cortical ribbon pattern. 15 (40.5%) patients showed a hypoperfusion pattern with prolonged MTT/ Tmax with a regional or holo-hemispheric distribution and a decrease in CBF and CBV, contrary to the known increase of CBV in the ischemic penumbra by reactive collateral flow. Involvement of thalamus and hippocampus was associated with hyperperfusion and also with epileptiform EEG. Patients with hyperperfusion showed postictal MRI-changes (11/16). The two groups did not differ in clinical presentation, but hospital stay was longer in patients with hyperperfusion and they had a worse clinical outcome.

CONCLUSION

Our study results emphasize the benefit of an advanced CT stroke-protocol to identify SM, additional to the well-established mismatch-concept.

CLINICAL RELEVANCE/APPLICATION

CT perfusion appears attractive as diagnostic tool to identify stroke mimics and differentiate these from acute stroke and in further consequence lead to a more appropriate treatment.

RC305-04 Brain Computed Tomography Using Iterative Reconstruction to Diagnose Acute Ischemic Stroke: Usefulness in Combination with Optimized Window Setting and Thin-Slice Reconstruction

Tuesday, Nov. 28 9:20AM - 9:30AM Room: N228

Participants

Taihei Inoue, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose
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Koichi Yokoyama, Amakusa, Japan (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The purpose of this study was to determine whether iterative model reconstruction (IMR) specialized for brain computed tomography (CT) with a combination of thin-slice images and narrow window settings would improve the detection of acute stroke.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board; patient informed consent was waived. We retrospectively enrolled 27 patients with acute middle cerebral artery (MCA) stroke and 27 non-stroke patients matched for age and gender with individual stroke patients (control). Using images reconstructed using 1- and 5-mm-thick images with filtered back projection (FBP) and 1-mm-thick images with IMR, we compared the CT numbers in infarcted areas, image noise in the temporal pole, and contrast-to-noise ratios (CNRs) of infarcted and noninfarcted areas. To analyze the performance of acute MCA stroke detection, we used receiver-operating characteristic (ROC) curve techniques and compared 5 mm FBP with standard window settings, 1 mm FBP with narrow window settings, and 1 mm IMR with narrow window settings.

RESULTS

The image noise was significantly lower with 1 mm IMR [3.7 Hounsfield units (HU) ± 1.1] than with 5 mm (4.7 HU ± 0.6) and 1 mm (9.3 HU ± 1.5) FBP ($p < 0.001$), and CNR with 1 mm IMR (1.1 ± 1.0) was significantly higher than that with 5 mm (0.8 ± 0.7) and 1 mm (0.4 ± 0.4) FBP ($p < 0.001$). Furthermore, the average area under the ROC curve was significantly higher with 1 mm IMR with narrow window settings [0.90; 95% confidence interval (CI): 0.86,0.94] than with 5 mm FBP with standard window settings (0.78; 95% CI: 0.72,0.83).

CONCLUSION

The combination of thin-slice images and narrow window settings under IMR provides better diagnostic performance than the conventional reconstruction methods for acute MCA stroke detection.

CLINICAL RELEVANCE/APPLICATION

Combination of iterative model reconstruction and narrow window settings can improve the detectability of acute middle cerebral artery stroke.

RC305-05 Relationship between Collateral Circulation and Cerebral Hemodynamics in North American Moyamoya Patients

Tuesday, Nov. 28 9:30AM - 9:40AM Room: N228

Participants

Greg Zaharchuk, MD, PhD, Stanford, CA (*Presenter*) Research Grant, General Electric Company; Consultant, General Electric Company;

Zungho Zun, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

Huy M. Do, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

Michael P. Marks, MD, Stanford, CA (*Abstract Co-Author*) Research Grant, Siemens AG

Thomas J. Brosnan, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

Sun-Won Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Patients with Moyamoya disease typically have significantly abnormal cerebral hemodynamics and extensive collateral networks. We undertook this prospective study to understand the relationship between collaterals and MR perfusion imaging in a large cohort of North American Moyamoya disease patients.

METHOD AND MATERIALS

In 86 prospectively recruited, pre-operative North American Moyamoya disease patients (mean age 42 ± 11 yrs, M/F 24/62), we performed 3T MR imaging (GE Healthcare) and digital subtraction angiography (DSA) (Axiom Artis dBA Twin; Siemens Medical Systems). Two neurointerventionalists scored the DSA for collaterals (0=none visible, 1=mild/moderate, 2=robust, 3=antegrade flow) in 20 pre-defined regions per patient (Kim et al., Stroke 2008). After placing all imaging into MNI-152 template space, cerebral hemodynamics (3D pseudocontinuous ASL with white paper parameters (Alsop et al., MRM 2015) ($n=86$) and bolus dynamic susceptibility contrast perfusion-weighted imaging (PWI) ($n=82$), which was processed using automated RAPID software (Straka et al., JMRI 2010) were measured in the same regions. We tested for trends using the Jonckheere-Terpstra Test for Ascending Ordered Alternatives.

RESULTS

There was a significant positive trend between increasing collateral score and increased ASL CBF ($p < 0.0001$); regions with robust collateral flow and antegrade flow had the same CBF. No trend between collaterals and rCBF or rCBV was observed. Lower mean transit time (MTT) and time-to-maximum (Tmax) was seen with increasing collateral score (both $p < 0.0001$). Increased ASL signal in serpentine vessels ("arterial transit artifact") was present in regions with higher collateral scores.

CONCLUSION

Increasing collateral scores on DSA predict increased CBF as measured by ASL, and decreased transit time metrics (MTT and Tmax) as measured by bolus DSC PWI. These relationships on MR perfusion imaging may be helpful to evaluate collateral flow in patients who do not receive DSA.

CLINICAL RELEVANCE/APPLICATION

Increasing collateral scores are associated with higher CBF (measured with ASL imaging) and lower MTT and Tmax (measured with bolus contrast PWI) in pre-operative North American Moyamoya disease patients.

RC30506 Imaging for Stroke Prevention: The Next Frontier

Tuesday, Nov. 28 9:40AM - 10:10AM Room: N228

Participants

Ajay Gupta, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify imaging strategies that can be implemented into clinical practice to aid in primary stroke prevention efforts including imaging of high-risk plaque, silent ischemic brain disease, and impaired cerebral hemodynamics; and 2) Identify imaging strategies that can be implemented into clinical practice to aid in secondary stroke prevention efforts, including identification of potential culprit atherosclerotic lesions in patients with cryptogenic strokes.

RC30507 Intracranial Vessel Wall Imaging

Tuesday, Nov. 28 10:20AM - 10:50AM Room: N228

Participants

Mahmud Mossa-Basha, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand intracranial vessel wall MRI techniques and their advantages/disadvantages. 2) To understand why better diagnostic tools for intracranial vasculopathy assessment are necessary. 3) To understand the benefits of intracranial vessel wall MRI in disease differentiation. 4) To understand scenarios in which vessel wall MRI may be beneficial for diagnosis and management.

RC305-08 Lesion Evolution in Stroke and Ischemia on Neuroimaging (LESION) Study: The Probability of Ischemic Stroke Therapeutic Targets Across Time

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N228

Participants

Adrienne N. Dula, PhD, Austin, TX (*Presenter*) Nothing to Disclose
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Ben T. King, Austin, TX (*Abstract Co-Author*) Nothing to Disclose
Lisa A. Davis, Austin, TX (*Abstract Co-Author*) Nothing to Disclose
Jose G. Merino, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Amie W. Hsia, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Lawrence L. Latour, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Steven Warach, MD, PhD, Austin, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To quantify the relation of time from ischemic stroke onset to the probability of detection of therapeutic targets on imaging.

METHOD AND MATERIALS

A consecutive series of 7,007 patients were screened at two regional stroke centers over a ten-year period with 1,092 patients meeting criteria. Untreated patients with confirmed acute ischemic cerebrovascular syndrome with an evaluable MRI obtained within 24 hours from last known well and a NIHSS > 3 or in patients treated with an acute intervention with an MRI obtained prior to any intervention were included. Potential therapeutic targets were identified on MRI including vascular occlusion on MRA (ARTERY), ICA or M1 occlusion (ENDOVASCULAR), M1 or M2 occlusion (MCAO), hypoperfusion on perfusion MRI (PERFUSION), and perfusion-diffusion mismatch (MISMATCH). Logistic regression models defined the probability of each therapeutic target related to time from onset.

RESULTS

The probability of detection of therapeutic targets: ARTERY and ENDOVASCULAR ($p < 0.01$), MCAO, PERFUSION, MISMATCH ($p < 0.001$), decreased over time. Higher admit NIHSS increased the probability of target detection by approximately 5% per NIHSS point. At 24 hours from onset, 20% of patients still had a therapeutic target. At 24-hours, MISMATCH was observed in 76% of patients with MCA occlusion and ENDOVASCULAR in 77%. At least one therapeutic target was identified in 78.7% of patients prior to 4.5 hours, 79.2% up to 6 hours and 71.7% from 6 to 24 hours. In a multiple logistic regression model the probability of detection of MISMATCH was best fit by time from onset, NIHSS, MCAO, and the interaction of NIHSS MCAO.

CONCLUSION

Imaging therapeutic targets were found in a substantial proportion of patients (67%) beyond proven time windows for thrombolysis or endovascular therapy, and this proportion can be estimated by a logistic regression model based on time from onset and NIHSS thresholds. These results support the rationale for reperfusion trials beyond proven time windows.

CLINICAL RELEVANCE/APPLICATION

Treatment for acute stroke is limited to patients presenting within a specific time window. We found 38% of patients maintain a therapeutic target well past the times specified in current guidelines.

RC305-09 Patient Outcomes After Endovascular Vasospasm Treatment of Delayed Cerebral Ischemia Following Aneurysmal Subarachnoid Hemorrhage: A 10-Year Experience at a Neurovascular Referral Center

Awards

Student Travel Stipend Award

Participants

Vivek P. Patel, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose
Michael A. Marks, MD, Stanford, CA (*Abstract Co-Author*) Consultant, Medtronic plc Stockholder, Likemark Medical, Inc Research Grant, Siemens AG
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Jeremy J. Heit, MD, PhD, Stanford, CA (*Abstract Co-Author*) Consultant, Terumo Corporation

PURPOSE

Cerebral arterial vasospasm and delayed cerebral ischemia (DCI) following aneurysmal subarachnoid hemorrhage (aSAH) accounts for up to 50% of the morbidity and mortality in these patients. Endovascular vasospasm treatment in patients with DCI with intra-arterial (IA) vasodilator infusion or cerebral angioplasty is often performed to increase cerebral perfusion, although the effectiveness of these treatments has not been conclusively demonstrated. We determined patient outcomes and mortality following endovascular treatment of vasospasm and DCI over a 10-year period at our neurovascular referral center.

METHOD AND MATERIALS

We performed a retrospective cohort study of all patients who underwent endovascular vasospasm treatment following aSAH from 2006 to 2016. Primary outcome was good clinical outcome at 3-6 months (modified Rankin Scale [mRS] of ≤ 2). Secondary outcomes were mortality at discharge and at 3-6 months.

RESULTS

175 patients who developed DCI (121 female, 54 males; $p=0.0001$) with a mean age of 51 years, mean Hunt and Hess Scale score 3, and mean Fisher Grade 3 were included. The ruptured aneurysm was treated by endovascular coiling in 86 patients (49%) and surgical clipping in 89 patients (51%). Endovascular treatment for angiographic vasospasm in the context of DCI consisted of IA nicardipine infusion in 103 patients (59%) or a combination of IA nicardipine and balloon angioplasty in 72 patients (41%). 91 (58%) and 109 (69%) patients had follow-up at 3-6 months for the mRS and mortality data, respectively. 65 patients (71%) had a mRS ≤ 2 at 3-6 months. 18 patients (10%) died before discharge, and one additional patient (1%) died at 6 months.

CONCLUSION

Endovascular vasospasm treatment of DCI results in a good clinical outcome at 3-6 months and low mortality rates.

CLINICAL RELEVANCE/APPLICATION

Endovascular vasospasm treatment may reduce morbidity and mortality following aSAH. Additional studies are needed to define the most optimal endovascular management of DCI.

RC305-10 Virtual Non-Contrast Images Enable Better Delineation of Acute Infarction After Mechanical Thrombectomy Compared to Conventional Images Using a Dual-Layer Detector Spectral CT

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N228

Participants

Isabelle Riederer, MD, Munich, Germany (*Presenter*) Nothing to Disclose
Alexander A. Fingerle, MD, Muenchen, Germany (*Abstract Co-Author*) Nothing to Disclose
Jan S. Kirschke, MD, Muenchen, Germany (*Abstract Co-Author*) Speakers Bureau, Philips Healthcare
Ernst J. Rummeny, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Martin Renz, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the potential of the dual-layer detector spectral CT for the detection of acute ischemic lesions in the brain after mechanical thrombectomy by comparing virtual non-contrast with conventional images.

METHOD AND MATERIALS

Unenhanced head spectral-CT was performed in twenty-five patients 13 \pm 6 h after mechanical thrombectomy using a dual-layer detector spectral CT (IQon spectral CT, Philips Healthcare, USA). Virtual non-contrast (VNC) and conventional (CO) images were reconstructed using a dedicated software. As gold standard, Magnetic Resonance Imaging (MRI), acquired during the follow-up procedure (2 \pm 2 d), was utilized. Region of interest (ROI) analysis was performed in the center of the acute infarction and the corresponding contralateral healthy tissue and contrast-to-noise ratio (CNR) was calculated. The volume of the ischemic area was measured in VNC, CO and MRI in a random order.

RESULTS

Developing ischemic lesions appear more hypodense in VNC compared to CO (18.2 \pm 3.6 HU versus 26.5 \pm 4.4 HU). CNR is significantly higher in VNC compared to CO (3.1 \pm 1.5 versus 1.1 \pm 1.1, $p < 0.0005$). The mean ischemic lesion volume was higher in VNC compared to CO (27 \pm 51 cm³ versus 21 \pm 49 cm³, 72% versus 55% of the infarct volume measured in MRI; $p < 0.05$).

CONCLUSION

Developing ischemic lesions appear more hypodense in VNC compared to CO with significantly higher CNR and better delineation of infarct volume.

CLINICAL RELEVANCE/APPLICATION

Dual-layer detector spectral CT improves diagnostic image quality for the detection of developing ischemic lesions after mechanical thrombectomy compared to conventional CT.

RC305-11 Can Dual-Energy CT of the Brain Performed After Mechanical Thrombectomy for Acute Ischemic Stroke Predict Hemorrhagic Complications?

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N228

Participants

Matteo Bonatti, MD, Bolzano, Italy (*Presenter*) Nothing to Disclose
Fabio Lombardo, MD, Bolzano, Italy (*Abstract Co-Author*) Nothing to Disclose
Giulia A. Zamboni, MD, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
Bruno Bonetti, Bolzano, Italy (*Abstract Co-Author*) Nothing to Disclose
Roberto Curro Dossi, Bolzano, Italy (*Abstract Co-Author*) Nothing to Disclose
Fabio Vittadello, Padua, Italy (*Abstract Co-Author*) Nothing to Disclose
Giampietro Bonatti, Bolzano, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the capability of Dual-Energy CT (DECT) of the brain performed immediately after mechanical thrombectomy to predict immediate and belated hemorrhagic complications.

METHOD AND MATERIALS

IRB-approved retrospective study, need for informed consent was waived. We included 85 consecutive patients who underwent brain DECT immediately after mechanical thrombectomy for acute ischemic stroke between August 2013 and January 2017. Two radiologists independently evaluated DECT images for the presence of parenchymal hyperdensity, iodine extravasation and hemorrhage. Maximum iodine concentration was measured using commercially available software. Follow-up CT examinations performed until patients' discharge were reviewed for intracranial hemorrhage (ICH) presence. Correlation between DECT parameters and ICH development was analyzed by Mann-Whitney U test and Fisher exact test. ROC curves were generated for continuous variables.

RESULTS

Fourteen out of 85 patients (16.5%) developed ICH (7/14 within 24 hours and 7/14 during the following days). On post-operative DECT, parenchymal hyperdensities and iodine extravasation were present in 100% of the patients who developed ICH and in 56.3% of the patients who did not ($P=0.002$); signs of bleeding were present in 35.7% of the patients who later developed ICH and in 0% of the patients who did not ($P<0.001$). Median maximum iodine concentration was 2.6 mg/ml in the patients who developed ICH and 1.4mg/ml in the patients who did not ($P<0.001$). Maximum iodine concentration showed an AUC of 0.89 for identifying patients developing ICH.

CONCLUSION

Presence of parenchymal hyperdensity with maximum iodine concentration $>1.35\text{mg/ml}$ identifies patients developing ICH with 100% sensitivity and 67.6% specificity.

CLINICAL RELEVANCE/APPLICATION

The identification of patients with high hemorrhagic risk after mechanical thrombectomy enables to better tailor their medical treatment in order to minimize bleedings and to improve their outcome.

RC30512 What's in Store for Stroke in the Next 10 Years?

Tuesday, Nov. 28 11:30AM - 12:00PM Room: N228

Participants

Colin P. Derdeyn, MD, Saint Louis, MO (*Presenter*) Stock options, Pulse Therapeutics, Inc; ;

LEARNING OBJECTIVES

1) Recognize the importance of multidisciplinary performance improvement efforts in driving key metrics for stroke care. 2) Identify the major emerging new stroke diagnosis and treatment tools and approaches. 3) Recognize the driving force for all these efforts is to achieve revascularization as fast as possible.

RC306

Bread and Butter Sinus Imaging: Telling Your Referrers What They Need to Know

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E451B

HN NR

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

Sub-Events

RC306A Sinonasal Anatomy and Important Variants for Endoscopic Sinus Surgery (ESS)

Participants

Michelle A. Michel, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the anatomy of the sinonasal cavities and drainage pathways using multiplanar imaging. 2) Recognize important anatomic variants that may predispose a patient to chronic inflammatory disease or complications during endoscopic sinus surgery (ESS). 3) Discuss the role of imaging in treatment planning of chronic sinus inflammatory disease with ESS.

RC306B Rhinosinusitis with Attention to Red Flags and Complications

Participants

Ashley H. Aiken, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Recognize the imaging appearance of early acute fulminant invasive fungal sinusitis on CT and MRI. 2) Recognize the intraorbital and intracranial complications of IFS and bacterial rhinosinusitis. 3) Develop a standard approach and checklist for the interpretation of the sinus CT.

ABSTRACT

Presentation Summary: A specific search pattern and certain red flags will help the audience to suspect more aggressive infection or inflammation rather than routine sinusitis on the initial workhorse non-contrast sinus CT. Both CT and MR imaging play an important role in the timely diagnosis of aggressive sinonasal processes, especially invasive fungal sinusitis (IFS). Early CT imaging findings will be reviewed, along with the clinical presentation and population at risk, in order to emphasize the importance of high clinical suspicion and early diagnosis. The complimentary role of MRI to characterize late complications of bacterial and fungal infection will also be covered. References: 1. Epstein VA and Kern RC. Invasive Fungal Sinusitis and Complications of Rhinosinusitis. *Otolaryngol Clin North Am.* 2008 Jun; 41(3): 497-524 2. Aribandi M, McCoy V, Bazan C. Imaging Features of Invasive and Noninvasive Fungal Sinusitis: A Review. *Radiographics.* 2007 Sep-Oct; 27 (5): 1283-96 3. Gillespie B, O'Malley B, Francis H. An Approach to Fulminant Invasive Fungal Rhinosinusitis in the Immunocompromised Host. *Arch Otolaryngol Head Neck Surg.* 1998; 124:520-526 4. DelGaudio J, Swain R, Kingdom T, Muller S, Hudgins P. Computed Tomographic Findings in Patients With Invasive Fungal Sinusitis. *Arch Otolaryngol Head Neck Surg.* 2003; 129:236-240 5. Silverman CS, Mancuso AA. Periantral soft-tissue infiltration and its relevance to the early detection of invasive fungal sinusitis: CT and MR findings. *AJNR Am J Neuroradiol.* 1998; 19:321-325

RC306C Recognizing and Reporting Sinonasal Tumors

Participants

Christine M. Glastonbury, MBBS, San Francisco, CA (*Presenter*) Author with royalties, Reed Elsevier

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LEARNING OBJECTIVES

1) Recognize key features that suggest a lesion is a sinonasal malignancy and be aware of the important imaging mimics. 2) Learn the common patterns of sinonasal tumor dissemination. 3) Understand the most important imaging features to describe when staging a sinonasal tumor.

ABSTRACT

PRESENTATION KEY CONCEPTS: It is critical that on routine non-contrast sinus CT scans radiologists identify findings that suggest malignant or *potentially* malignant disease. Once this is recognized then additional findings can be sought so that the patient is correctly managed, biopsy can be obtained and treatment is not delayed. Even on non-contrast CT scans it is possible to evaluate for orbital and intracranial invasion and the retropharyngeal and often level 2 nodes can be commented on. There are many different sinonasal malignancies and while there are some features which may suggest the likely pathological diagnosis, the role of the radiologist is more for recognizing malignancy, staging the tumor with CT/MR and describing features which may make surgery more hazardous or unwarranted. REFERENCES: 1. Kraus DH, Lydiatt WM, Patel SG, O'Sullivan B, Ghossein RA, Mukherji SK, Shah JP.

Nasal Cavity & Paranasal Sinuses. Chapter 12. AJCC Cancer Staging Manual 8th Edition. Amin MB, Edge SB, Greene FL et al Springer 2017. 2. Koeller KK. Radiologic Features of Sinonasal Tumors. Head Neck Pathol. 2016 Mar;10(1):1-12. Review.

RC307

Chronic Pelvic Pain: Added Value of MRI in Endometriosis, Fibroids, and Pelvic Floor Relaxation

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E450B

GU **MR**

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

Participants

Susan M. Ascher, MD, Washington, DC (*Coordinator*) Nothing to Disclose
Susan M. Ascher, MD, Washington, DC (*Moderator*) Nothing to Disclose
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose
Yuliya Lakhman, MD, New York, NY (*Presenter*) Nothing to Disclose
Gaurav Khatri, MD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of the economic and psychosocial impact of chronic pelvic pain. 2) Review the indications and MRI imaging protocols for endometriosis. 3) Recognize the MRI appearance of endometriosis. 4) Review the epidemiology and clinical presentations of leiomyomas. 5) Review current treatment options for symptomatic leiomyomas. 6) Recognize the MRI appearance of leiomyomas to include differentiating them from other myometrial masses. 7) Review common surgical interventions for stress urinary incontinence and pelvic organ prolapse. 8) Describe the MRI technique for imaging synthetic material in the pelvic floor. 9) Recognize normal and abnormal MRI appearances of synthetic materials used in pelvic floor dysfunction. *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.

RC308

Emergency Radiology Series: Updating Your Emergency Radiology Practice

Tuesday, Nov. 28 8:30AM - 12:00PM Room: S402AB



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

Participants

Martin L. Gunn, MBChB, Seattle, WA (*Moderator*) Research Grant, Koninklijke Philips NV; Royalties, Cambridge University Press; Spouse, Consultant, Reed Elsevier; Spouse, Consultant, athenahealth, Inc
Ken F. Linnau, MD, MS, Seattle, WA (*Moderator*) Royalties, Cambridge University Press;
Scott D. Steenburg, MD, Zionsville, IN (*Moderator*) Research collaboration, IBM Corporation

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LEARNING OBJECTIVES

1) List strategies for optimizing MRI protocols for conditions frequently encountered in the ER setting. 2) Understand the challenges of accepting, reviewing, and reporting on images transferred from outside facilities. 3) List strategies for streamlining and optimizing complex workflow in the Emergency setting. 4) Describe methods, techniques and pearls for 'right sizing' your Emergency Radiology section.

Sub-Events

RC308-01 Staffing an Emergency Radiology Section

Tuesday, Nov. 28 8:30AM - 9:00AM Room: S402AB

Participants

Scott D. Steenburg, MD, Zionsville, IN (*Presenter*) Research collaboration, IBM Corporation

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LEARNING OBJECTIVES

At the end of this session, the learner should be able to: 1. List strategies for optimizing MRI protocols for conditions frequently encountered in the ER setting. 2. Understand the challenges of accepting, reviewing, and reporting on images transferred from outside facilities. 3. List strategies for streamlining and optimizing complex workflow in the Emergency setting. 4. Describe methods, techniques and pearls for 'right sizing' your Emergency Radiology section.

ABSTRACT

Timely and relevant interpretation of imaging studies obtained on Emergency Room patients is critical. Optimizing radiologist coverage levels to provide quality care must be balanced with expected imaging volumes and the cost of providing that service. Overstaffing can result in excess physician cost per RVU, however understaffing can result in longer report turn around times, pressure to perform complex work, increase the potential for burnout, and compromise patient care. Determining the appropriate level of coverage can be challenging, but utilizing historical data and creative scheduling can be used to optimize and 'right size' your ER Section.

Active Handout: Scott David Steenburg

<http://abstract.rsna.org/uploads/2017/17000827/Active RC308-01.pdf>

RC308-02 The Effect of Fatigue from Overnight Shifts on Radiology Search Patterns

Tuesday, Nov. 28 9:00AM - 9:10AM Room: S402AB

Participants

Tarek N. Hanna, MD, ATLANTA, GA (*Presenter*) Nothing to Disclose
Matthew E. Zygmunt, MD, Decatur, GA (*Abstract Co-Author*) Nothing to Disclose
Ryan B. Peterson, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Haris Shekhani, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
David M. Theriot, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
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Elizabeth A. Krupinski, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Assess the effect of overnight shifts (ONS) on radiologist fatigue, visual search, and diagnostic confidence.

METHOD AND MATERIALS

Institutional review board approval was obtained. 12 radiologists (5 faculty and 7 residents) each completed two sessions: one during a normal work-day ("not fatigued") and another in the morning following an ONS ("fatigued"). During each session radiologists viewed 20 bone radiographs consisting of normal and abnormal exams. Viewing time, diagnostic confidence, and eye-tracking search data were recorded for each radiograph. Radiologists completed the Swedish Occupational Fatigue Inventory (SOFI). Confidence data were analyzed using the OB-DBM MPMC ROC technique. Analysis of Variance (ANOVA) was used for SOFI and eye-tracking search data. Data are presented as mean \pm standard deviation.

RESULTS

Mean faculty age was 37.8 and resident age was 30.3 years. SOFI results demonstrated worsening in all 5 variables (lack of energy, physical exertion, physical discomfort, lack of motivation, sleepiness) following ONS ($p < 0.01$). Overall, there was a significant difference between fatigued and not fatigued performance ($p < 0.05$). Total viewing time per case was significantly longer when fatigued (35.9 ± 25.8 seconds) than not fatigued (24.8 ± 16.3) ($p < 0.0001$). Total viewing time per case was longer for residents ($p < 0.05$), and the effect of fatigue on lengthening per-case view time was more pronounced with residents. There was a significant increase in the total gaze fixations generated during the search of each image during fatigued vs not fatigued sessions ($p < 0.0001$), and by residents compared with faculty ($p = 0.009$) (Figure 1). Time to first fixate on the fracture increased significantly during fatigued sessions ($p < 0.0001$), and was longer for residents ($p < 0.01$). The effect of fatigue in lengthening time to fracture fixation was more pronounced in residents.

CONCLUSION

Following ONS, faculty and residents were more fatigued, displayed decreased diagnostic confidence, increased view time per case, increased total gaze fixations, and increased time to fixate on the fracture. The effects of fatigue were more pronounced in residents.

CLINICAL RELEVANCE/APPLICATION

Fatigue from ONS alters radiologist search patterns and extends overall time per case. Experience mitigates but does not eliminate this effect. Practice managers and quality officers should be cognizant of this impact.

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/> Elizabeth A. Krupinski, PhD - 2017 Honored Educator

RC308-03 24/7 Emergency Radiology Improves Care in a Single Payer System

Tuesday, Nov. 28 9:10AM - 9:20AM Room: S402AB

Participants

Jason W. Motkoski, MD,BSC, Vancouver, BC (*Presenter*) Nothing to Disclose
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PURPOSE

To quantitatively and qualitatively evaluate the impact of on-site 24/7 Staff Emergency Radiology coverage at our quaternary centre in one of the world's largest single payer health care systems.

METHOD AND MATERIALS

We reviewed 175,000 consecutive patient encounters at our quaternary centre, spanning 12-months before and 12-months after implementing 24/7 on-site Staff Radiologist coverage. For each patient, we recorded (1) time of patient presentation, (2) presence or absence of trauma, (3) initial acuity score, (4) length of stay (LOS) in the ED, (5) admission status at end of the encounter. This data was correlated with our Radiology Information System (RIS) and all imaging studies performed on these patients while in the ED were identified. For each imaging study, relevant parameters were collected: (1) time of the study, (2) imaging modality, (3) imaged body part, (4) turnaround time (TAT) for the complete radiology report. Analysis of the data was performed on a per patient as well as per imaging study basis with relevant statistical analysis for all calculations.

RESULTS

(1) Quality: Preliminary report discrepancies were eliminated with the introduction of 24/7 Emergency Radiology coverage, which improved diagnostic confidence throughout the hospital, improved patient care and created opportunities for operational standardization. (2) Patient Length of Stay: The length of stay of each imaged patient in the ED was reduced after the introduction of 24/7 Radiology coverage. Average length of stays were reduced by approximately 30 minutes for each CTAS 1 patient, by 20 minutes for each of the CTAS 2 patient, by 10 minutes for each CTAS 3 patient and slightly increased for CTAS 4/5 patients. (3) Prioritization of Care: Improvements were disproportionately allocated toward more acutely unwell patients, which is an important component of any single-payer health system where overcrowding is a daily reality.

CONCLUSION

The implementation of on-site 24/7 Staff Emergency Radiologist coverage at our quaternary care centre in a single payer health care system was associated with improved quality of patient care, reduced patient length of stay and prioritization of more acutely unwell patient care.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, this is one of the earliest papers documenting improved patient care with the implementation of 24/7 on-site Staff Radiologist coverage in a single payer health care system.

RC308-04 Handling Emergency Radiology Workflow

Tuesday, Nov. 28 9:20AM - 9:50AM Room: S402AB

Participants

Tim O'Connell, MD, Meng, Vancouver, BC (*Presenter*) President, Resolve Radiologic Ltd; CEO, Emtelligent Software Ltd; Speaker, Siemens AG

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LEARNING OBJECTIVES

Review some of the emergency radiology workflow challenges at an academic tertiary care medical centre
Understand the role of informatics, visual control, and data analytics in optimizing ER workflow
Learn how innovative informatics solutions can be deployed to improve patient workflow in the ER

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC308-05 Start Time of Emergency Operation: Impact of Expedited Radiology Turnaround Time after the Establishment of Dedicated Emergency Radiology Section

Tuesday, Nov. 28 9:50AM - 10:00AM Room: S402AB

Participants

Gihong Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

To determine if the establishment of dedicated emergency radiology section(DERS) affects radiology performance and start time of emergency operation.

METHOD AND MATERIALS

This retrospective study included 838 patients who underwent abdomen/chest CT and emergency operation within 24 hours after emergency department(ED) visit from January 2005 to December 2014: 335 patients before the establishment of the DERS(pre-DERS period) and 503 patients after the establishment of DERS(post-DERS period). The pre-operative radiology reporting rates were compared between pre-and post-DERS period. In the patients in whom the preoperative radiology report was made, R-TATs and start time of emergency operation (ST-OP) were assessed and compared between pre-and post-DERS period using Person's Chi-square test, independent t-test, Wilcoxon rank test and simple regression analysis.

RESULTS

The preoperative preliminary and finalized radiology reporting rates in post-DERS period significantly increased than those of pre-DERS period(77.3% vs. 39.0%, $p<0.001$; and 34.3% vs. 18.2%, $p<0.001$). The mean preliminary R-TAT and finalized R-TAT in post-DERS period significantly decreased than those in pre-DERS period(1.6 hrs \pm 2.2 SD vs. 3.6 hrs \pm 4.0 SD, $p<0.001$; and 3.5 hrs \pm 3.5 SD vs. 5.0 hrs \pm 4.4 SD, $p=0.016$, respectively). The median ST-OP in post-DERS period significantly decreased than those of pre-DERS period in both whom preoperative preliminary report was made (14.3 hrs vs. 8.4 hrs, $p<0.001$) and whom preoperative finalized report was made (19.7 hrs vs. 14.2 hrs, $p<0.001$). ST-OP showed good linear correlation both with the preliminary R-TAT ($r=0.487$, $p<0.001$) and finalized R-TAT ($r=0.6$, $p<0.001$).

CONCLUSION

The pre-operative radiology reporting rate significantly increases in post-DERS period. The preliminary and finalized R-TATs and ST-OP in post-DERS period significantly decrease than those in pre-DERS period. ST-OP and R-TAT show good linear correlation.

CLINICAL RELEVANCE/APPLICATION

Dedicated emergency radiology section has a marked effect on the pre-operative radiology reporting rate and expediting radiology turnaround time, which advances a start time of emergency operation.

RC308-06 CT Completion and Interpretation Times in a Mass Casualty Incident: Is There a Difference Between Pre Registered EMR and Downtime Protocols?

Tuesday, Nov. 28 10:00AM - 10:10AM Room: S402AB

Participants

Marla Sammer, MD, The Woodlands, TX (*Presenter*) Nothing to Disclose
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PURPOSE

Computerized Physician Order Entry (CPOE) has been proven to prevent medical error. However, during a mass casualty incident (MCI), CPOE can become too cumbersome or rendered non-functional. During an MCI in 2016, 29 children were triaged to our hospital, to both the adult ED (AED) and the children's ED (CED). The departments are physically immediately adjacent but operate under independent trauma protocols. In the AED, a CPOE trauma-specific order set of 50 unassigned "John Doe" patients with ghost Electronic Medical Record (EMR) numbers was available at all times. In the CED, no such order sets were available, and manual paper downtime protocol (used when computerized systems are nonfunctional) was used. During downtime protocol, CT's can be performed but cannot be completed or read until electronic registration is complete. CT's from each ED are performed on different machines, but are sent to a common PACS worklist and read by the same radiologists, independent of scan location. The purpose of this study was to determine if CT completion (available on PACS for radiologists and clinicians to review) and/or read times (report available in EMR) during an MCI were different between pre-existing ghost EMR protocol and downtime protocol.

METHOD AND MATERIALS

After IRB approval, CT data was retrospectively collected from the RIS. Statistical analysis between the two groups (patients in the AED using CPOE ghost EMR vs in CED with downtime registration) was performed using the Independent Samples t Test. A value of <0.05 was considered significant.

RESULTS

21 CT's were performed on 7 patients (6-9 years, mean 7.6 years) in the CED using downtime protocol. 17 CT's were performed on 5 patients (6-11 years, mean 8.6 years) in the AED using pre-existing CPOE order sets. 17 patients were not imaged with CT. In the CED, mean time from CT ordered to completed was 134 minutes longer ($p<0.002$, mean 148 min, range 1-435 min) than in the AED (mean 14 min, range 4-39 min). In the CED, mean time from CT ordered to read by radiologist was 268 min longer ($p<0.002$, mean 296 min, range 15-1283 min) than the AED (mean 28 min, range 7-58 min).

CONCLUSION

In this MCI, CT completion and interpretation times were significantly shorter using preset buffer ghost EMR protocol.

CLINICAL RELEVANCE/APPLICATION

Preregistered "John Doe" type CPOE order sets are suggested for any hospital that may be subject to an MCI.

RC308-07 Optimizing Emergency Abdominal MRI

Tuesday, Nov. 28 10:20AM - 10:50AM Room: S402AB

Participants

Stephan W. Anderson, MD, Cambridge, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC308-08 MRI as the Initial Imaging Modality of Choice in Children with Suspected Acute Appendicitis: Institutional Experience

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S402AB

Participants

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PURPOSE

Ultrasound is the most frequently performed first line imaging procedure in pediatric appendicitis, despite low sensitivity and negative predictive value. Emergent MRI is often limited to cases with equivocal findings on ultrasound. The purpose of our study is to determine the feasibility of performing MRI as the initial imaging modality in children with suspected acute appendicitis.

METHOD AND MATERIALS

Pediatric patients, 18 years or younger, presenting with abdominal pain to an academic institution who subsequently underwent nonenhanced ultrafast MRI examination as the initial diagnosing imaging modality for suspect appendicitis were included in the study. Electronic medical records and radiology reports were retrospectively evaluated to identify following parameters: patient demographics, clinical features, laboratory findings, image acquisition and reporting intervals, need for sedation, adequacy of the imaging, surgical/histopathological findings, clinical management and follow-up. Statistical evaluation was performed using non-parametric tests.

RESULTS

450 subjects met the inclusion criteria for this study from January 2013 through June 2016. Initial evaluation of 150 cases (mean age=12.01 +/- 3.6) are presented in this abstract. MRI studies were acquired without sedation in 146/150 subjects. All examinations were deemed diagnostic with 77 (51.3%) negative scans. Out of 73 children with positive findings, 35 (48%) received a diagnosis of acute appendicitis and 33 (94%) patients underwent emergent surgical intervention. The average duration of acquiring images was 23 minutes with a mean time of 47 minutes till end of scan to interpretation of images. Patients with negative exams and alternative diagnoses who did not meet criteria for admission were discharged with a mean duration of 2 hours and 18 minutes from the time of interpretation of images. MRI demonstrated high sensitivity, specificity, accuracy and negative predictive value in diagnosis of acute appendicitis.

CONCLUSION

MRI is a relatively rapid and practical alternative to ultrasound as the initial imaging modality of choice in children with higher accuracy in diagnosing acute appendicitis and in providing alternative diagnoses.

CLINICAL RELEVANCE/APPLICATION

MR as the initial imaging modality serves as a rapid and practical alternative to ultrasound in evaluating pediatric acute abdomens.

RC308-09 Handling Outside Imaging

Tuesday, Nov. 28 11:00AM - 11:30AM Room: S402AB

Participants

Jeffrey D. Robinson, MD, MBA, Seattle, WA (*Presenter*) Consultant, HealthHelp, LLC; President, Cleareview, Inc;

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LEARNING OBJECTIVES

1) Consider implications of advanced imaging of patients to be transferred. 2) Appreciate the complexity of accepting outside imaging of transfer patients. 3) Develop a multidisciplinary team to improve the handling of outside imaging. 4) Maintain compliance with relevant CMS guidelines on second interpretations.

ABSTRACT

Emergency Department patients transferred to referral centers typically have undergone advanced imaging at the presenting facility. These exams present several difficulties to the receiving facility. This talk will outline the many technical and logistical issues surrounding transfer patient imaging, describe how one enterprise addressed these problems, and provide a template for attendees to use to better manage these patients.

RC308-10 Second Interpretation of Outside C-Spine CTs in a Trauma Transfer Setting at a Level 1 Trauma Center: Do Interpretation Discrepancies Affect Clinical Course?

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S402AB

Participants

Michael Adam, MD, Houston, TX (*Presenter*) Nothing to Disclose
Ronald M. Bilow, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Chunyan Cai, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Second interpretation of trauma transfer imaging at Level 1 Trauma Centers is common practice. This is due partly to the fact that radiological errors are a known hazard, affecting around 30% of reports in several retrospective studies. Discrepancies are often found - false findings are cleared, or missed findings are identified. Our purpose is to demonstrate whether or not second interpretation of CT C-spine studies at a Level 1 Trauma Center results in a significant number of changes in patients' clinical courses.

METHOD AND MATERIALS

465 consecutive trauma transfer patients to our Level 1 Trauma Center with an outside CT C-spine and associated radiology report between 1/1/2016 and 12/31/2016 were included. We compared the second interpretation report to the original report and documented each as concordant negative, concordant positive, discrepant with false finding, or discrepant with missed finding. Descriptions of all discrepant findings were recorded. Patients with discrepant reports were evaluated for a change in clinical course with review of emergency medicine notes, neurosurgical/orthopedic notes, and subsequent imaging within 72 hours.

RESULTS

Of the 465 patients evaluated, 30 were excluded due to the absence of an outside radiology report. Out of 435 included patients we found: 344 (79%) concordant negative cases, 49 (11%) concordant positive cases, 11 (3%) discrepant with false finding cases, and 29 (7%) discrepant with missed finding cases. The 40 (10%) discrepant cases resulted in 21 (4.8%, 95% CI 3.0%-7.3%) incidents of a change in clinical course. Examples of change in clinical course include Miami J collar with neurosurgical follow up, receiving or not receiving an additional imaging study, and emergent surgical intervention. The most common missed finding was occipital condyle fracture, and the most common false positive finding was vertebral fracture (typically found to be vascular channels).

CONCLUSION

Second interpretation of outside C-spine CTs in trauma transfer patients at our Level 1 Trauma Center results in a significant number of clinical changes and more appropriate clinical courses.

CLINICAL RELEVANCE/APPLICATION

Second interpretation of outside C-spine CTs in trauma transfer patients at our Level 1 Trauma Center adds value by resulting in a

significant number of changes in clinical course.

RC308-11 Downstream Imaging Utilization Following Emergency Department Ultrasound Interpreted by Radiologists versus Non-Radiologists in Medicare Patients

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S402AB

Participants

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PURPOSE

Recent work has shown that Medicare patients on average undergo more downstream diagnostic imaging examinations when initial emergency department (ED) ultrasound (US) examinations are performed by non-radiologists as compared to radiologists. We explore this observation further by assessing which ED US examinations are common to both radiologists and ED practitioners and studying downstream diagnostic imaging events specific to those services.

METHOD AND MATERIALS

Using 100% sample Medicare Physician Supplier Procedure Summary Master Files from 2014, we determined which ED US examinations performed by non-radiologists were most likely performed by ED (rather than other non-radiologist) practitioners, and determined which services common to radiologists were also performed by those ED practitioners. After determining that abdominal US examinations were most common to both groups, we used 5% Medicare Research Identifiable Files from 2010 to 2014 to identify downstream imaging events within 30 days of an initial ED abdominal US examination. We then stratified the frequency of downstream imaging events by radiologists vs. ED practitioners.

RESULTS

We found abdominal US examinations were the most common US services performed by both radiologists and ED practitioners. After excluding vascular and cardiac US examinations, these services accounted for 91.6% (9609/10489) of ED US examinations performed by radiologists in the ED setting and 38.4% (916/2386) of those performed by ED practitioners. The mean number of downstream imaging events occurring after abdominal US examinations within 30 days was 1.29 for examinations performed by radiologists and 1.50 for those performed by ED physicians.

CONCLUSION

Despite recent observations that more downstream imaging occurs when ED US examinations overall are interpreted by non-radiologists, the differences in downstream imaging attributable to specialty variation in performance of abdominal ultrasound in the ED setting is small.

CLINICAL RELEVANCE/APPLICATION

Differences in downstream imaging after ED US between specialists are likely multifactorial reflecting the sum of small differences at the service and examination level rather than provider type alone.

RC308-12 Using Social Media as a Platform to Provide Humanitarian Tele-Radiology Services to Areas Under Siege

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S402AB

Participants

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PURPOSE

To report our experience of using social media platforms to provide humanitarian tele-radiology services to areas under siege.

METHOD AND MATERIALS

Four American and Syrian radiologists have established the Tele-Radiology Relief Group to provide diagnostic reports to healthcare workers in besieged areas of Syria since February 2015 till present. Imaging modalities were plain radiographs, ultrasound, and CT. Volunteer radiologists live in different time zones which ensures continuous coverage. Facebook® (Facebook, Menlo Park, CA, USA) is the main platform used to share the data-sets. Each case is published as a post with a link to the images. Each post includes a detailed history and physical exam of the patient. Radiologists provide reading reports as comments on the original post. Healthcare workers on the ground discuss the findings with the radiologists online. WhatsApp® application (WhatsApp, Menlo Park, CA, USA) was used by healthcare workers inside the besieged areas to notify the covering radiologist of a new study uploaded to Facebook®.

RESULTS

475 imaging studies were reported between Feb 2015 and April 2017. That includes 359 CT scans (75.6%), only 10 with contrast (9 IV, 1 PO); 112 radiographs (23.6); and 4 ultrasound studies (0.8%). 412 studies (86.6%) were reported within 24 hours from posting. Poor protocoling and lack of contrast were the main limitations.

CONCLUSION

In a limited resources setting, free and easy-to-use social media platforms can facilitate the delivery of humanitarian tele-radiology services to areas under siege.

CLINICAL RELEVANCE/APPLICATION

Pointing to the availability of free platforms to deliver humanitarian tele-radiology services to areas under siege.

RC309

Gastrointestinal Series: Advances in Abdominal CT

Tuesday, Nov. 28 8:30AM - 12:00PM Room: E350

CT **GI**

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

FDA Discussions may include off-label uses.

Participants

Avinash R. Kambadakone, MD, Boston, MA (*Moderator*) Nothing to Disclose
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Sub-Events

RC309-01 Technical Advances and Multi-energy CT

Tuesday, Nov. 28 8:30AM - 8:50AM Room: E350

Participants

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LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of multienergy CT imaging for clinical practice. 2) Understand simple and rapid approaches to improve clinical disease detection with multienergy CT. 3) Discuss how common image artifacts can be reduced using multienergy CT. 4) Understand how contrast material may be viewed and quantified using multienergy CT

LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of multienergy CT imaging for clinical practice. 2) Understand simple and rapid approaches to improve clinical disease detection with multienergy CT. 3) Discuss how common image artifacts can be reduced using multienergy CT. 4) Understand how contrast material may be viewed and quantified using multienergy CT.

RC309-02 Dual Source Dual-Energy CT for Reduction of Contrast Medium Dosage (389mgI/Kg) In Abdominal Follow-Up CT: Effects on Image Quality and Detectability of Focal Liver Lesions

Tuesday, Nov. 28 8:50AM - 9:00AM Room: E350

Participants

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PURPOSE

To investigate the feasibility of use of dual source dual-energy CT (DSCT) in abdominal follow-up scans to reduce total dosage of contrast medium while maintaining image quality and detectability of focal liver lesions during late arterial phase (LAP) and portal venous phase (PVP).

METHOD AND MATERIALS

Forty-six patients with 46 hypervascular liver lesions (HPELL) during LAP and 48 patients with 48 hypovascular liver lesions (HPOLL) during PVP underwent multiphase abdominal follow-up CT twice within 12 months. One of scans was performed with conventional 100 kVp and 555 mgI/kg. The other was performed with dual-energy mode (80 kVp/Sn140 kVp) and 389 mgI/kg during LAP and PVP.

CT number and standard deviation of liver, lesion, pancreas, aorta, portal vein, paravertebral muscle, and abdominal wall fat were measured on 100 kVp and virtual monochromatic images (VMI) (40-120 keV, 10 keV interval) to calculate signal-to-noise ratio (SNR) and lesion contrast-to-noise ratio (CNR). Two radiologists independently evaluated VMI based on lesion detectability and image quality including artifacts and diagnostic acceptability, compared with the 100 kVp images, using six-point scales.

RESULTS

The SNRs of pancreas, aorta, and portal vein were similar at 40-50 keV images during LAP and at 40-60 keV images during PVP, compared to those at 100 kVp images ($p > 0.05$) with exception of the SNRs of aorta and portal vein, which were significantly higher at 40 keV images during both phases ($p < 0.0013$) and PVP ($p < 0.0001$), respectively. The SNR of liver was similar at 60-70 keV images during LAP ($p > 0.05$) and at 40-60 keV images during PVP ($p > 0.05$). The CNR of HPELL was significantly higher at 40-50 keV images ($p < 0.0002$) and was similar at 60 keV images ($p > 0.05$). The CNR of HPOLL was similar at 40-120 keV images ($p > 0.05$). Two radiologists voted 50 keV and 50-60 keV images comparable or superior to the 100 kVp images more frequently than the other VMI in patients with HPELL (84.8-89.1%, $p < 0.0018$) and HPOLL (70.8-83.3%, $p < 0.0018$), respectively.

CONCLUSION

Using 50-60 keV images, DSCT can reduce total contrast dosage by 30% in abdominal follow-up scans without compromising image quality and detectability of focal liver lesions, compared with the conventional 100 kVp CT.

CLINICAL RELEVANCE/APPLICATION

DSCT with reduced contrast dosage by 30% is feasible in abdominal follow-up scans without compromising image quality and detectability of focal liver lesions.

RC309-03 Oral and IV Contrast Media Considerations

Tuesday, Nov. 28 9:00AM - 9:20AM Room: E350

Participants

Avinash R. Kambadakone, MD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Apply principles of IV contrast dynamics and its impact on enhancement characteristics to enhance lesion detection and characterization. 2) Improve the knowledge of technical innovations in power injectors and apply the knowledge to optimize iodine contrast dose. 3) Apply principles of oral contrast media selection to optimize lesion detection in hollow visceral organs and assess their role in routine abdominal CTs. 4) Learn the advances in oral and iv contrast materials and their utility in the realm of multienergy/spectral CT.

RC309-04 Iodine Contrast Reduction Algorithm Using Patient Weight and Low Tube Potential: Impact on Image Quality and Diagnostic Confidence in Single or Multiphase Contrast-Enhanced Abdominal CT

Tuesday, Nov. 28 9:20AM - 9:30AM Room: E350

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To determine the ability of an iodine contrast reduction (CR) algorithm to maintain diagnostic image quality for single or multiphase contrast-enhanced abdominal CT.

METHOD AND MATERIALS

CT exams with CR were prescribed by radiologists in our clinical practice for patients at risk for renal dysfunction. The CR algorithm combines 1) weight-based contrast volume selection with 2) width-based low tube potential selection and 3) bolus-tracking with fixed delays depending on the desired phase(s) of enhancement. Control exams with routine iodine dose were selected based on patient weight, width and scanning protocol. Three radiologists evaluated CR and routine contrast dose exams in randomized order. Sharpness and noise were each evaluated on a 1 to 3 point scale; artifacts and diagnostic confidence were each evaluated on a 1 to 4 point scale (<3 defined as acceptable). A 4th radiologist reviewed medical records to assess CR indications, prior avoidance of IV contrast, and measured portal vein (PV) and liver contrast-to-noise (CNR) ratios.

RESULTS

48 CR exams were compared to 48 control CTs (mean weight 86 vs 84 kg, $p=0.27$; mean creatinine 1.8 vs 1.1 mg/dl, $p=0.02$). 44 CR patients (88%) had eGFR <60 ml/min/1.73m² and 12 had single or transplanted kidney. 14 (29%) CR patients previously underwent prior unenhanced imaging (11 for metastatic disease). Contrast volume was lower in the CR group; mean volume 67 ml vs 135 ml, $p<0.01$. Across readers, diagnostic confidence was rated as acceptable in 94% (135/144) CR exams and 100% for

control exams. Mean diagnostic confidence ranged from 1.20 - 1.32 for CR exams, and 1.04 - 1.13 for controls (not significant for 2 of 3 readers, $p > 0.07$). For other image quality measures, 2 of 3 readers found no difference in sharpness ($p=0.84$, 1.0), noise ($p=0.09$, 0.42), and artifacts (0.06, 0.29). PV attenuation and CNR (mean 160 HU vs 190 HU, $p<0.01$; 12 vs 18, $p<0.01$) were significantly lower in CR exams, but liver attenuation and CNR were similar (mean 105 vs 109 HU; $p=0.46$ and 8 vs 9, $p=0.15$).

CONCLUSION

The abdominal CT contrast prescription algorithm used in this study reduced iodine contrast volume by 50%, while achieving acceptable image quality in nearly 95% of exams.

CLINICAL RELEVANCE/APPLICATION

The developed iodine contrast prescription algorithm can preserve image quality while extending the benefit of contrast-enhanced abdominal CT exams to patients with perceived risk of nephrotoxicity.

RC309-05 Dosing Iodinated Contrast Agent (CA) for Abdominal CT: Lean Body Weight (LBW) versus Total Body Weight (TBW)

Tuesday, Nov. 28 9:30AM - 9:40AM Room: E350

Participants

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PURPOSE

The CA dose for body CT is typically based on TBW. We hypothesized that adipose tissue does not contribute to volume distribution and that CA dose would be more appropriately based on LBW instead of TBW. The aim of this pilot study was to calculate the equivalent CA dose/LBW leading to the same liver contrast enhancement (LCE) as for the CA dose/TBW in relation to BMI.

METHOD AND MATERIALS

After Ethics Committee approval, we retrospectively evaluated 201 abdominal CT (106 males), injected with Iopamidol (370mg/ml) or Iomeprol (400mg/ml). Patient LBW was estimated using James or Boer formula. LCE was measured as the difference between density in CT Hounsfield units in portal and unenhanced phases. Data were reported as mean±standard deviation; correlation and regression analyses were performed. To account for different iodine concentrations, the CA dose was calculated as grams of iodine (gI).

RESULTS

Patient age was 66±13 years, TBW 72±15 kg, LBW 53±11 kg, and BMI 26±5 kg/m². The CA dose was 0.46±0.06 gI/kg of TBW, corresponding to 0.63±0.09 gI/kg of LBW; LCE was 43±9 HU. Underweight patients (BMI<18.5 kg/m²) received 0.56±0.05 gI/kg of TBW with CE of 51±18 HU; normal weight patients (18.5≤BMI<25 kg/m²) 0.48±0.07 and 44±8 HU, respectively; overweight patients (25≤BMI<30 kg/m²) 0.44±0.04 and 42±9 HU; and obese patients (BMI≥30 kg/m²) 0.41±0.05 and 40±6 HU. A high negative correlation was found between TBW and dose ($r=-0.686$, $P<.001$). A significant negative correlation between LCE and BMI was also observed ($r=-0.206$; $P=.003$). A low but significant positive correlation between LCE and CA dose based on both TBW ($r=0.371$; $P<.001$) and LBW ($r=0.333$; $P<.001$) was found. At multivariate regression analysis using LCE as dependent variable and TBW and CA dose as covariates, CA dose was the only independent predictor of CE (standardized coefficient of 0.322, $P<.001$).

CONCLUSION

The injected CA dose as well as LCE were highly variable, reflecting the practice of radiologists to account for BMI and potential comorbidities. The equivalent CA dose/LBW leading to the same CE as for the CA dose/TBW was 0.63 gI/kg of LBW. These preliminary data seem to support our hypothesis of more appropriate CA dosage based on the LBW.

CLINICAL RELEVANCE/APPLICATION

Dosing on LBW may reduce the LCE variability and avoid overdosing underweight patients and underdosing obese patients, with a net reduction of CA dose administered to the population.

RC309-06 Low kV Scanning

Tuesday, Nov. 28 9:40AM - 10:00AM Room: E350

Participants

Joel G. Fletcher, MD, Rochester, MN (*Presenter*) Grant, Siemens AG; ;

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LEARNING OBJECTIVES

1. To describe the diagnostic benefit of high and low tube potentials in abdominal CT. 2. To explain how low tube potentials can be used to reduce radiation dose and to perform diagnostic exams with lower volumes of iodinated contrast dye. 3. To describe how automatic tube potential selection systems work based on patient size and diagnostic task. 4. To review when automatic tube

potential selection is and is not helpful.

LEARNING OBJECTIVES

1) To describe the diagnostic benefit of high and low tube potentials in abdominal CT. 2) To explain how low tube potentials can be used to reduce radiation dose and to perform diagnostic exams with lower volumes of iodinated contrast dye. 3) To describe how automatic tube potential selection systems work based on patient size and diagnostic task. 4) To review when automatic tube potential selection is and is not helpful.

RC309-07 Dependence of Size-Specific Dose Estimates on Patient Size in Adult and Pediatric Patients Undergoing Body CT under Tube Current Modulation

Tuesday, Nov. 28 10:00AM - 10:10AM Room: E350

Participants

Omid Khalilzadeh, MD, MPH, New York, NY (*Presenter*) Nothing to Disclose
Ali Gholamrezanezhad, MD, Glendale, CA (*Abstract Co-Author*) Nothing to Disclose
Azita S. Khorsandi, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Body CT scans are routinely performed using automatic exposure control (AEC) with tube current modulation. CT manufacturers set different goals for their AEC systems in order to maintain a constant image quality/ image noise regardless of patient size and attenuation level. Therefore, correlation analysis between CT dose and patient size is a good measure for CT radiation dose monitoring at medical institutions. In this study, we aimed to evaluate the correlation between the size-specific dose estimates (SSDE) and patient size across different CT systems.

METHOD AND MATERIALS

Data of abdomen/pelvis CT scans performed over a 1-year time period in a large medical institution was analyzed. CT systems of different manufacturers used for adult or pediatric patients were studied. Different radiation dose parameters including CTDIvol, SSDE, and patient diameter were calculated, using a commercially available CT dosimetry software. All systems were performing under the optimized or recommended manufacturer settings. Only studies with acceptable diagnostic quality were included. The trends in patient dose across different body sizes were assessed in different CT systems. Regression models were employed to evaluate the correlation between CTDIvol, SSDE and patient size.

RESULTS

Data of 5,172 patients were analyzed. The mean CTDIvol was 8.7 mGy (SD: 3.7) and the mean SSDE was 10.2 mGy (SD: 3.5) across all CT systems. The mean scan length was 572 mm and mean effective diameter was 303 mm. There was a strong correlation between CTDIvol and effective diameter across all CT systems ($r=0.70-0.88$, $p>0.001$). There was a relatively weaker but significant correlation between SSDE and effective diameter across all CT systems ($r=0.36-0.67$, $p>0.001$). The radiation dose efficiency was compared across different CT systems.

CONCLUSION

In CT radiation dose monitoring, correlation analysis between SSDE and patient size could be used as a performance measure of the AEC systems. A strong correlation is suggestive of radiation dose inefficiency for large-size patients; and a weak correlation is suggestive of radiation dose inefficiency for small-size/pediatric patients. Ideally, a moderate correlation between SSDE and patient size is desired.

CLINICAL RELEVANCE/APPLICATION

Correlation analysis between SSDE and patient size could be used as a performance measure of the AEC systems. Ideally, a moderate correlation between SSDE and patient size is desired.

RC309-08 Initial Experience Using Automatic Tube Voltage Selection (kVp assist) on a Recently Introduced Wide Detector CT Scanner

Tuesday, Nov. 28 10:10AM - 10:20AM Room: E350

Participants

Manuel Patino, MD, Boston, MA (*Presenter*) Nothing to Disclose
Anushri Parakh, MBBS, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Avinash R. Kambadakone, MD, 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 the effect of different reference settings of automatic tube voltage selection (ATVS) on applied tube voltage, tube current, and radiation exposure on a recently introduced wide detector, 256-slice CT scanner.

METHOD AND MATERIALS

In this IRB approved retrospective study, 247 subjects (mean age: 62 ± 14 years) underwent abdominal CT exams on a scanner with ATVS technique (kV assist; Revolution CT, GE Healthcare). Initially, 161 subjects were scanned using ATVS with 120kVp reference (group A). Subsequently, 86 subjects were scanned using ATVS with 100kVp reference (group B). Automatic tube current

modulation (ATCM) was applied for both groups (Min mA: 200 and Max mA: 720), and other scan parameters remained constant. Images were reconstructed using ASIR-V 40%. Within each group, subjects were categorized based on body weight (<150lb, 151-200lb, >201lb). Applied scan parameters (tube voltage and mean tube current) were compared for all body weight categories among the two ATVS groups. SSDE (mGy) was compared between groups A and B; student's t test was performed

RESULTS

There was no significant difference in body weight between group A and B (173 ± 42 lbs vs. 171 ± 46 lbs) ($p=0.3$). 100 kVp was selected more frequently in Group B (86 %; $n=74/86$) compared to group A (19%; $n=31/161$) across all weight categories. In < 200 lbs, 100 kVp was equally selected in Group A (83%; $n=26/31$) and Group B (84%; $n=58/69$). In subjects >201lb, 94% (16/17) CT acquisitions were performed at 100 kVp in group B, compared to only 12.5% (5/35) in group A. There was no difference in the image quality between subjects scanned using 100kVp vs. 120kVp, even in patients with body weight >201lb ($p>0.05$). SSDE was significantly higher on group A (10.8 ± 3.8 mGy), compared to group B (7.7 ± 2.2 mGy) ($p<0.001$).

CONCLUSION

While applying ATVS, low reference tube voltage setting (100kVp) leads to selection of 100kVp in the majority of cases (86%), regardless of body weight, leading to lower radiation dose and no compromise in image quality.

CLINICAL RELEVANCE/APPLICATION

Automatic tube voltage selection techniques are commonly available in new CT scanners. The algorithms for ATVS vary for different vendors. Knowledge of appropriate reference tube voltage setting and its effect on image quality and radiation dose is necessary before implementing in clinical protocols. Tube voltage applied by a scanner while using ATVS depends upon body composition and reference kVp

RC309-09 Panel Discussion-To Use or Not to Use OCM in Abdomen CT

Tuesday, Nov. 28 10:20AM - 10:40AM Room: E350

RC309-10 Iterative Reconstruction

Tuesday, Nov. 28 10:40AM - 11:00AM Room: E350

Participants

Rendon C. Nelson, MD, Durham, NC (*Presenter*) Research Consultant, General Electric Company; Research Consultant, Nemoto Kyorindo, Ltd; Consultant, VoxelMetrix, LLC; Co-owner, VoxelMetrix, LLC; Advisory Board, Bracco Group; Advisory Board, Guerbet, SA; Research grant, Nemoto Kyorindo, Ltd; Speaker Bureau, Bracco Group; Royalties, Wolters Kluwer nv

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LEARNING OBJECTIVES

1) Understand the definition of iterative reconstruction. 2) Recognize the differences between filtered back projection and iterative reconstruction techniques. 3) Understand how iterative reconstruction techniques use slice data, raw data or both. 4) Recognize the advantages and disadvantages of the various iterative reconstruction techniques.

RC309-11 Multi-reader Multi-case Observer Performance for Detection of Hepatic Metastases at Contrast-enhanced CT: Lowest Radiation Dose Levels that Insure Performance

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E350

Participants

Joel G. Fletcher, MD, Rochester, MN (*Presenter*) Grant, Siemens AG; ;
Jeff L. Fidler, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Shannon P. Sheedy, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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Sudhakar K. Venkatesh, MD, FRCR, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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John M. Barlow, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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Lifeng Yu, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Tammy A. Drees, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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David R. Holmes III, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Alicia Toledano, DSc, Kensington, MD (*Abstract Co-Author*) Consultant, iCAD, Inc
Rickey Carter, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Detection of low contrast lesions such as hepatic metastases (HM) is a challenging diagnostic task for contrast-enhanced CT. Based on prior performance estimates, we designed a multi-reader study to determine the lowest radiation dose at which proven HM could be detected, using varying dose levels with or without iterative reconstruction (sinogram-affirmed iterative

reconstruction; IR).

METHOD AND MATERIALS

Projection data from 102 CT contrast-enhanced exams were collected (51 with HM). HM was defined by histopathology or progression/regression on CT/MR. Using a validated noise insertion technique, 5 dose-reconstruction configurations were generated for each patient (automatic exposure control setting of 200 quality reference mAs [QRM] with filtered back projection [FBP], 160 QRM with IR, 120 QRM with FBP and IR, and 100 QRM with IR), with axial and coronal images. Ten abdominal radiologists used a dedicated workstation to circle suspected HM and indicate a confidence score (0 - 100), evaluating each patient once per reading session. After automated matching of reference and reader HMs, non-inferiority was assessed using JAFROC figure of merit (FOM) on a per-HM basis using a narrow non-inferiority limit of -0.05.

RESULTS

There were 124 HM with a median size of 1.6 ± 0.7 cm. Routine dose levels in the 102 patients were CTDIvol of 12.9 ± 5.6 mGy; (SSDE of 15.1 ± 4.8 mGy). JAFROC FOM for routine dose 200 QRM-FBP CT was 0.809 (95% CI: 0.751, 0.866), with lower dose FOM's ranging from 0.782 to 0.818. Estimated differences in observer performance were non-inferior for 160 QRM-IR and 120 QRM-IR (+ 0.009 [95% CI: -0.011, +0.029] and -0.017 [95% CI: -0.037, +0.003], respectively). The per-patient pooled sensitivity and specificity at 200 QRM FBP was 93% (95% CI: 88, 97) and 74% (95% CI: 66, 82), with widely overlapping confidence intervals at other doses, and identical ranges in reader per-patient sensitivities for both 200 QRM FBP and 120 QRM IR (80 - 98%).

CONCLUSION

This multi-reader study shows that lower dose CT exams reconstructed with iterative reconstruction and dose levels corresponding to 120 QRM (CTDIvol 7.7 mGy; SSDE 9.06 mGy) and higher perform similarly compared to 200 QRM FBP across a narrow range of performance.

CLINICAL RELEVANCE/APPLICATION

For the evaluated iterative reconstruction technique, a 40% reduction from routine dose levels resulted in nearly identical performance for the difficult task of detecting hepatic metastases.

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/> Sudhakar K. Venkatesh, MD, FRCR - 2017 Honored Educator Naoki Takahashi, MD - 2012 Honored Educator Michael L. Wells, MD - 2017 Honored Educator

RC309-12 Diagnostic Yield of Ultra-low-dose Multi-Detector Row CT Compared to Abdominal Radiograph

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E350

Participants

John Jonghun Lee, Toronto, ON (*Presenter*) Nothing to Disclose
Silvio G. Bruni, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Vimarsha G. Swami, MD, BSc, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Sean A. Kennedy, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Pascal N. Tyrrell, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Ravi Menezes, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Patrik Rogalla, MD, Toronto, ON (*Abstract Co-Author*) Institutional Research Grant, Toshiba Medical Systems Corporation

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PURPOSE

The aim of this study was to determine the relative diagnostic performance of ultra-low-dose CT (ULDCT) and abdominal x-ray (AXR) with respect to sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) in the emergency setting.

METHOD AND MATERIALS

Our institution initiated a new CT protocol for evaluation of patients presenting with acute abdominal pain in the emergency department. According to the new CT protocol, all patients with acute abdominal pain who would be referred to AXR were automatically converted to ULDCT. Target exposure values were set to achieve 1 mSv equivalent exposure to a standard 75 kg individual. Our study examined 171 consecutive ULDCT ordered since initiation of the new protocol over a period of 2 months. Control group of 171 consecutive AXR ordered from the emergency department were also collected before the inception of the ULDCT protocol. Final diagnosis was compared to the gold standard diagnosis which comprised of lab values, clinical encounter notes, further imaging tests, endoscopy, and surgery. Each patient was followed up for at least one month.

RESULTS

Between the ULDCT and AXR groups, there were no statistical difference between gender (49% vs. 51% male, $p=0.7$) and age (63.7 vs. 60.5, $p=0.5$). When comparing ULDCT to AXR, sensitivity (0.85 vs. 0.40, $p<0.01$), specificity (0.98 vs. 0.82, $p=0.02$), PPV (0.96 vs. 0.51, $p<0.01$) and NPV (0.92 vs. 0.74, $p=0.02$) were higher for ULDCT.

CONCLUSION

ULDCT has statistically higher sensitivity, specificity, PPV and NPV compared to AXR. ULDCT delivers significantly better diagnostic information despite a radiation dose profile comparable with conventional AXR.

CLINICAL RELEVANCE/APPLICATION

This is the largest study to date comparing the diagnostic accuracy of ULDCT compared to AXR. ULDCT has the potential to replace

AXR providing similar radiation profile with much better diagnostic yield.

RC309-13 Role of Imaging Biomarkers

Tuesday, Nov. 28 11:20AM - 11:40AM Room: E350

Participants

Meghan G. Lubner, MD, Madison, WI (*Presenter*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;

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LEARNING OBJECTIVES

1. Review basic concepts, definitions and metrics used in CT texture analysis. 2. Discuss oncologic applications of texture analysis as a virtual biopsy, in pre-treatment assessment of primary and metastatic tumors, and in response to therapy. 3. Review some specific histopathologic correlates/associations with texture parameters. 4. Review emerging non-oncologic applications of texture analysis with emphasis on evaluating hepatic fibrosis. 5. Discuss methodological challenges and unknowns that exist around CT texture analysis.

LEARNING OBJECTIVES

1) Review basic concepts of CT texture analysis (CTTA). 2) Discuss oncologic applications of CTTA in pretreatment assessment of tumors and in response to therapy. 3) Briefly discuss non-oncologic applications of CTTA. 4) Discuss challenges and limitations of CTTA.

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/> Meghan G. Lubner, MD - 2014 Honored Educator Meghan G. Lubner, MD - 2015 Honored Educator

RC309-14 Evaluation of Hepatocellular Carcinoma Before and After Transarterial Chemoembolization: Quantifying Residual Tumor Utilizing Novel Software Applied to Dual-Energy CT Images

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E350

Awards

Student Travel Stipend Award

Participants

Zachary A. Lambertsen, MD, Birmingham, AL (*Presenter*) Nothing to Disclose
Desiree E. Morgan, MD, Birmingham, AL (*Abstract Co-Author*) Research Grant, General Electric Company
Jessica G. Zarzour, MD, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose
Andrew J. Gunn, MD, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To test the ability of semi-automated volumetric segmentation software to detect and measure viable hepatocellular carcinoma (HCC) on dual-energy CT (DECT) before and after transarterial chemoembolization (TACE), compared to explant pathology data.

METHOD AND MATERIALS

Inclusion: HCC patients with standardized multiphasic hepatic DECT pre- and post-TACE, followed by transplantation within 90 days of follow-up DECT. Software measurements included liver volume, and on HCC lesions greater than 1 cm diameter: tumor cross-dimensional area, volume, Hounsfield units, and iodine content. Measurements were performed on 70 keV, 52 keV, and iodine material density DECT image data acquired in late hepatic arterial phase for each lesion by single operator. Ability to detect measurable enhancement and iodine content in HCC lesions after treatment was cross-referenced to explant pathology reports to evaluate viability concordance. Semi-automated seeding accuracy was assessed for each DECT image type; measurement accuracy was graded on a scale of 1-5: grade 3- no correction; grade 1- major, grade 2- minor undermeasurement; grade 4- minor, grade 5- major overmeasurement.

RESULTS

From a single-center database of over 300 patients transplanted since 2011, a total of 27 patients (mean age 59.4; 16 M) with 40 lesions met inclusion criteria. Mean±std dev liver volume was 1557±462; lesion size pre-TACE was 2.49±1.16 cm, on explant 2.45±1.42 (p=0.90); post-TACE (viable component) 1.28 ±0.29, and did not vary with image type (p=0.62, ANOVA); Of 40 lesions, 22 were found to be 100% necrotic at explant and demonstrated a lack of measurable enhancement on post-TACE images. 18 lesions demonstrated viability at explant ranging from 1% to 100%; subtle enhancement was best on 52 keV DECT image sets, and some lesions demonstrated no measurable enhancement despite known tumor at explant. A total of 244 measurements were performed, with distribution of Grades 1-5 (in order): 16, 39, 111, 35, and 26; 70 keV DECT images required least correction after auto contour.

CONCLUSION

DECT image data on 70 keV, 52 keV and Iodine images allow accurate and reproducible 2D and volumetric liver and lesion analyses using semiautomated software.

CLINICAL RELEVANCE/APPLICATION

Accurate semi-automated volumetric segmentation detection and measurement of HCC on DECT images before and after TACE may

Accurate semi-automated volumetric segmentation detection and measurement of HCC on DCEI images before and after TACE may allow more rapid tumor surveillance and positively impact treatment decisions.

RC309-15 Survival Prognosis Based on Parametric Response Mapping of Pre- and Postinterventional Biphasic Computed Tomography in HCC Patients Under cTACE Treatment

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E350

Participants

Aventinus Noerthen, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Asendorf, Goettingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Andreas Voskrebenzev, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Hoen-Oh Shin, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Arndt Vogel, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Frank K. Wacker, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Rodt, MD, Hannover, Germany (*Presenter*) Advisory Board, Guerbet SA; Speakers Bureau, Siemens AG

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PURPOSE

Parametric response mapping (PRM) - a novel post-processing approach for follow-up imaging - was established in hepatocellular carcinoma (HCC) patients under conventional transarterial chemoembolization (cTACE). Aim of this study was the evaluation of voxel-specific parameters regarding survival prognosis.

CONCLUSION

PRM - a novel post-processing approach for follow-up imaging - allowed survival prognosis for HCC patients under cTACE treatment, the prognostic value was superior to conventional response assessment criteria.

CLINICAL RELEVANCE/APPLICATION

PRM enabled survival prognosis for HCC patients under cTACE and will be useful for supervision of the therapeutic strategy after further validation.

RC310

Emergency Obstetrical Ultrasound

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E451A

OB **US**

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

LEARNING OBJECTIVES

1) Recognize sonographic signs of early pregnancy failure and understand which sonographic signs are definitive for pregnancy failure and which are suspicious for but not diagnostic of pregnancy failure. 2) Diagnose and exclude ectopic pregnancy based on sonographer findings, and recognize unusual ectopic pregnancies, such as interstitial and cervical ectopic pregnancy. 3) Use ultrasound to identify the causes of bleeding and pain during pregnancy in each of the three trimesters. 4) Recognize placental abnormalities, including abruption, previa, and accreta, and understand how the sonographic appearance of abnormalities of the placenta may change as pregnancy progresses.

Sub-Events

RC310A Abnormal Findings in Early Intrauterine Pregnancies

Participants

Carol B. Benson, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify a very early intrauterine pregnancy and understand that previously published signs of early pregnancy are not always present when the gestational sac is first identified. 2) Recognize sonographic signs of early pregnancy failure and understand which sonographic signs are definitive for pregnancy failure and which are suspicious for but not diagnostic of pregnancy failure. 3) Understand which sonographic findings indicate that a pregnancy may subsequently miscarry, even though an embryonic heartbeat is present at the time of the sonogram. 4) Understand the role of hCG measurement in the evaluation of pain and bleeding in early pregnancy.

RC310B Acute Pain in the First Trimester

Participants

Peter M. Doubilet, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) How to diagnose miscarriage in early pregnancy. 2) How to diagnose ectopic pregnancy. 3) How to diagnose ovarian torsion.

RC310C Second and Third Trimester Emergencies

Participants

Paula J. Woodward, MD, Salt Lake City, UT (*Presenter*) Editor, Reed Elsevier

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LEARNING OBJECTIVES

1) Recognize the imaging features and be confident in diagnosing cervical insufficiency, vasa previa, and morbidly adherent placenta.

ABSTRACT

Emergencies in the 2nd and 3rd trimester include preterm birth or conditions which pose a significant risk of morbidity or mortality to either the fetus or mother at the time of delivery.

RC311

Improving PET Interpretation (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S504CD

CT **NM**

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

LEARNING OBJECTIVES

1) Understand the patient preparation issues with performing PET/CT. 2) Review recommendations on patient preparation prior to performing PET/CT. 3) Review the issues in performing PET/CT scans on diabetic patients and learn ways to optimize the glucose level. 4) With the aid of challenging case examples, this activity aims improve PET-CT interpretation through recognition of pitfalls and variants. In addition, it aims to review typical as well as unusual examples of commonly encountered oncologic diagnoses. 5) Learn how to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy.

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

RC311A Therapy-induced Complications on PET/CT

Participants

Gary A. Ulaner, MD, PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd

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LEARNING OBJECTIVES

1) Learn how to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy.

ABSTRACT

FDG is not a cancer-specific agent, and FDG-avidity can be seen in many benign processes. It can be particularly challenging to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy. FDG-avid lesions caused by surgery and procedures includes inflammation at sites of incision or dissection, inflammation from vascular compromise or surgical retraction, surgical transposition of structures with physiologic FDG-avidity (such as ovaries or testes), and pleurodesis inflammation. Radiation may induce FDG-avid pneumonitis, esophagitis, or hepatitis, as well as osteoradionecrosis or fractures. FDG-avid chemotherapy complications include pneumonitis, osteonecrosis, enterocolitis, and pancreatitis. Granulocyte Colony Stimulating Factor for treatment of bone marrow suppression after chemotherapy induces temporary increases of FDG-avidity in the bone marrow and spleen. We will illustrate common and unusual iatrogenic causes of FDG-avidity that can confound FDG PET/CT interpretation.

RC311B Impact of Patient Preparation

Participants

Don C. Yoo, MD, E Greenwich, RI (*Presenter*) Consultant, Endocyte, Inc

LEARNING OBJECTIVES

1) Understand the patient preparation issues with performing PET/CT. 2) Review recommendations on patient preparation prior to performing PET/CT. 3) Review the issues in performing PET/CT scans on diabetic patients and learn ways to optimize the glucose level.

ABSTRACT

F18-FDG PET/CT is a valuable tool for a variety of oncologic applications. The purpose of this educational activity is to discuss the importance of appropriate patient preparation prior to performing oncologic F18-FDG PET/CT scans. The recommendations from the American College of Radiology (ACR), the Society of Nuclear Medicine and Molecular Imaging (SNMMI), and the National Cancer Institute (NCI) for patient preparation will be discussed. Issues that will be discussed include fasting, limiting exercise, hydration, sedation, low carbohydrate meals, and diabetic patients.

Patients are typically asked to fast for at least 4 hours before tracer injection for oncologic PET/CT scans. The ACR and SNMMI both recommend checking glucose levels on all patients prior to administration of F18-FDG. SNMMI guidelines recommend that patients with glucose of greater than 150–200 mg/dL should usually be rescheduled. Performing PET/CT scans in poorly controlled diabetic patients can result in a PET/CT scan with an altered biodistribution limiting interpretation of the study. In a poorly controlled diabetic patient with a glucose level of greater than 200 mg/dl, the study should usually be rescheduled if it does not critically affect patient care. Hyperglycemia will dilute the FDG uptake by tumors through competitive inhibition. Subcutaneous insulin should not be administered to a diabetic patient with high glucose within 4 hours of a PET/CT scan as insulin will stimulate

FDG uptake by skeletal muscle resulting in an altered biodistribution which can severely limit interpretation.

RC311C Challenging Case Examples

Participants

Esma A. Akin, MD, Washington, DC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) With the aid of challenging case examples, this activity aims improve PET-CT interpretation through recognition of pitfalls and variants. 2) Aims to review typical as well as unusual examples of commonly encountered oncologic diagnoses.

RC312

CTA for TAVR and Other Aortic Valve Replacements

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E351

CA CT VA

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

Participants

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

Sub-Events

RC312A Pre-TAVR CT Imaging Protocols

Participants

Philipp Blanke, MD, Vancouver, BC (*Presenter*) Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc; Consultant, Tendyne Holdings, Inc; Consultant, Circle Cardiovascular Imaging Inc

LEARNING OBJECTIVES

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

RC312B CTA for Sizing Transcatheter Heart Valves

Participants

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

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LEARNING OBJECTIVES

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

Honored Educators

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

RC312C Post-TAVR Evaluation: Leaflet Thickening and Other Assessments

Participants

Gregor Pache, MD, Singen, Germany (*Presenter*) Consultant, Edwards Lifesciences Corporation

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LEARNING OBJECTIVES

1) Understand the role of post-procedural CTA imaging in TAVR patients and discuss imaging parameters. 2) Understand normal and abnormal appearances of transcatheter heart valves on CTA. 3) Review the published literature on leaflet thickening and discuss clinical implications.

RC312D CT for the Evaluation of Surgical Bioprostheses

Participants

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

LEARNING OBJECTIVES

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

RC313

Pediatric Series: Chest/Cardiovascular Imaging

Tuesday, Nov. 28 8:30AM - 12:00PM Room: N226

CA CH MR PD VA

AMA PRA Category 1 Credits™: 3.25

ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants

Robert J. Fleck JR, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose

Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Moderator*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;

Rajesh Krishnamurthy, MD, Columbus, OH (*Moderator*) Nothing to Disclose

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

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Sub-Events

RC313-01 Imaging of Obstructive Sleep Apnea

Tuesday, Nov. 28 8:30AM - 8:50AM Room: N226

Participants

Robert J. Fleck JR, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

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Active Handout: Robert Joseph Fleck

[http://abstract.rsna.org/uploads/2017/17000774/Active RC313-01.pdf](http://abstract.rsna.org/uploads/2017/17000774/Active_RC313-01.pdf)

LEARNING OBJECTIVES

1) Describe the rational and usefulness that underlies cine MR imaging prior to surgery for obstructive sleep apnea. 2) Explain the anesthesia procedures for obtaining a safe, useful and accurate MRI during drug-induced sleep. 3) Construct an imaging protocol for your scanner. 4) Describe the typical findings of a study. 5) Synthesize the information from imaging into a report that will be helpful to the surgeon.

ABSTRACT

Obstructive sleep apnea (OSA) occurs in approximately 3% of the pediatric population and is usually very treatable with tonsil and adenoidectomy. However, up to 25% of subjects may not be cured by this common, first line treatment. This is especially true in obese children and children with syndromes, especially Down syndrome. In patient with continued positive symptom review, polysomnography is indicated to confirm continued presence of OSA. Continuous positive airway pressure is the next step in treatment, but compliance is poor in some patient despite persistent attempts to help the patient adapt. Causes of continue airway obstruction during sleep include glossoptosis or hypopharyngeal collapse from poor activation of the dilator muscles, recurrent adenoids, enlarged lingual tonsils and relative macroglossia. These can be addressed by removal of excess tonsil tissue, tongue reduction surgery, tongue suspension, or expansion pharyngoplasty. MR imaging can be critical to guide surgical planning.

RC313-02 Quantitative Characterization of Bronchopulmonary Dysplasia Severity Using Neonatal Pulmonary MRI and Correlation to Short-Term Outcomes

Tuesday, Nov. 28 8:50AM - 9:00AM Room: N226

Awards

Student Travel Stipend Award

Participants

Nara Higano, MS, Cincinnati, OH (*Presenter*) Nothing to Disclose

David Spielberg, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Robert J. Fleck JR, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Andrew Schapiro, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Laura Walkup, PhD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Andrew Hahn, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Jean A. Tkach, PhD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Paul Kingma, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Stephanie Merhar, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Sean B. Fain, PhD, Madison, WI (*Abstract Co-Author*) Research Grant, General Electric Company Research Consultant, Marvel Medtech, LLC

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PURPOSE

Bronchopulmonary dysplasia (BPD) is a serious pulmonary condition associated with premature birth, but the underlying parenchymal disease is poorly characterized, with unclear links between initial NICHD consensus severity diagnosis and clinical outcomes. This work relates MRI-based radiological scoring of structural parenchymal abnormalities in neonates to NICHD severity and short-term clinical outcomes, and demonstrates preliminary quantitative characterization of BPD severity via parenchymal intensity distributions.

METHOD AND MATERIALS

With IRB approval, 22 quiet-breathing neonates (11 severe BPD, 4 moderate, 4 mild, 3 non-BPD control; 27±3 wk birth PMA) underwent structural pulmonary MRI (ultrashort echo-time, UTE, TE~0.2ms; gradient echo, TE~2ms) in a NICU-sited, neonatal-sized 1.5T scanner, with no procedurally-ordered sedation. MRI-based BPD severity was scored by one radiologist with a modified Ochiai system (7 categories, range 0-14). Scores were compared to NICHD severity and short-term outcomes. Separately, whole-lung segmentations from UTE images for a cohort subset (5 severe; 2 moderate; 4 mild) and 1 additional term control yielded normalized lung intensity distributions, a measurement akin to volumetric density (range 0-1 g/cm³).

RESULTS

MRI scores correlate significantly with NICHD severity ($P<0.0001$, $R^2=0.71$), respiratory support at discharge (room air, oxygen, ventilator, death; $P<0.0001$, $R^2=0.84$), and length of hospital stay (slope=0.06[score]/day, $P<0.0001$, $R^2=0.60$). Qualitatively, lung intensity distributions for controls demonstrated a homogenous peak at ~0.5 g/cm³ (expected in healthy newborns), with this peak broadening toward increased density with severity through moderate BPD (representative subjects shown in Figure); severe BPD subjects exhibited prominent low- and high-density regions, particularly for deceased subjects.

CONCLUSION

Pulmonary neonatal MRI can assess structural determinants of BPD without sedation or ionizing radiation, with predictive measurements for severity and short-term outcomes. Importantly, structural and regional quantification from MRI yields the ability to phenotype BPD, with the potential to personalize clinical care via serial evaluation.

CLINICAL RELEVANCE/APPLICATION

Pulmonary neonatal MRI can classify underlying features in infants with bronchopulmonary dysplasia and may provide image-based disease phenotyping with relationship to short-term outcomes.

RC313-03 Evaluation of Tracheobronchial Tree Using Three-dimensional Turbo Field Echo Magnetic Resonance Imaging Sequence

Tuesday, Nov. 28 9:00AM - 9:10AM Room: N226

Participants

Qiaoru Hou, MD, Shanghai, China (*Presenter*) Nothing to Disclose

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

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PURPOSE

Tracheobronchial anomalies including tracheobronchial stenosis, tracheal bronchus, cardiac bronchus, and bronchial isomerism are common in congenital heart disease (CHD). It is necessary to assess tracheobronchial tree and make a preoperative airway evaluation. Our study intend to evaluate tracheobronchial tree using Three-dimensional Turbo Field Echo (3D-TFE) Magnetic Resonance Imaging Sequence

METHOD AND MATERIALS

Institutional Review Board exemption was obtained. Sixty-two consecutive children (32 males; mean age: 30 months, age range: 2-141 months) were enrolled from September 2016 to December 2016, who were diagnosed congenital heart disease by echocardiography. MR was performed to provide preoperative information about anatomy or/and function evaluation. 3D-TFE and 3D-B-TFE as well as CE-MRA sequences were performed to evaluate tracheobronchial anatomy. Image quality was objectively evaluated including contrast-to-noise ratio (CNR), signal intensity and tracheal-bronchial sharpness measurements. Two independent observers subjectively evaluated image quality and image noise using a 5-point scale.

RESULTS

The CNR and signal intensity of 3D-TFE (26.62±5.72, 539.92±54.17) in trachea was higher than that of 3D-B-TFE (9.39±3.09, 131.81±22.73) and CE-MRA (6.11±2.58, 63.30±11.85) (both $P<0.005$). The image quality scores of 3D-TFE (4.65±0.19) in tracheal-bronchial tree were also higher than those on 3D-B-TFE (3.83±0.20) and CE-MRA (2.64±0.31) ($P<0.005$). Tracheal-bronchial sharpness delineation of 3D-TFE was better than that of 3D-B-TFE and CE-MRA, and had significant difference.

CONCLUSION

3D-TFE had significantly higher CNR, signal intensity and image quality scores than 3D-B-TFE and CE-MRA. 3D-TFE can supply helpful information for preoperative strategies and postoperative follow-up.

CLINICAL RELEVANCE/APPLICATION

RC313-04 Differing Pulmonary Structural Abnormalities Detected on MRI in Cystic Fibrosis Patients with Varying Pancreatic Function

Tuesday, Nov. 28 9:10AM - 9:20AM Room: N226

Participants

Mareen S. Kraus, MD, Tübingen, Germany (*Presenter*) Nothing to Disclose
Matthias Teufel, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Joachim Riethmüller, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Esser, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Sven Schneeweiss, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Nadja Selo, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Konstantin Nikolaou, MD, Tübingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Ilias Tsiflikas, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Jürgen F. Schaefer, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cystic fibrosis (CF) patients with sufficient pancreatic function (PS) are known to exhibit milder lung disease compared to CF patients known to have insufficient pancreatic function (PI). We aimed to evaluate and correlate differences in the severity, type and distribution of pulmonary manifestations in CF patients with differing pancreatic status using standardized pulmonary magnetic resonance imaging (MRI).

METHOD AND MATERIALS

Twenty patients of our CF database were selected, ten with PS (mean age 11.8 years; six male; BMI 17.04 kg/m²; FeV1 102%), that were matched by gender, age and similar lung function with ten PI patients. We evaluated changes in each individual lung lobe on MRI. Experienced observers semi-quantitatively assessed whether bronchiectasis, mucus plugging, centrilobular opacity, consolidation, sacculization, and air trapping were present using an established 'MRI-CF-Score'. The severity and distribution of pulmonary disease were compared using nonparametric Kruskal-Wallis tests.

RESULTS

Patients with CF-PS had overall significantly lower MRI-CF scores (with 7.5; $p=0.024$), and therefore milder lung disease, compared to CF-PI. The differences were most significant in scores for bronchiectasis ($p=0.0047$) and air trapping ($p=0.0336$). In general the upper lobes were more affected, however there was a significant difference in PS and PI patients for both upper and lower lobes ($p=0.0273$ and 0.0217) and no predominant area for lung manifestation in PS patients.

CONCLUSION

Pulmonary MRI can depict significant differences in pathologic lung manifestations in patients with CF-PS compared to CF-PI. In PI the severity was higher, especially with respect to bronchiectasis and air trapping.

CLINICAL RELEVANCE/APPLICATION

Pulmonary MRI can identify differences in pathologic lung manifestation in cystic fibrosis patients with varying pancreatic function.

RC313-05 What Can the Single Axial Rotation with 16cm Wide-Detector Bring in Imaging Infant Lungs? Comparison between 256-Row CT and 64-Row CT

Tuesday, Nov. 28 9:20AM - 9:30AM Room: N226

Participants

Yanan Zhu, Ankang, China (*Abstract Co-Author*) Nothing to Disclose
Zhian Pi, Ankang, China (*Abstract Co-Author*) Nothing to Disclose
Zhengjun Li, Ankang, China (*Abstract Co-Author*) Nothing to Disclose
Xianfeng Qu, Ankang, China (*Presenter*) Nothing to Disclose
Mingxing Xu, Ankang, China (*Abstract Co-Author*) Nothing to Disclose
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Jianying Li, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company

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PURPOSE

To explore the clinical value of using a single axial rotation with 16cm wide-detector CT in imaging infant lungs.

METHOD AND MATERIALS

Prospectively enrolled 32 infants (Group 1) for non-enhanced chest CT without sedation using a single axial rotation of 0.35s on a 16cm wide-detector Revolution CT scanner. Patients were scanned with automatic tube current modulation (ATCM) and tube voltages of 80kVp for patients <5 kg and 100 kVp for patients >5 kg to achieve a noise index (NI) of 8.5 HU. The subjective image quality was evaluated by 2 radiologists using a 3 point scoring system with scores equal or greater than 2 being clinically acceptable. Patient preparation time, radiation dose and the quantitative and qualitative image quality were compared with those of 30 infants in Group 2 who underwent a conventional helical scan with sedation using a 64-row VCT with 60 mAs tube current and 120 kVp tube voltage.

RESULTS

There was no statistical difference in body weight and age between the two groups. There was no significant difference between Group 1 and Group 2 in the mean CT value (41.00 ± 11.49 HU vs. 39.60 ± 9.95 HU), noise (12.40 ± 4.67 HU vs. 11.55 ± 2.98 HU) and signal-

to-noise ratio (3.70 ± 1.60 vs. 3.64 ± 1.24) in the descending aorta and average subjective image quality score (2.80 ± 0.35 vs. 2.81 ± 0.24) (all $p > 0.05$). While no sedation was used in Group 1, 14 of the 30 (46.7%) patients in Group 2 required sedation. Compared with the conventional group (Group 2), Group 1 significantly reduced the scan time by 82.6% (0.35 s vs. 2.01 ± 0.21 s), preparation time by 57.4% (41.25 ± 103.78 min vs. 96.5 ± 151.77 min), and effective radiation dose by 53.7% (0.81 ± 0.28 mSv vs. 1.75 ± 0.49 mSv) ($P < 0.05$).

CONCLUSION

The use of axial CT mode in a single rotation for imaging infant lung without sedation on a 16cm wide-detector CT scanner provides same image quality as the conventional helical CT with sedation while effectively reduces radiation dose, patient preparation time to optimize scanning procedures, avoids the complications as well as potential risks of sedation.

CLINICAL RELEVANCE/APPLICATION

The single rotation, axial CT with 16cm wide-detector can be used in imaging infant chest to avoid sedation, optimize scanning procedures and provide good image quality with reduced radiation dose.

RC313-06 Towards Endotracheal Tube Sizing By Measurement on Neonatal Radiographs

Tuesday, Nov. 28 9:30AM - 9:40AM Room: N226

Participants

William F. Sensakovic, PhD, Orlando, FL (*Presenter*) Speaker, Bayer AG; Grant, Mazor Robotics Ltd
Hussnain Mirza, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
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Laura J. Varich, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
Vincent Grekoski, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
Gregory A. Logsdon, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
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William Oh, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine if radiographic measurements are accurate and repeatable enough to be used for sizing endotracheal tubes (ETTs) in the neonatal population. Further, to determine if image processing can improve measurement.

METHOD AND MATERIALS

Database: Radiographs were acquired for two phantoms. Phantom 1: Gammex 610 neonatal chest (trachea diameter: 4.57mm). Phantom 2: Solid water block with 10 air-filled tubes ranging 1.57mm to 9.13mm diameter. Phantoms were scanned with our standard clinical chest protocol. Patient data consisted of 12 chest and/or neck radiographs of children (<3months) acquired with our standard clinical protocol. A second set of radiographs was created by applying local normalization image processing to the original unenhanced images. Three observers independently measured the trachea in all images using digital calipers. Measurement accuracy, precision, and linearity with trachea size were assessed using phantom images with known trachea size. Precision was further measured on clinical images. Observers made 3 measurements for each patient image, above the carina, mid-trachea, and upper shoulder/neck, to assess the impact of measurement position on trachea diameter. ETTs are sized in 0.5mm increments, thus radiographic sizing was considered acceptable if mean absolute differences (MADs) were less than 0.5mm and ideal if 95% CI <0.5mm.

RESULTS

Phantom Data: MAD between measurement and true diameter was 0.2mm (95%CI [0.15,0.25]) for both phantoms. Measurements were linear over the investigated range with regression between true and measured values of $Y = 1.02X$ ($r^2 = 0.99$). Local normalization did not produce significant measurement differences ($p = 0.4$). Patient Data: MAD among observer measurements was 0.48mm (95%CI [0.40, 0.56]). Diameter significantly changed with position of measurement ($p < 0.05$). Measurements near the carina were 0.5mm larger than neck/upper shoulder measurements. Mid-trachea measurements were 0.3mm smaller than neck/upper shoulder measurements.

CONCLUSION

Radiographic trachea measurement has acceptable accuracy and precision for clinical use. Measurement position must be standardized since position substantially alters measured diameter. Local normalization did not improve measurement, but future work should investigate other enhancement methods.

CLINICAL RELEVANCE/APPLICATION

Radiographic measurement is suitable for determining trachea diameter for ETT sizing in neonates.

RC313-07 Ferumoxytol for Pediatric Vascular Imaging

Tuesday, Nov. 28 9:40AM - 10:00AM Room: N226

Participants

Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Presenter*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;

LEARNING OBJECTIVES

1) Know advantages of ferumoxytol for pediatric cardiovascular imaging. 2) Know risks of ferumoxytol. 3) Know method of ferumoxytol administration.

ABSTRACT

Ferumoxytol is an iron oxide nanoparticle approved by the FDA for iron replacement therapy in adults. This presentation will discuss

Ferumoxytol is an iron oxide nanoparticle approved by the FDA for iron-replacement therapy in adults. This presentation will discuss off-label use of ferumoxytol for pediatric cardiovascular MRI. The most significant advantages of ferumoxytol are high signal enhancement in the blood pool and long blood pool residence time. These advantages can enable very high resolution imaging with less anesthesia. However, ferumoxytol has risks of hypotension and anaphylaxis. Hence, a slow dilute administration under direct visualization of the patient in a setting optimized for resuscitation is recommended. Compelling applications include congenital heart disease, peripheral MRV including vascular malformations, and pre-surgical mapping.

RC313-08 Extracardiac Complications of Cavopulmonary Bypass

Tuesday, Nov. 28 10:20AM - 10:40AM Room: N226

Participants

Rajesh Krishnamurthy, MD, Columbus, OH (*Presenter*) Nothing to Disclose

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

RC313-09 Assessment of Daunorubicin-Induced Cardiotoxicity in Childhood Acute Leukemia by Cardiac Magnetic Resonance Tissue Tracking

Tuesday, Nov. 28 10:40AM - 10:50AM Room: N226

Participants

Rong Xu, Chengdu, China (*Presenter*) Nothing to Disclose
Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Ke Shi, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
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Yingkun Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the deformation and dysfunction in children with acute leukemia caused by daunorubicin-induced cardiotoxicity using cardiac magnetic resonance (CMR) imaging tissue tracking.

METHOD AND MATERIALS

Forty-three children with acute leukemia were prospectively enrolled in the study (19 males and 24 females; mean age, 6.5years; range, 1-12 years), the clinical dose of daunorubicin was 25mg/kg and cumulative dose were 175mg/kg. Prior to chemical therapy, the baseline characteristics of heart were collected, including the biochemistry index and the CMR data. At the end of first-stage daunorubicin-containing therapy (32th weeks), the above mentioned data were recollected and compared, respectively. The imaging data were analyzed including the left ventricular ejection fraction (LVEF), tissue-tracking parameters (radial, circumferential, longitudinal peak strain (PS) and peak displacement (PD)) using dedicated post-processing software (cmr42; version, 5.2.2; Circle Cardiovascular Imaging Inc.; Calgary; Canada).

RESULTS

The decreased LVEFs was found in the 32th weeks during therapy ($66.89 \pm 4.03\%$ vs. $49.74 \pm 3.27\%$, $P < 0.05$) when compared with the LV function before therapy. At 32 weeks after the first-stage therapy, there are 11 children (approximately 26%) with impaired LV function (EF <50%), and 32 patients (74%) with a preserved LV function (EF $\geq 50\%$). The regional radial, circumferential, longitudinal PS and radial PD decreased significantly in the 32 patients before-therapy compared with the 32th weeks therapy ($p < 0.05$), and the results were similar to the 11 patients before-therapy and 32th weeks agents, and the strain were all lower in the impaired EF group than in the preserved group (all $p < 0.05$). Furthermore, the radial direction of PS was associated with the LVEF ($r = 0.349$); circumferential and longitudinal PS were positive correlates with troponin T ($r = -0.151$).

CONCLUSION

CMR can monitor the myocardial deformation and dysfunction for early detection myocardial daunorubicin-induced cardiotoxicity in children with acute leukemia. Further follow-up of our subjects in children patients is underway.

CLINICAL RELEVANCE/APPLICATION

CMR strain can monitor the myocardial biomechanics in children daunorubicin-induced cardiotoxicity and is recommended as part of a MR study prior to left ventricle function.

RC313-10 Automatic Quantification of Left Ventricular Noncompaction using Fractal Analysis and Perimetric Ratio in Pediatric Population

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N226

Participants

Amol Pednekar, PhD, Houston, TX (*Presenter*) Former Employee, Koninklijke Philips NV
Tobias Schlingmann, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Cory Noel, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Prakash M. Masand, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Left ventricular noncompaction (LVNC) is being diagnosed more frequently due to robust imaging techniques such as cardiac MR.

The purpose of this study is to quantify left ventricular noncompaction (LVNC) by fractal analysis and perimeter ratio using a novel automated analysis tool in a pediatric population.

METHOD AND MATERIALS

Short-axis stack of end-diastolic balanced SSFP images from 22 (age 14 ± 4.7 , range 2-21yrs) LVNC positive and 20 (age 15 ± 10.5 , range 5-46yrs) LVNC negative patients were analyzed retrospectively using a novel automated tool; only user interaction required was to select the most basal and apical slices to be included in the analysis. Geometric constraint based automatically tracked and cropped LV images were thresholded using an Otsu algorithm to obtain edges delineating papillary and trabeculae muscles. Fractal dimensions (FD) were computed on the edge images using the box counting method for all slices. A piecewise closed Bézier curve of 2nd order geometric continuity was fitted through the salient points of the convex hull of edges to delineate the endocardial contours (Fig 1). The ratio of blood pool to endocardial contour perimeter (PR) is computed for each slice and also as a cumulative value for all slices (cPR). Mean (mFD, mPR) and mean+std.dev (msFD, msPR) of the FD and PR were used as LVNC indices along with cPR.

RESULTS

Total computation time per subject was 7+2 sec. All three indices, were significantly lower ($p < 0.001$) in LVNC+ (mFD: 1.40 ± 0.02 , mPR: 1.34 ± 0.06 , cPR: 1.37 ± 0.07) than in LVNC- (mFD: 1.47 ± 0.04 , mPR: 1.90 ± 0.30 , cPR: 1.93 ± 0.30) patients. One to one line plot and Box plots for msFD, msPR and cPR indices is depicted in Fig 2. Correlation coefficients between msFD and msPR/cPR for LVNC- (2.27/0.86) and LVNC+ (6.87/6) indicate enhanced dynamic range of msPR & cPR. Distribution of mFD-mPR for LVNC-/+ over the long-axis was: basal ($1.4/1.42-1.3/1.7$), mid ($1.4/1.5-1.5/2.2$), apical ($1.3/1.5-1.1/1.7$).

CONCLUSION

In this study, we described a novel automatic tool as well as a novel index to quantify LV trabecular complexity and irregularity. Both fractal analysis and perimeter ratio indices distinguish LVNC patients from negative controls, while the perimeter ratio provides a six times higher dynamic range.

CLINICAL RELEVANCE/APPLICATION

This novel tool can be used in an automated fashion to provide two quantitative indices that successfully distinguish between LVNC patients and negative controls.

RC313-11 Diagnostic Accuracy of Non-Contrast, Self-Navigated, Free-Breathing Coronary MR Angiography in Children with Coronary Anomalies: Prospective Comparison with Coronary CT Angiography

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N226

Participants

Moritz H. Albrecht, MD, Charleston, SC (*Presenter*) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
Domenico Mastrodicasa, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Philipp L. von Knebel Doeberitz, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ;
Davide Piccini, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG
Christian Tesche, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
John W. Nance JR, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Megha Penmetsa, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
Marwen Eid, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Domenico De Santis, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Arni C. Nutting, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Anthony M. Hlavacek, MD, Charleston, SC (*Abstract Co-Author*) Investigator, Siemens AG Research Grant, Siemens AG

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PURPOSE

To evaluate the diagnostic accuracy of a non-contrast, free-breathing, self-navigated 3D (SN3D) coronary MR angiography (cMRA) technique for the evaluation of coronary artery (CA) anatomy in children with known or suspected coronary abnormalities, using coronary CT angiography (cCTA) as the reference standard.

METHOD AND MATERIALS

We prospectively enrolled 21 pediatric patients (15 male, 12.3 ± 2.6 years) in this IRB-approved, HIPAA-compliant study. Patients underwent same-day unenhanced SN3D cMRA and contrast-enhanced cCTA. Two radiologists scored the depiction of CA segments and reader confidence using a 3-point scale: 1=insufficient, 2=moderate, and 3=excellent. Readers assessed CAs for anomalies, high CA origin, and both inter-arterial and intra-mural CA course. Sensitivity, specificity, positive and negative predictive values (PPV, NPV) were calculated to evaluate diagnostic accuracy. Inter-observer agreement was assessed using Intra-class Correlation Coefficients (ICC).

RESULTS

Fourteen children showed CA anomalies or pathologies on cCTA images. Depiction of CA segments was scored higher for cCTA compared to cMRA ($P < 0.015$), except regarding the left main CA ($P = 0.301$), with good (ICC=0.62) to excellent (ICC=0.94) inter-observer agreement. Diagnostic confidence was higher for cCTA evaluation ($P = 0.046$). Sensitivity, specificity, PPV and NPV of cMRA were 92%, 92%, 96% and 87% for the detection of CA anomalies, 85%, 85%, 74% and 92% for high CA origin, 71%, 92%, 82% and 87% for inter-arterial course, and 41%, 96%, 87% and 80% for intra-mural course.

CONCLUSION

SN3D cMRA is highly accurate for the detection of CA anomalies and inter-arterial course in children without radiation exposure.

SN3D cMRA is highly accurate for the detection of CA anomalies and inter-arterial course in children without radiation exposure, contrast administration, or need for breathing commands. Diagnostic confidence and CA visualization, however, are still inferior in comparison with cCTA.

CLINICAL RELEVANCE/APPLICATION

SN3D cMRA can be used instead of cCTA in pediatric patients with suspected CA anomalies in order to avoid both ionizing radiation and contrast media administration. This cMRA technique is feasible, allows for excellent diagnostic accuracy and is especially useful for the evaluation of the proximal CA course.

RC313-12 Global Strain Analysis Using Cardiovascular Magnetic Resonance Feature Tracking to Predict Deterioration of Ventricular Function in Patients with Repaired Fontan at Follow Up: A Feasibility Study

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N226

Participants

Li Wei Hu, BEng, Shanghai, China (*Presenter*) Nothing to Disclose
Qian Wang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Ai-Min Sun, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
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Yumin Zhong, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Ventricular dysfunction is common complication in young survivors with the Fontan circulation and has been identified as a risk factor for mortality. We hypothesized that the global ventricular strain would predict deterioration of ventricular function in patients with repaired Fontan.

METHOD AND MATERIALS

27 patients who haven't had interventional surgical or catheter procedures in 6 months after Fontan procedures were enlisted. CMR imaging was conducted on a 1.5 Tesla scanner (Achiva, Philips, the Netherlands) using a 8-channel phased-array cardiac coil. Global longitudinal(GLS), global radial(GRS) and global circumferential(GCS) strains of the left or dominant ventricle were measured using a CMR-Feature Tracking(FT) software(Circle Cardiovascular Imaging, Calgary, Canada). To compare ejection fraction and follow-up duration using Pearson's correlation and Paired sampled test (two tailed) on GraphPad Prism. We constructed ROC curved analysis to assess the independent effect of CMR-FT on subsequent risks of ventricular dysfunction. Bland-Altman method using MedCalc (Mariakerke, Belgium) to identify possible bias and the limits of agreement of the global strain between two observers.

RESULTS

The mean age of 27 patients was 9.6 ± 2.92 years, 60% male. The mean follow-up duration between the time of surgery and previous CMR scanning was 5.1 ± 1.9 years. Of the 27 patients, clinical diagnosis of suspected patients was cardiac dysfunction in 14 cases (NT-proBNP > 125 pg/ml). The correlations between follow-up duration and LVEF measured using the conventional method were negative weak but still significant ($r = -0.45$, $p < 0.05$). GCS (AUC = 0.82) and GLS (AUC = 0.78) were the best predict subsequent risks of ventricular dysfunction in 27 cases ($p < 0.05$, respectively). Bland Altman analysis of global strain inter-observer reproducibility yielded a better agreement (bias -0.08 and 95% CI -0.25 to 0.07 for GLS, bias -0.15 and 95% CI -0.28 to 0.02 for GCS, bias 0.28 and 95% CI -0.19 to 0.75 for GRS).

CONCLUSION

Feature Tracking strain analysis is clinically feasible and accessible tool for ventricular chamber quantification. GCS and GLS provides strengthen prognostic Information compared to conventional EF for predicting deterioration of ventricular function.

CLINICAL RELEVANCE/APPLICATION

CMR global strain analysis has the potential to detect myocardial motion using cardiovascular magnetic resonance. It is a new tool in following up patients after Fontan operation.

RC313-13 Assessing the Precision and Reproducibility of Novel MRI Sequence in Pediatric Congenital Heart Disease with Cardiac Volumetry and Function

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N226

Awards

Student Travel Stipend Award

Participants

Bill Zhou, Los Angeles, CA (*Presenter*) Nothing to Disclose
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PURPOSE

We have developed a novel 4D, multiphase, steady state imaging with contrast enhancement (MUSIC) MR sequence for pediatric congenital head disease (CHD) imaging that captures both detailed anatomy and 3D cardiac function in a single scan. It is hypothesized that with its higher resolution and phase-resolved 3D data, 4D MUSIC will allow for highly precise and reproducible measurements of ventricular volumetry and function.

METHOD AND MATERIALS

50 children with CHD (ages 2 days to 18 years, 25 females) who underwent MRI at 3.0T with 4D MUSIC sequence between 2013-2017 were included in the study. DICOM data were analyzed for cardiac volume and function with a 2D image processing software (Medis QMass) after reformatting into short-axis images as well as with a 3D image processing software (Materialise Mimics). The trabeculae, papillary muscles, and right ventricular outflow tracts were purposely excluded from the blood pool. 10 randomly selected patients were repeated for intrarater reliability and measured by a second observer for interrater reliability. Five sets of measurements (2D versus 3D software, intrarater for 2D and 3D, interrater for 2D and 3D) were compared for statistical differences using Wilcoxon signed-rank test, intraclass correlation coefficients, and Bland-Altman plots.

RESULTS

There was a high degree of reliability between measurements made on the 2D and 3D softwares. The intraclass correlation coefficient (ICC) between the two methods was 0.997 for LV (left ventricular) EDV (end-diastolic volume), 0.997 for LV ESV (end-systolic volume), 0.961 for LV EF% (ejection fraction), 0.998 for RV (right ventricular) EDV, 0.999 for RV ESV, 0.941 for RV EF%, and 0.996 all variables. The intrarater reliability for the 2D and 3D softwares were 0.985 and 0.998, respectively; similarly, the interrater reliability were 0.997 and 0.998, respectively.

CONCLUSION

This study demonstrates the clinical utility of 4D MUSIC as a MR sequence with both high precision and reproducibility across different image processing softwares and different readers. Both intrarater and interrater reliability were higher with the 3D software than with the 2D. 4D MUSIC has the potential to become the new standard of care in pediatric CHD diagnosis and surveillance.

CLINICAL RELEVANCE/APPLICATION

Novel MR sequence enables precise and reproducible cardiac volumetry and function measurements and is recommended for imaging pediatric congenital heart disease.

RC313-14 Low-Dose Dual-Source Computed Tomography for Evaluating Right Ventricle and Pulmonary Artery in Infant Patients with Tetralogy Of Fallot: Correlation with Post-Operative Pulmonary Regurgitation

Tuesday, Nov. 28 11:30AM - 11:40AM Room: N226

Participants

Yue Gao, Chengdu, China (*Presenter*) Nothing to Disclose
Ke Shi, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Yingkun Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Kaiyue Diao, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
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Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of this study was to assess the influence of pre-operative right ventricle (RV) and pulmonary artery (PA) imaging characteristics by low-dose dual-source computed tomography (DSCT) on post-operative pulmonary regurgitation (PR).

METHOD AND MATERIALS

Fifty-five patients after tetralogy of Fallot (TOF) repair were recruited. The RV and PA parameters evaluated by pre-operative DSCT were compared between the PR and non-PR groups. Spearman's rank correlation was used to determine the correlations between the pre-operative parameters and PR. Receiver operating characteristic (ROC) analysis was used to predict the possibility of PR using individual effective parameters.

RESULTS

There were 20 patients in the PR group and 35 patients in the non-PR group. The pre-operative left PA (LPA) diameter, McGoon ratio, and Nakata index showed significant differences between the two groups (20.40 ± 6.13 mm/m² vs. 16.41 ± 4.69 mm/m², $p = 0.0025$; 2.18 ± 0.53 vs. 1.76 ± 0.49 , $p = 0.005$; 399.95 ± 150.38 mm²/m² vs. 275.50 ± 81.93 mm²/m², $p < 0.0001$). The results showed a significant correlation between PR and LPA diameter, McGoon ratio and Nakata index ($r = 0.350$, 0.338 , and 0.426 , respectively; all $p < 0.05$). ROC analysis revealed that sensitivity and specificity were obtained for predicting the occurrence of PR with LPA (70.0%,77.1%), McGoon ratio (75.0%,57.1%) and Nakata index (50.0%,91.4%).

CONCLUSION

For TOF patients, the pre-operative LPA diameter and PA development indexes by DSCT are associated with post-operative PR. These pre-operative imaging characteristics can be new predictive factors for the occurrence of PR.

CLINICAL RELEVANCE/APPLICATION

Pre-operative right ventricle (RV) and pulmonary artery (PA) imaging characteristics on DSCT can be new predictive factors for the occurrence of post-operatively PR.

RC313-15 Lymphatic System in Congenital Heart Disease

Tuesday, Nov. 28 11:40AM - 12:00PM Room: N226

Participants

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

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LEARNING OBJECTIVES

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

RC314

Interventional Series: Venous Disease

Tuesday, Nov. 28 8:30AM - 12:00PM Room: E353A

CH **VA** **IR**

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

FDA Discussions may include off-label uses.

Participants

Robert J. Lewandowski, MD, Chicago, IL (*Moderator*) Consultant, BTG International Ltd; Advisory Board, Boston Scientific Corporation; Consultant, Cook Group Incorporated; Advisory Board, ABK Medical Inc; Advisory Board, Accurate Medical
Brian S. Funaki, MD, Chicago, IL (*Moderator*) Data Safety Monitoring Board, Novate Medical Ltd

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LEARNING OBJECTIVES

1) Describe the use of radio frequency wire in central venous occlusion. 2) List rationale for venous thrombolysis. 3) Describe the indications for balloon retrograde transvenous occlusion (BROTO). 4) Discuss one approach to establishing a PE response team.

Sub-Events

RC314-01 PE I: Diagnosis and Triage of Pulmonary Embolism

Tuesday, Nov. 28 8:30AM - 8:45AM Room: E353A

Participants

Akhilesh K. Sista, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Be able to distinguish between the Wells criteria and the simplified PESI score. 2) Be able to distinguish between massive, submassive, and low-risk PE. 3) Know the major prospective trials of CDT for pulmonary embolism.

RC314-02 PE Treatment Options and PERT

Tuesday, Nov. 28 8:45AM - 9:00AM Room: E353A

Participants

Ryan P. Lokken, MD, Chicago, IL (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discuss indications and techniques for catheter-based therapy for PE. 2) Discuss models for PE response teams.

RC314-03 Mortality Benefit of IVC Filters in Patients with Pulmonary Embolism and Coagulopathies

Tuesday, Nov. 28 9:00AM - 9:10AM Room: E353A

Participants

Vibhor Wadhwa, MBBS, MD, Little Rock, AR (*Presenter*) Nothing to Disclose
Narendra B. Gutta, MBBS, MD, Little Rock, AR (*Abstract Co-Author*) Nothing to Disclose
Premal S. Trivedi I, MSc, MD, Denver, CO (*Abstract Co-Author*) Nothing to Disclose
Kshitij Chatterjee, MD, Little Rock, AR (*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

We sought to evaluate if patients with coagulopathy and pulmonary embolism (PE) receive any mortality benefit from IVC filter

placement in the inpatient setting.

METHOD AND MATERIALS

The 2005-2014 Nationwide Inpatient Sample was used for this study. Patients with PE were identified using corresponding ICD9 diagnosis codes. Patients with coagulopathy were identified using the Elixhauser comorbidity variable in the NIS database. Only patients >18 years of age were included. IVC Filter placement was identified using ICD9 procedure code (38.7, interruption of the vena cava). Case fatality rates were calculated and logistic regression modeling was used to determine the difference in mortality between patients with and without filter placements. Covariates included in the regression model were all other Elixhauser Comorbidities, age, race, gender, hospital characteristics, severity indices for massive PE (pressor dependence, mechanical ventilation, shock and thrombolytic therapy) and anticoagulation use.

RESULTS

During study years 2005-2014, a total of 212360 were hospitalized with PE and coagulopathy (52.2% male, 47.8% female; median age years), with 48538 (22.90%) of them receiving filters. 31353 (14.80%) patients died during the hospital stay. The all cause fatality rate amongst patients who received a filter was 12.5% (6085 of 31352), compared to 15.4% (42453 of 181009) (two tailed $p < 0.001$) without a filter, with an absolute risk reduction of 2.9%. Using the regression model, the odds ratio of mortality associated with IVC filter placement was 0.511 (95% CI: 0.493 - 0.531, $p < 0.001$).

CONCLUSION

Patients with coagulopathy and PE who received an IVC Filter during the hospital stay had a lower all-cause mortality rate compared to patients who did not receive a filter.

CLINICAL RELEVANCE/APPLICATION

In the absence of randomized controlled trials, this study using an administrative database suggests that IVC filter could potentially be beneficial in preventing death from recurrent PEs in coagulopathy patients.

RC314-04 Mortality Benefit of IVC Filters in Patients with Pulmonary Embolism and Congestive Heart Failure

Tuesday, Nov. 28 9:10AM - 9:20AM Room: E353A

Participants

Vibhor Wadhwa, MBBS, MD, Little Rock, AR (*Presenter*) Nothing to Disclose
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Premal S. Trivedi I, MSc, MD, Denver, CO (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Pulmonary embolism (PE) is associated with a higher mortality in patients with congestive heart failure (CHF) compared to those without heart failure. The purpose of this study was to evaluate if IVC Filter placement provides any mortality benefit in patients admitted with CHF and PE, compared to patients without filters.

METHOD AND MATERIALS

The 2005-2014 Nationwide Inpatient Sample was used for this study. Patients with PE were identified using respective ICD9 diagnosis codes. Patients with CHF were identified using the Elixhauser comorbidity variable in NIS database. Only patients >18 years of age were included in the study. IVC Filter placement was identified using ICD9 procedure code (38.7, interruption of the vena cava). Logistic regression modeling was used to determine the difference in mortality between patients with and without filter placements. Covariates used in the regression model included all Elixhauser Comorbidities, age, race, gender, hospital characteristics and PE severity indices (pressor dependence, mechanical ventilation, shock and use of thrombolytic therapy).

RESULTS

During study years 2005-2014, a total of 393264 patients were hospitalized with PE and CHF (44% male, 56% female; median age 74 years), with 64328 (16.4%) of them receiving filters. 47209 (12.0%) of the patients died during the hospital stay. The all cause fatality rate amongst patients who received a filter was 9.7% (6258 of 64330 patients), compared to 12.4% (40951 of 328935 patients) without a filter (two tailed $p < 0.001$), with an absolute risk reduction of 2.7%. Using the regression model, the odds ratio of mortality associated with IVC filter placement was 0.515 (CI: 0.498 - 0.533, $p < 0.001$).

CONCLUSION

A lower all-cause mortality rate was observed in patients with CHF and PE who received an IVC Filter during the hospital stay, compared to patients who did not receive a filter.

CLINICAL RELEVANCE/APPLICATION

In the absence of randomized controlled trials, this study using an administrative database suggests that IVC filters could potentially be beneficial in preventing death from recurrent PEs in CHF patients.

RC314-05 Chronic Venous Recanalization

Tuesday, Nov. 28 9:20AM - 9:35AM Room: E353A

Participants

Brooke Spencer, MD, Lone Tree, CO (*Presenter*) Researcher, Cook Group Incorporated; Researcher, Veniti, Inc; Researcher, Medtronic plc; Medical Advisory Committee, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

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LEARNING OBJECTIVES

1.) To understand the US and venographic correlation in chronic DVT2.) To learn techniques for crossing chronic venous obstructions3.) Review early experience and outcomes with recanalization of chronic DVT

ABSTRACT

While post thrombotic syndrome (PTS) occurs in approximately 50% of patients, we have not yet identified a clear treatment algorithm to significantly reduce the chronic effects of extensive DVT. As such there are many patients suffering from significant PTS. They often present years later and while a small percentage develop ulceration, the sheer number of patients with chronic pain, wounds and CEAP 4-6 venous disease is staggering. Recanalization of chronic DVT is gaining favor, but can be very technically challenging. Rationale, techniques and adjunct therapies that lead to improved outcomes from these challenging procedures will be discussed.

RC314-06 Stenting for IVC Stenosis after Liver Transplantation: Meta-analysis

Tuesday, Nov. 28 9:35AM - 9:45AM Room: E353A

Awards

Student Travel Stipend Award

Participants

Jeffrey B. Donaldson, MD, MS, Cleveland, OH (*Presenter*) Nothing to Disclose
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Rebecca Le, BSC, Miami, FL (*Abstract Co-Author*) Nothing to Disclose
Charles Martin III, MD, Pepper Pike, OH (*Abstract Co-Author*) Scientific Advisory Board, Boston Scientific Corporation
Amanjit S. Gill, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To describe the determinants of outcomes for liver transplant patients with IVC stenosis treated by endovascular stenting, through meta-analysis. Outcomes of interest include symptom relief, mortality, duration of survival and cause of mortality.

METHOD AND MATERIALS

Using the PRISMA checklist, this meta-analysis searched databases including Medline and Pubmed for retrospective cohort studies, case series/case report studies, letters to the editor, and conference abstracts reporting on IVC stenting in the population of interest. Two reviewers independently evaluated the publications by the QUADAS-2 scale for bias and applicability. Data was extracted and compiled into a database, and verified by the two reviewers. Logistic and Cox proportional hazards regression were used to identify predictors of outcome; odds ratios and hazard ratios were estimated with 95% CIs.

RESULTS

Database search of 5277 records found 17 studies that met criteria for inclusion, totaling 73 patients. Technical success, defined as stent patency at most distant followup, was found in 98% of patients (85/87 stents). Clinical success, defined as symptom relief, was achieved in 85% of patients (46/54). The reason for liver transplant was a statistically significant predictor of all-cause mortality ($p=0.046$). Subjects with HCC had a higher hazard of dying compared to the composite mortality in all other reasons for liver transplant ($HR=3.95$, with 95% CI of [1.3, 12], $p=0.015$). A marginally significant negative correlation was found between the number of stents and symptom relief, suggesting that stenoses more resistant to stenting may lead to refractory symptoms.

CONCLUSION

Between 1995 and 2014, 17 studies reported 73 patients were treated for IVC stenosis after a liver transplant by stenting. Meta-analysis of patient level data found a significantly increased risk of all-cause mortality in patients with HCC. This corresponds to increased mortality of patients with HCC the post-liver transplant patients described in multiple observational studies. Thus, patients treated for IVC stenosis after liver transplant through endovascular methods have similar outcomes to those without IVC stenosis.

CLINICAL RELEVANCE/APPLICATION

For IVC stenosis after liver transplantation, stenting is an effective and durable procedure for relieving symptoms of venous obstruction. Patients with HCC had significantly higher mortality, similar to existing literature.

RC314-07 Debate: Submassive PE: Should Catheter-directed Therapy be Used?

Tuesday, Nov. 28 9:45AM - 10:00AM Room: E353A

Participants

Akhilesh K. Sista, MD, New York, NY (*Presenter*) Nothing to Disclose

RC314-08 May-Thurner and Paget-Schroetter: Commonalities and Differences

Tuesday, Nov. 28 10:15AM - 10:30AM Room: E353A

Participants

Charles E. Ray JR, MD, PhD, Chicago, IL (*Presenter*) Editor, Thieme Medical Publishers, Inc; Consultant, W. L. Gore & Associates, Inc; ; ; ;

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LEARNING OBJECTIVES

1) To understand the commonalities and differences between May Thurner syndrome and Paget Schroetter syndrome. 2) To discuss the role of minimally invasive therapies in the treatment of both disease processes.

ABSTRACT

n/a

RC314-09 The Application of Combined Venography in the Diagnosis of Iliac Vein Compression Syndrome with Dual Source Computed Tomography

Tuesday, Nov. 28 10:30AM - 10:40AM Room: E353A

Participants

Li-Wei Wang, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose
Yu-Chen Chen, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose
Xindao Yin, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose
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Liyen Lu, Nanjing, Christmas Island (*Presenter*) Nothing to Disclose

PURPOSE

To explore the clinical value of the combined dual-source CT venography (CTV) for the diagnosis of iliac vein compression syndrome (IVCS).

METHOD AND MATERIALS

Forty-three patients with clinically suspected deep venous thrombosis (DVT) underwent CTV examination. Among them, 22 cases were assessed with combined CTV while 21 cases were given conventionally indirect CTV. The lower extremity deep vein was scanned from foot to head. The dual-energy technology is applied for data acquisition.

RESULTS

Two kinds of CTV methods could be used directly for diagnosing IVCS and checking the asymptomatic mild iliac vein compression. 32 IVCS patients were diagnosed by CTV. In 27 cases with DVT, the average diameter of the left iliac vein was 3.23 ± 1.45 mm and the average compression rate was 67%. The differences were statistically significant in comparisons of the average diameter of left iliac vein between IVCS patients with or without DVT and patients without IVCS. The image quality scores of bidirectional CTV were higher than indirect CTV with statistically significant difference.

CONCLUSION

Combined CTV is a feasible technique for lower extremity venography. The image quality of combined CTV is better than conventionally indirect CTV with greater clinical value.

CLINICAL RELEVANCE/APPLICATION

Combined CTV is a feasible technique for lower extremity venography with greater clinical value.

RC314-10 IVC Filters: Evidence and Ongoing Trials

Tuesday, Nov. 28 10:40AM - 10:55AM Room: E353A

Participants

Matthew S. Johnson, MD, Indianapolis, IN (*Presenter*) Research Consultant, Argon Medical Devices, Inc; Research Consultant, Bayer AG; Research Consultant, Bristol-Myers Squibb Company; Research Consultant, Boston Scientific Corporation; Research Consultant, Cook Group Incorporated; Research Consultant, BTG International Ltd; Research support, BTG International Ltd; Research Consultant, Guerbet SA; Research Consultant, Surefire Medical, Inc; ;

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LEARNING OBJECTIVES

1) Describe caval filters currently available for use in the United States. 2) Understand accepted indications for filter placement and areas of controversy in those indications. 3) Describe potential complications related to vena cava filter usage. 4) Discuss the rationale for the PRESERVE trial. 5) Apply understanding of the indications and potential complications of vena cava filters to their clinical use.

RC314-11 Trends in Inferior Vena Cava Filter Placement and Retrieval Amongst Radiologists and Other Specialists

Tuesday, Nov. 28 10:55AM - 11:05AM Room: E353A

Participants

David Guez, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
David R. Hansberry, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Carin F. Gonsalves, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
David J. Eschelman, MD, Bryn Mawr, PA (*Abstract Co-Author*) Nothing to Disclose
Laurence Parker, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Vijay M. Rao, 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

To evaluate inferior vena cava (IVC) filter placement and retrieval rates amongst radiologists, vascular surgeons, cardiologists, neurosurgeons, other surgeons, and all other healthcare providers in Medicare fee-for-service beneficiaries between the years 2012 and 2015.

METHOD AND MATERIALS

The nationwide Medicare Physician/Supplier Procedure Summary Master Files were used to determine the volume of IVC filter placement, IVC filter repositioning, and IVC filter retrieval, which correspond to procedure codes 37191, 37192 and 37193, respectively. Data was reviewed for all years that procedural code 37193 was available, which includes 2012 to 2015, as this code was not available prior to 2012.

RESULTS

The total volume of IVC filter placement decreased from 57,785 in 2012 to 44,378 in 2015 with radiologists placing the majority of them at 60%. Volume of IVC filter placement declined across all specialties, including radiologists who placed 33,744 in 2012 and 27,957 in 2015. However, total retrieval of IVC filters has increased over the same time period with 4,060 and 6,166 removals in 2012 and 2015, respectively. Radiologists have removed the bulk of the filters: 64% in both 2012 and 2015. Vascular surgeons, cardiologists, and other surgeons retrieved 20%, 10%, and 5%, respectively, of all IVC filters in 2012 and 22%, 9%, and 5%, respectively, in 2015.

CONCLUSION

From 2012 to 2015, IVC filter placement steadily decreased across all specialties; however, IVC filter retrieval rates have continued to rise over the same time period. Radiologists are responsible for the majority of IVC filters placed and retrieved. They have placed over 60% and retrieved over 63% of all IVC filters over the evaluated 4 year period. Given the results of the PREPIC trial and subsequent recommendations by the FDA, the retrieval rate of IVC filters has risen and likely will continue. Additionally, the implementation of structured IVC filter clinics has improved follow-up in patients who have IVC filters placed.

CLINICAL RELEVANCE/APPLICATION

Recent studies have shown complications related to filters that were implanted for longer periods. Although the number of filters being inserted is declining, the number retrieved is increasing.

RC314-12 DVT Lysis: An Update

Tuesday, Nov. 28 11:05AM - 11:20AM Room: E353A

Participants

Kush R. Desai, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Consultant, Cook Group Incorporated; Consultant, The Spectranetics Corporation; Consultant, AngioDynamics, Inc; Consultant, Boston Scientific Corporation

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LEARNING OBJECTIVES

1) To review the history, rationale, and the most recent data behind deep venous thrombolysis. 2) Discuss current practice, emerging technologies, and future directions.

RC314-13 IVC Filters: Past, Present, and Future

Tuesday, Nov. 28 11:20AM - 11:35AM Room: E353A

Participants

Matthew S. Johnson, MD, Indianapolis, IN (*Presenter*) Research Consultant, Argon Medical Devices, Inc; Research Consultant, Bayer AG; Research Consultant, Bristol-Myers Squibb Company; Research Consultant, Boston Scientific Corporation; Research Consultant, Cook Group Incorporated; Research Consultant, BTG International Ltd; Research support, BTG International Ltd; Research Consultant, Guerbet SA; Research Consultant, Surefire Medical, Inc; ;

RC314-14 How IVC Filters Fail: A Review of the FDA MAUDE Database

Tuesday, Nov. 28 11:35AM - 11:45AM Room: E353A

Awards

Student Travel Stipend Award

Participants

Ahmed Abbas, BS , Tracy, CA (*Presenter*) Nothing to Disclose

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PURPOSE

We hypothesized that inferior vena cava (IVC) filter reported adverse events are specific to filter type, brand, and geometry.

METHOD AND MATERIALS

The FDA MAUDE database was reviewed from 01/01/2013 to 12/31/2016 for reported adverse events (fracture, limb embolization, tilt, migration, IVC wall erosion, deployment problems, retrieval failure and distal thrombosis) for different filter type (retrievable filter (RF) vs. non-retrievable filter (NRF)), brand (ALN, Argon, Braun, Bard, Boston, Cook, Cordis, Rex and Volcano) and geometry (biconical, complex, conical, conical with cylindrical, conical with umbrella, and helical). Chi-square test was used to examine the null hypothesis and Holm's method was used to adjust the p-values to control the family-wise type I error rate.

RESULTS

Association was seen between complications and filter type ($n = 3751$, $p < 0.001$): higher proportion of tilt in NRF than RF (14.4% vs. 3.5%, $p < 0.001$); but more deployment problems in RF as compared to NRF (34.3% vs. 19.4%, $p < 0.001$). There was an association between complications and filter brand ($n = 4275$, $p < 0.001$): compared to other brands, Cook filters had a higher proportion of migration (11.5% vs. 7.7%) and erosion (26.1% vs. 20.8%) but fewer deployment problems (8.2% vs. 17.8%); Cordis filters had a higher proportion of thrombus (8.9% vs. 2.0%) and retrieval failure (18.6% vs. 9.0%), but fewer fractures (7.9% vs. 18.0%) and Bard filters had more deployment problems (25.0% vs. 17.8%). We also found an association between complications and filter geometry ($n = 3969$, $p < 0.001$): when compared to others, biconical filters had a higher proportion of thrombus (10.9% vs. 2.1%) but fewer fractures (9.7% vs. 19.6%); Complex filters had a higher proportion of fractures (25.9% vs. 19.6%), migrations (11.1% vs. 5.9%), limb emboli (11.1% vs. 5.9%), and erosions (40.7% vs. 23.1%) but fewer deployment problems (0% vs. 19.1%).

CONCLUSION

There are significant differences in the proportion of reported adverse events based on the filter brand, geometry, and type.

CLINICAL RELEVANCE/APPLICATION

Knowledge of relative proportion of reported IVC filter adverse events with respect to the brand, geometry, and type may help guide the appropriate IVC filter selection based on patient characteristics to minimize the risk of adverse events.

RC314-15 Debate: Retrievable Filters: Get Them All Out!

Tuesday, Nov. 28 11:45AM - 12:00PM Room: E353A

Participants

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

Robert J. Lewandowski, MD, Chicago, IL (*Presenter*) Consultant, BTG International Ltd; Advisory Board, Boston Scientific Corporation; Consultant, Cook Group Incorporated; Advisory Board, ABK Medical Inc; Advisory Board, Accurate Medical

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LEARNING OBJECTIVES

1) Understand the importance of removing IVC filters that are no longer required. 2) Name the risks of potentially retrievable IVC filters. 3) Cite literature demonstrating safety and efficacy of removing IVC filters with advanced techniques.

RC315

Breast Series: MRI Emerging Technology

Tuesday, Nov. 28 8:30AM - 12:00PM Room: Arie Crown Theater

BR MR

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

FDA Discussions may include off-label uses.

Participants

Savannah C. Partridge, PhD, Seattle, WA (*Moderator*) Research Grant, General Electric Company
Hiroyuki Abe, MD, Chicago, IL (*Moderator*) Nothing to Disclose

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Sub-Events

RC315-01 Screening Breast MRI

Tuesday, Nov. 28 8:30AM - 8:50AM Room: Arie Crown Theater

Participants

Christopher E. Comstock, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To analyze the data supporting the use of MRI for supplemental breast cancer screening. 2) To understand which sub-groups of women supplemental screening with MRI is currently recommended. 3) To become familiar with the potential future role of MRI for breast cancer screening.

RC315-02 Differential Performance of Screening Breast MRI in Varying Populations with Elevated Breast Cancer Risk

Tuesday, Nov. 28 8:50AM - 9:00AM Room: Arie Crown Theater

Participants

Kristine S. Burk, MD, Boston, MA (*Presenter*) Nothing to Disclose
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Research Consultant, Gamma Medica, Inc Research Consultant, K2M Group Holdings, Inc
Geoffrey M. Rutledge, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Christine E. Edmonds, MD, Boston, MA (*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

PURPOSE

Evaluate screening breast MRI performance across populations with varying indications for elevated breast cancer risk.

METHOD AND MATERIALS

This IRB approved, HIPAA compliant study reviewed all screening breast MRI exams performed from 2011-2014 at our academic medical center. Exam indication was extracted from the report and a primary indication determined for each study: BRCA mutation carrier (BRCA), history of mediastinal radiation (RAD), family history of breast cancer (FH), personal history of breast cancer (PH), and personal history of high-risk lesion (HRL). The final cohort included 5,301 exams in 2,709 patients. Cancer detection rate (CDR) and positive predictive value for biopsies performed (PPV) were compared using a X2 test.

RESULTS

The most common indication was PH (n=2917, 55%), followed by FH (n=1366, 26%), BRCA mutation (n=582, 11%), HRL (n=395, 7%), and RAD (n=41, 1%). Performance measures were compared across three groups: (1) BRCA or RAD, (2) FH, and (3) PH or HRL. There was a significant difference in CDR across the three groups (p=0.027) by X2 test with CDR highest in the BRCA/RAD group (22/1000), lowest in the FH group (8/1000), and moderate in the PH/HRL group (12/1000). Using logistic regression to control for age, mammographic density, and available prior breast MRI, there was no significant difference in CDR between the PH/HRL and BRCA/RAD groups (p=0.80), but the CDR was significantly lower in the FH group compared to the BRCA/RAD group (p=0.024). Presence of a prior MRI was significant in the logistic regression (p=0.020), suggesting the difference in CDR between the PH/HRL and BRCA/RAD groups may be related to availability of a prior breast MRI. The PPV was highest in the PH/HRL group at 40% (95% CI: 30%-50%), followed by the BRCA/RAD group at 33% (95% CI: 20%-50%), and lowest in the FH group at 14% (95% CI: 8%-25%).

CONCLUSION

Screening breast MRI may be considered for women with a personal history of breast cancer or high-risk lesion, as performance is

screening breast MRI may be considered for women with a personal history of breast cancer or high risk lesion, as performance is similar to that in BRCA patients. Better risk assessment strategies are needed for patients with a family history of breast cancer to identify those most likely to benefit from breast MRI screening.

CLINICAL RELEVANCE/APPLICATION

The American Cancer Society supports MRI to screen BRCA carriers, but not for women with a history of breast cancer or high risk lesion. We found screening MRI performs equivalently for these groups.

RC315-03 Population-Based Assessment of the Effect of MRI Background Parenchymal Enhancement on Future Primary Breast Cancer Risk

Tuesday, Nov. 28 9:00AM - 9:10AM Room: Arie Crown Theater

Awards

Student Travel Stipend Award

Participants

Vignesh A. Arasu, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
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Constance D. Lehman, MD, PhD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company
Karla Kerlikowske, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the effect of background parenchymal enhancement (BPE) on future risk of breast cancer among women undergoing breast MRI.

METHOD AND MATERIALS

In this IRB-approved and HIPAA-compliant prospective cohort study, data from five Breast Cancer Surveillance Consortium (BCSC) registries were collected on women who underwent breast MRI with qualitative BPE assessment between 2005-2014. Women were included if BPE was measured more than 3 months prior to their first diagnosis of invasive breast cancer or ductal carcinoma in situ (DCIS), using the baseline BPE assessment level. Cancer outcomes were ascertained through linkages with state or regional cancer registries and pathology databases. Breast cancer risk associated with BPE was estimated using a Cox proportional hazards model stratified by BCSC registry and adjusted for age and MRI indication (screening vs. diagnostic).

RESULTS

A total of 3,223 women were included, of whom 100 women developed cancer (71 invasive, 29 DCIS) during an average of 2.5 years of follow-up. Cases had a higher proportion of pre-menopausal women (41% versus 33%) and first-degree family history (59% vs. 51%). When using four ordinal categories of BPE with minimal BPE as reference, increasing levels of BPE were associated with significant or near significantly increasing cancer risk: mild BPE hazard ratio (HR) 1.66 (95% confidence interval (CI) 0.93, 2.96), moderate BPE HR of 2.23 (95% CI 1.25, 3.96) and marked BPE HR of 3.35 (95% CI 1.82, 6.16). When dichotomizing BPE using minimal BPE as reference, women with mild, moderate, or marked BPE had a significantly increased risk of cancer (HR 2.17, 95% CI 1.33, 3.55). Subgroup analysis using dichotomized BPE showed similar effects among women stratified by mammographically fatty/scattered fibroglandular breasts (HR 2.19, 95% CI 0.84, 5.70) and heterogeneous/extremely dense breasts (HR 1.93, 95% CI 0.99, 3.77). Dichotomized BPE significantly increased risk of invasive cancer (HR 2.44, 95% CI 1.35, 4.39), but associations with DCIS were weaker and not statistically significant (HR 1.61, 95% CI 0.66, 3.91).

CONCLUSION

BPE is a predictor of future breast cancer risk independent of breast density with stronger associations with invasive cancer than DCIS.

CLINICAL RELEVANCE/APPLICATION

BPE should be considered for incorporation into risk prediction models for high-risk women undergoing MRI.

RC315-04 Is the Amount of Fibroglandular Breast Tissue and Background Parenchymal Enhancement Risk Predictors for Breast Cancer Development and False Positive Results in a Breast MRI Screening Program?

Tuesday, Nov. 28 9:10AM - 9:20AM Room: Arie Crown Theater

Participants

Suzan Vreemann, MSc, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Mehmet U. Dalmis, MSc, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research agreement, Siemens AG; Research agreement, Seno Medical Instruments, Inc; Research agreement, Identification Solutions Inc; Research agreement, Micrima Limited; Scientific Advisor, ScreenPoint Medical BV

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PURPOSE

Breast density in mammography is associated with breast cancer risk in the average risk population. Recent publications use Background Parenchymal Enhancement (BPE) as a predictive tool for breast cancer on breast MRI. The purpose of this study is to investigate whether the amount of fibroglandular tissue (FGT), and BPE measured on baseline breast MRI are related to risk on breast cancer and false positive recalls in subsequent screening examinations.

METHOD AND MATERIALS

Baseline MRI scans of 1568 women participating in an intermediate and high risk screening program between 01/01/2003 and 01/01/2014 were selected. Automated tools based on deep learning were used to obtain quantitative values for FGT and BPE, that were dichotomised in low and high groups. Logistic regression using a forward selection method was used to investigate the relationships, adjusting for age and BRCA status.

RESULTS

Sixty-one cancers were detected in 4788 follow-up scans. 267 false-positive recalls occurred with in total 206 false positive biopsies. FGT and BPE were not associated with breast cancer risk. Only BRCA status was significantly associated with breast cancer risk ($p=0.001$). High BPE and FGT were, however, associated with an increase in false positive recalls (OR: 1.303, $p=0.020$ and OR: 1.338, $p=0.026$, respectively) and high BPE increased the risk of false positive biopsy (OR: 1.540, $p=0.003$).

CONCLUSION

FGT and BPE, as measured on MRI baseline, are not associated to the risk of developing breast cancer in the future in this cohort of women at increased risk. High FGT and BPE at baseline are, however, associated with higher rates of false positive recall and biopsy.

CLINICAL RELEVANCE/APPLICATION

FGT and BPE cannot be used as an independent risk factors in models predicting breast cancer occurrence in high risk screening. Patient counseling should however include the higher risk of false positive outcomes in women with high FGT and BPE.

RC315-05 MRI Surveillance for Women with a Personal History of Breast Cancer: Comparison between Abbreviated and Full Diagnostic Protocol

Tuesday, Nov. 28 9:20AM - 9:30AM Room: Arie Crown Theater

Participants

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 Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
 Eun Sook Ko, MD, 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
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PURPOSE

To compare the diagnostic performance of breast magnetic resonance imaging (MRI) with Abbreviated Protocol (ABP) and Full diagnostic protocol (FDP) in women with a personal history of breast cancer.

METHOD AND MATERIALS

From September 2015, we started to obtain screening breast MRI in patients with a personal history of breast cancer using ABP. ABP consists of T2-weighted scanning and dynamic contrast enhanced imaging including one pre-contrast and two post-contrast scanning of gradient echo sequence at 80 and 160 seconds after contrast injection. Among the total 2918 screening breast MRIs using ABP, we selected 381 cases that were confirmed by histological diagnosis or by negative follow up images after one year. As a control group, we selected postoperative screening breast MRIs using FDP of recent 7 years before September 2015. We matched patients' age, interval between the cancer surgery and MRI examination, and stage of the operated breast cancer. Finally 311 matched cases from ABP and FDP groups were included. We analyzed diagnostic performance for detecting recurrent breast cancer including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and area under the curve (AUC) and compared the results between ABP and FDP.

RESULTS

The sensitivity and NPV were 100% in both ABP and FDP. Specificity, PPV, accuracy, and AUC of ABP and FDP were 95.7% vs 96.1%, 40.9% vs 14.3%, 95.8% vs 96.1%, and 97.9% vs 98.1%, respectively. Specificity, accuracy and AUC were FDP were slightly higher than ABP, but statistically not significant. PPV was significantly higher in ABP than FDP suggesting decreased number of false positive cases.

CONCLUSION

ABP showed comparable performance to the FDP in detecting recurrent breast cancer and decreased false positive cases.

CLINICAL RELEVANCE/APPLICATION

ABP can provide a better choice that has similar diagnostic performance and shorter MRI acquisition time in MRI surveillance for women with a personal history of breast cancer.

RC315-06 Does a T2-Weighted Sequence Add Accuracy to the Abbreviated Breast MR Examination?

Tuesday, Nov. 28 9:30AM - 9:40AM Room: Arie Crown Theater

Participants

Susan Weinstein, MD, Philadelphia, PA (*Presenter*) Consultant, iCAD, Inc
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Elizabeth S. McDonald, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Alice Chong, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Hologic, Inc Consultant, Siemens AG

PURPOSE

Studies have shown that dense breast tissue decreases the sensitivity of mammography. Women with dense breasts may opt to have supplemental screening. One such screening option is an abbreviated form of the MRI examination (AB-MR). The goal of the AB-MR exam is to efficiently deliver a supplemental screening study with high sensitivity and specificity, however retrospective, reader studies evaluating the AB-MR protocols have included T2-weighted sequences in addition to the pre- and post contrast sequences, with the T2-weighted sequence taking the longest acquisition time. The added value of T2-weighted sequence should be weighed against the time needed to obtain the sequence. In this prospective study, we evaluate what, if any, additional information was gained from by a T2-weighted sequence in the interpretation of clinical, prospectively acquired, AB-MR examinations.

METHOD AND MATERIALS

An IRB approved and HIPAA compliant prospective study was performed of women with heterogeneous or extremely dense breast tissue and recent negative mammograms who underwent supplemental screening with AB-MR. The study was initially interpreted utilizing only the pre- and post contrast injection sequences. The examination was then re-interpreted after review of the T2-weighted sequence. Radiologists reported any change in final assessment and recommendation in the interpretation after the addition of the T2-weighted sequence.

RESULTS

86 women underwent supplemental screening with AB-MR from January 2016 - April 2017. The age ranged from 41 to 76, mean 56 years. In 84/86 cases (97.6%), the T2-weighted sequence had no impact on the final interpretation. The radiologists reported that T2-weighted sequence altered the final interpretation 2/86 (2.3%) and in both cases, the lesions were downgraded to BI-RADS 2 from BI-RADS 4.

CONCLUSION

In this prospective study evaluating the utility of the T2-weighted sequence in the interpretation of the AB-MR, the radiologists indicated that the T2-weighted sequence was only helpful 2.3 % of the time although it accounts for approximately 60% of the total active scan time. However, the T2-weighted sequence was helpful in averting biopsy in two patients.

CLINICAL RELEVANCE/APPLICATION

As the T2-weighted sequence appears to have limited utility in the final interpretation, the fast MRI examination may be further shortened by eliminating the T2-weighted sequence. More data is needed.

RC315-07 Diagnostic Breast MRI

Tuesday, Nov. 28 9:40AM - 10:00AM Room: Arie Crown Theater

Participants

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

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LEARNING OBJECTIVES

Review the current diagnostic roles of breast MRI Describe the role of breast MRI in evaluating tumor heterogeneity Review the role of ultrafast dynamic contrast-enhanced MRI Describe the radiogenomic analysis of breast cancer with MR

ABSTRACT

Breast MRI is used to predict breast cancer risk, to define extent of disease, and to monitor response to neoadjuvant chemotherapy. MRI is at the forefront of technology providing prognostic biomarkers that play an important role in this era of precision medicine. Technological advances and improvements in spatial and temporal resolution allow breast MRI to evaluate tumor heterogeneity. Breast cancer is a heterogeneous disease with inter- and intra-tumor genetic variation impacting predictive and prognostic risk. Radiogenomics, with feature extraction from breast MRI, allows the correlation of genomic information with non-invasive imaging biomarkers.

LEARNING OBJECTIVES

1) Review the current diagnostic roles of breast MRI. 2) Describe the role of breast MRI in evaluating tumor heterogeneity. 3) Review the role of ultrafast dynamic contrast-enhanced MRI. 4) Describe the radiogenomic analysis of breast cancer with MRI.

ABSTRACT

Breast MRI is used to predict breast cancer risk, to define extent of disease and to monitor response to neoadjuvant chemotherapy. MRI is at the forefront of technology providing prognostic biomarkers that play an important role in this era of precision medicine. Technological advances and improvements in spatial and temporal resolution allow breast MRI to evaluate tumor heterogeneity. Breast cancer is a heterogeneous disease with inter- and intra-tumor genetic variation impacting predictive and prognostic risk. Radiogenomics, with feature extraction from breast MRI, allows the correlation of genomic information with non-invasive imaging biomarkers.

RC315-08 Time to Enhancement at Ultrafast Breast DCE-MRI: Potential Imaging Biomarker of Tumor Aggressiveness

Participants

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Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare the time to enhancement (TTE) of breast cancer at ultrafast breast DCE-MRI according to the histopathological characteristics

METHOD AND MATERIALS

Between January and April 2017, 86 consecutive breast cancer patients (mean age, 51.3; range, 27-78 years) who underwent the ultrafast breast DCE-MR examinations and subsequent surgery were identified. A total of 88 breast cancers (75 IDC and 13 DCIS) were included for analysis. Ultrafast-MR images were obtained using time-resolved angiography with stochastic trajectories sequence with a 4.5 second resolution for 20 phases (TR/TE 4.1/1.3 ms, $1.1 \times 1.1 \times 1.0$ mm³ voxel) before conventional high spatial resolution DCE-MR images. One radiologist aware of tumor location but no other clinical or histopathologic information reviewed the ultrafast-MR images and assessed the TTE of the tumor. TTE was calculated as the phase of initial enhancement of tumor relative to the descending aorta, multiplied by 4.5 sec. Phase of initial enhancement was defined as the timing when the signal intensity of a region of interest became more than twice than that of non-enhancement images. Independent sample t-test was performed to compare the mean TTE according to the histologic type (invasive cancer vs. DCIS), histologic grade (high vs. low grade), lesion type (mass vs. non-mass), tumor subtype (luminal vs. HER-2 enriched vs. triple negative subtype) and level of Ki-67 (>20% vs. ≤20%).

RESULTS

Mean TTE of triple-negative subtype (TNBC) was shorter than that of non-TNBC (9.00 ± 0.00 vs. 11.61 ± 4.49 , $P < .001$). Mean TTE of tumors with high Ki-67 (>20%) was shorter than that of tumors with low Ki-67 (≤20%) (9.00 ± 0.00 vs. 11.50 ± 4.44 , $P < .001$). No difference was found in the TTE between IDC and DCIS (11.22 ± 4.40 vs. 12.46 ± 4.17 , $P = .347$), high-grade and low-grade IDC (10.13 ± 2.47 vs. 11.62 ± 4.88 , $P = .087$), high-grade and low-grade DCIS (12.00 ± 5.20 vs. 12.60 ± 4.14 , $P = .838$), or mass and non-mass type (11.10 ± 4.14 vs. 11.40 ± 4.83 , $P = .775$).

CONCLUSION

TTE of aggressive breast tumors is shorter than that of less aggressive breast tumors at ultrafast breast DCE-MRI.

CLINICAL RELEVANCE/APPLICATION

Early kinetic information of breast tumors at Ultrafast-MR images has the potential to provide information of refined tumor characterization.

RC315-09 Ultrafast DCE-MRI: Correlation with Microvessel Density in Invasive Breast Carcinoma

Tuesday, Nov. 28 10:10AM - 10:20AM Room: Arie Crown Theater

Participants

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PURPOSE

To evaluate whether parameters from model-based analysis of ultrafast dynamic contrast-enhanced (DCE) MRI correlate with histological microvessel density (MVD) in invasive breast cancer.

METHOD AND MATERIALS

38 consecutive patients with invasive breast cancers underwent an IRB-approved "ultrafast" DCE-MRI including a pre- and 18 post-contrast ultrafast scans followed by 4 standard scans (60 seconds) using a 3T system. Ultrafast 3D bilateral scans were acquired with temporal resolution of 3 seconds per image. ROIs were placed within each lesion where the highest signal increase was observed on ultrafast DCE-MRI, and enhancement rate was calculated as follows: $\Delta S = (SI_{post} - SI_{pre}) / SI_{pre} \times 100$. Where ' ΔS ' is the change in signal intensity after contrast injection, and ' SI_{post} ' and ' SI_{pre} ' are signal intensities post- and pre-contrast injection. The kinetic curve obtained from ultrafast DCE-MRI was analyzed using an empirical mathematical model: $\Delta S(t) = A * (1 - e^{-at})$. Where A is the upper limit of the signal intensity, $a(\min^{-1})$ is the rate of signal increase. The initial slope of the kinetic curve is given by ' $A * a$ '. Initial area under curve (AUC30) was calculated by integrating the kinetic curve. From the standard DCE-MRI, the initial enhancement rate and the signal enhancement ratio (SER) were calculated as follows: the initial uptake $= (SI_{early} - SI_{pre}) / SI_{pre}$, $SER = (SI_{early} - SI_{pre}) / (SI_{delayed} - SI_{pre})$. The parameters from ultrafast and standard images were compared with MVD obtained from surgical specimens. MVD was calculated by dividing the CD31 positive hot-spot areas by the total area on a $\times 200$ field.

RESULTS

With respect to parameters from ultrafast imaging, the initial slope of the kinetic curve or ' $A * a$ ', AUC30, and A correlated

with respect to parameters from contrast imaging: the initial slope of the kinetic curve or k^*a , k^*a_{DCE} , and $k^*a_{\text{conventional}}$ significantly with MVD; $r = 0.61, 0.59$, and 0.54 , respectively with $P < 0.0001$, $P = 0.0001$, and $P = 0.0004$, respectively. a , initial uptake and SER from conventional MRI did not correlate with MVD.

CONCLUSION

The model-based parameters, especially the initial slope or k^*a , from ultrafast DCE-MRI correlated with histological MVD in invasive breast cancer, while parameters from conventional MRI did not.

CLINICAL RELEVANCE/APPLICATION

The model-based parameters, especially the initial slope or k^*a , from ultrafast DCE-MRI correlated with histological MVD in invasive breast cancer.

RC315-10 Preoperative Breast MR Imaging Kinetic Features Using Computer-Aided Diagnosis: Association with Survival Outcome in Invasive Breast Cancer Patients

Tuesday, Nov. 28 10:20AM - 10:30AM Room: Arie Crown Theater

Participants

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Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate whether the preoperative breast dynamic contrast -enhanced (DCE) magnetic resonance (MR) imaging kinetic features assessed using computer-aided diagnosis (CAD) can predict the survival outcome in invasive breast cancer patients

METHOD AND MATERIALS

The Institutional Review Board approved this retrospective study, and waived the need for informed consent. Between March 2011 and December 2011, 301 women who underwent preoperative DCE MR imaging for invasive breast cancer, with CAD data, were identified. The Cox proportional hazards model was used to determine the association between the kinetic features assessed by CAD and the recurrence-free survival (RFS). The peak signal intensity and kinetic enhancement profiles were compared with the clinical-pathological variables using the Student t test and analysis of variance (ANOVA) test.

RESULTS

There were 32 recurrences during a mean follow-up time of 55.2 months (range, 5-72 months). On multivariate analysis, a higher peak enhancement (RFS hazard ratio, 1.004 [95% confidence interval (CI): 1.001, 1.006]; $P = .009$) on DCE MR imaging and a triple-negative subtype (RFS hazard ratio, 17.660 [95% CI: 2.255, 138.369]; $P = .006$) were associated with a poorer RFS. Higher peak enhancement was significantly associated with a higher T stage, clinical stage, and histologic grade. A higher washout component was associated with a higher histologic grade, triple-negative subtype, and pathologic diagnosis of invasive ductal carcinoma.

CONCLUSION

Patients with breast cancer that showed a CAD-derived higher peak enhancement on breast MR imaging had worse RFS. Peak enhancement and volumetric analysis of the kinetic patterns was useful for predicting the tumor aggressiveness.

CLINICAL RELEVANCE/APPLICATION

There has been a few report to date, to our knowledge, that has evaluated the correlation of preoperative MR imaging kinetic parameters assessed using a commercially available CAD with the recurrence outcomes in patients with breast cancer.

RC315-11 Maximum Intensity Projections for Incorporation of 4-Dimensional DCE-MR Images into Breast Lesion Classification with Deep CNNs

Tuesday, Nov. 28 10:30AM - 10:40AM Room: Arie Crown Theater

Participants

Natalia O. Antropova, Chicago, IL (*Presenter*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
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

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PURPOSE

To integrate volumetric and temporal components of dynamic contrast-enhanced magnetic resonance images (DCE-MRIs) into breast lesion malignancy assessment with convolutional neural network (CNN) features.

METHOD AND MATERIALS

A comparison study was conducted to investigate the benefit of using maximum intensity projections (MIPs) to efficiently incorporate 4D image data in CNN-based lesion classification. The study was performed on a clinical DCE-MRI dataset of 690 cases

- 212 benign and 478 malignant. A region of interest (ROI) was delineated around each lesion, with its size corresponding to the size of the enclosed lesion. First, MIPs were generated over the ROI area on the subtraction MRIs, 2nd postcontrast (t2) - precontrast (t0). For comparison, ROIs were selected on central slices of the subtraction and t2 MRIs. CNN features were extracted from the MIPs, the subtraction and the t2 central-slice ROIs using a VGGNet model pre-trained on ImageNet, a natural image dataset. The features were separately L2-normalized and were utilized to train support vector machine (SVM) classifiers to characterize lesions as malignant or benign. Classifier performance was evaluated using ROC analysis with five-fold cross-validation, standardizing training folds to zero mean and unit variance and the test folds with the statistics of the corresponding training folds. Area under the ROC curve (AUC) served as the figure of merit.

RESULTS

The SVMs trained on features from MIPs [AUC = 0.88 (se = 0.01)] outperformed the SVMs trained on features from subtracted central-slice ROIs [AUC = 0.84 (se = 0.02)] and t2 central-slice ROIs [0.80 (se = 0.02)], at a statistically significant level.

CONCLUSION

Integration of volumetric and temporal components of DCE-MRI through MIPs improves lesion classification with CNN features. In the task of malignancy assessment, a significantly better performance was achieved with CNN features from MIPs than from subtracted or t2 central-slice ROIs.

CLINICAL RELEVANCE/APPLICATION

MIPs are clinically used to evaluate the whole bilateral breast MRIs, integrating DCE-MRI's temporal and volumetric components. Utilizing MIPs, CNN-based radiomics extracts information from 4 dimensions of DCE-MRI data, significantly increasing the accuracy of the computer-aided malignancy assessment.

RC315-12 Kinetic Volume Analysis on Dynamic Contrast-Enhanced MRI of Triple Negative Breast Cancer: Association with Survival Outcomes

Tuesday, Nov. 28 10:40AM - 10:50AM Room: Arie Crown Theater

Participants

Yoko Hayashi, Nagoya, Japan (*Presenter*) Nothing to Disclose
Hiroko Satake, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Satoko Ishigaki, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Mariko Kawamura, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Hisashi Kawai, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinji Naganawa, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the association between kinetic volume analysis on dynamic contrast-enhanced MRI (DCE-MRI) and survival (disease-specific survival [DSS] and disease-free survival [DFS]) in patients with triple negative breast cancer (TNBC).

METHOD AND MATERIALS

Forty patients with TNBC who underwent pretreatment MRI between March 2008 and March 2014 were enrolled. DCE-MRI examinations were analyzed using a dedicated computer-assisted diagnosis (CAD) system, which allows volume analysis by segmentation of continuous enhancing voxels. Volumes of interest (VOI) were placed enclosing the entire tumor. Percentage tumor volume was calculated automatically by summing voxels meeting thresholds for kinetic curves in the initial and delayed phases. We selected 100% and 200% as thresholds of initial enhancement rate (IE), and selected $\pm 10\%$ and $\pm 30\%$ as thresholds for classification of delayed enhancement curve types into persistent, plateau, and washout. Clinico-pathologic factors, MR images based on BI-RADS MRI lexicon (including mass shape, mass margin, and internal enhancement), visual assessments on T2-weighted images (presence of intratumoral high signal intensity and peritumoral edema), and CAD-generated kinetic volume parameters were correlated with survivals using Cox Regression Analysis.

RESULTS

There were 12 recurrences and 7 deaths at a median follow-up of 73.6 months (range, 3.7-105.9 months). Multivariate Cox analysis showed that a higher percentage volume of IE > 200% (hazard ratio [HR] = 1.119; 95% confidence interval [CI]: 1.023, 1.223; $p = 0.014$) and higher percentage volume of IE > 100% followed by delayed persistent enhancement with >30% signal increase (HR = 1.328; 95% CI: 1.096, 1.609; $p = 0.004$) were associated with worse DSS. In multivariate analysis for DFS, irregular shape (HR = 28.245; 95% CI: 2.761, 288.895; $p = 0.005$) and higher percentage volume of IE > 100% followed by delayed persistent enhancement with >30% signal increase (HR = 1.375; 95% CI: 1.160, 1.630; $p < 0.001$) were associated with worse DFS.

CONCLUSION

Kinetic volume analysis on DCE-MRI showed a correlation with survival of TNBC.

CLINICAL RELEVANCE/APPLICATION

Our results suggest that kinetic volume analysis on DCE-MRI could be predictive of aggressiveness of TNBC, and has the potential to play a clinical role in personalized therapy.

RC315-13 Multiparametric Breast MRI

Tuesday, Nov. 28 11:00AM - 11:20AM Room: Arie Crown Theater

Participants

Katja Pinker, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Understand the principle of multiparametric breast MRI. 2) Identify the potential and challenges of multiparametric breast MRI using different quantitative functional parameters. 3) Recognize established and emerging techniques in multiparametric breast MRI. 4) Use multiparametric breast MRI in clinical practice. 5) Realize the future potential of functional imaging of breast tumors with multiparametric PET/MRI.

ABSTRACT

Magnetic resonance imaging (MRI) is an essential tool in breast imaging, with multiple established indications. Dynamic contrast-enhanced MRI (DCE-MRI) is the backbone of any breast MRI protocol and has an excellent sensitivity and good specificity for breast cancer diagnosis. DCE-MRI provides high-resolution morphological information, as well as some functional information about neo-angiogenesis as a tumour-specific feature. To overcome limitations in specificity, several other functional MRI parameters have been investigated and the application of these combined parameters is defined as multiparametric MRI (mpMRI) of the breast. MpMRI of the breast can be performed at different field-strengths (1.5 - 7T) and includes both established [diffusion-weighted imaging (DWI), MR spectroscopic imaging (MRSI)] and novel MRI parameters [sodium imaging (^{23}Na -MRI), chemical exchange saturation transfer (CEST) imaging, blood oxygen level-dependent (BOLD) MRI], as well as hybrid imaging with positron emission tomography (PET)/MRI and different radiotracers. Available data suggest that multiparametric imaging using different functional MRI and PET parameters can provide detailed information about the underlying oncogenic processes of cancer development and progression and thus may add additional specificity. MpMRI of the breast is a still-evolving field and more significant advances are expected, which will further aid the development of novel personalized approaches in the management of breast cancers. However, there are still some challenges to the ubiquitous implementation of mpMRI of the breast in the clinical routine. Further advances in hardware and software to address the challenges unique to the individual MRI parameters, as well as large-scale, standardized, multicenter studies, are necessary and have been instituted to confirm the encouraging single-institution results prior to widespread clinical application. This presentation aims to provide a comprehensive overview of the current applications, challenges and emerging techniques of mpMRI of the breast.

RC315-14 Multiparametric Deep Learning Tissue Signatures as an Imaging Biomarker for Breast Cancer: Preliminary Results

Tuesday, Nov. 28 11:20AM - 11:30AM Room: Arie Crown Theater

Participants

Michael A. Jacobs, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG

Vishwa Parekh, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

Katarzyna J. Macura, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Author with royalties, Reed Elsevier; Research Grant, Profound Medical Inc

Riham H. El Khoul, MD, PhD, Silver Spring, MD (*Abstract Co-Author*) Nothing to Disclose

Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

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

PURPOSE

This study was conducted to evaluate the feasibility and role of a novel deep learning method using multiparametric breast Magnetic Resonance Imaging (MRI) and to define tissue signatures for improved automated detection and characterization of breast lesions.

METHOD AND MATERIALS

We developed a multiparametric deep learning (MPDL) network for breast MRI for segmentation and classification of breast tissue into different tissue types. The MPDL network was constructed from stacked sparse autoencoders with five hidden nodes with input into the network using MPDL tissue signatures from multiparametric MRI of the breast (T1 and T2-weighted imaging, diffusion, and dynamic contrast imaging) obtained from 130 patients. Patients were randomly divided into two groups such that the proportions of benign and malignant cases were balanced. In order to evaluate the trained deep networks, the multi-fold cross-validation, sensitivity and specificity were computed. Finally, Dice similarity between MPDL post contrast DCE-MRI segmented lesions were evaluated. Gold standard MISNT (digit set) testing data was done for fine tuning the network. Benign versus malignant diagnoses was determined by histopathological examination or more than 2 years of follow-up confirming lesion stability. Statistical significance was set at $p \leq 0.05$.

RESULTS

The multiparametric deep learning approach accurately defined and segmented both synthetic and clinical data. In the synthetic data, the performance of the MPDL on MISNT data resulted in 99.7% accuracy. The MPDL successfully segmented glandular, fatty, and lesion tissue in the test cohort with a Dice similarity of 89%, Segmentation metrics of precision=0.94 and F1-score=0.88.

CONCLUSION

The integrated MPDL method resulted in accurate segmented and classified tissue from clinical breast MRI data. The constructed MPDL images allow for improved visualization of different tissue characteristics from multiple radiological parameters. Deep learning can be used to construct a personalized database of tissue signatures with accurate characterization of different tissue types.

CLINICAL RELEVANCE/APPLICATION

Integration of advanced machine learning and computational methods to assist radiologists in the interpretative tasks provides the foundation for modeling of clinical and radiological variables and thus facilitates development of radiological precision medicine.

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/> Katarzyna J. Macura, MD, PhD - 2012 Honored Educator Katarzyna J. Macura, MD, PhD - 2014 Honored Educator Riham H. El Khoul, MD, PhD - 2012 Honored Educator Ihab R. Kamel, MD, PhD - 2015 Honored Educator

RC315-15 Diffusion Tensor Magnetic Resonance Imaging of Breast Cancer: Correlation between Diffusion Metrics and Histologic Prognostic Factors

Tuesday, Nov. 28 11:30AM - 11:40AM Room: Arie Crown Theater

Participants

Jin You Kim, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jin Joo Kim, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Seok Choo, MD, Yangsan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate whether quantitative diffusion metrics derived from diffusion tensor imaging (DTI) are correlated with histological prognostic factors in patients with breast cancer.

METHOD AND MATERIALS

Institutional review board approval and written informed consent were obtained. Between June 2016 and January 2017, 248 women (mean age, 53.4 years; range, 25-93 years) with breast cancer (230 invasive and 18 in situ) who had undergone preoperative MR imaging with DTI using a 3.0 Tesla scanner were identified. Diffusion gradients were applied in 20 directions with b values of 0 and 1000 s/mm². DTI metrics such as mean diffusivity (MD) and fractional anisotropy (FA) were measured for breast lesions by two radiologists and correlated with histologic prognostic factors (invasive size; histological grade; lymphovascular invasion; axillary node metastasis; estrogen receptor, progesterone receptor, human epidermal growth factor receptor-2, Ki-67, and p53 status) using a Mann-Whitney U test and linear regression analysis.

RESULTS

MD and FA values in invasive breast cancers were significantly lower than those in ductal carcinoma in situ lesions ($1.009 \pm 0.256 \times 10^{-3} \text{ mm}^2/\text{s}$ versus $1.310 \pm 0.195 \times 10^{-3} \text{ mm}^2/\text{s}$, $P < 0.001$; 0.291 ± 0.099 versus 0.354 ± 0.101 , $P = 0.016$; respectively). In patients with invasive breast cancer, larger tumor size ($> 2 \text{ cm}$), high histological grade (grade 3), lymphovascular invasion, and axillary node metastasis showed significant associations with low MD values ($P < 0.001$, $P = 0.008$, $P < 0.001$, $P < 0.001$, respectively). Larger tumor size, and high histological grade also showed significant associations with low FA values ($P < 0.001$, $P = 0.008$, respectively). By multivariate stepwise linear regression analysis, larger tumor size, high histological grade, and axillary node metastasis were independently associated with low MD values ($P = 0.007$, $P = 0.045$, $P = 0.009$, respectively). Larger tumor size, and high histological grade were also independently associated with low FA values ($P < 0.001$, $P = 0.025$, respectively).

CONCLUSION

DTI-derived diffusion metrics such as MD and FA are associated with histologic prognostic factors in patients with breast cancer.

CLINICAL RELEVANCE/APPLICATION

Quantitative diffusion metrics derived from DTI facilitate evaluation of histologic prognostic factors before surgery and may serve as diffusion biomarkers for prediction of breast cancer prognosis.

RC315-16 ACRIN 6702 Trial: A Multi-Center Study Evaluating the Utility of Diffusion Weighted Imaging for Detection and Diagnosis of Breast Cancer

Tuesday, Nov. 28 11:40AM - 11:50AM Room: Arie Crown Theater

Participants

Savannah C. Partridge, PhD, Seattle, WA (*Presenter*) Research Grant, General Electric Company
Zheng Zhang, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Habib Rahbar, MD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company
Thomas L. Chenevert, PhD, Ann Arbor, MI (*Abstract Co-Author*) Consultant, Koninklijke Philips NV
Averi Kitsch, BS, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Lucy Hanna, MS, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Sara M. Harvey, MD, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Wendy B. Demartini, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*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
Christopher E. Comstock, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Diffusion-weighted imaging (DWI) has shown promise in single center studies to improve the positive predictive value (PPV) of conventional dynamic contrast enhanced (DCE) breast MRI. Many DCE false-positives exhibit higher apparent diffusion coefficient (ADC) values than breast cancers, suggesting an ADC threshold could be used to decrease the need for biopsy. The goal of ACRIN 6702 was to assess the performance of quantitative DWI added to DCE for differentiation of benign and malignant MRI-detected breast lesions in a multisite, multiplatform trial.

METHOD AND MATERIALS

This IRB-approved trial was performed at ten institutions on Philips, GE and Siemens 1.5T and 3T MR systems. Subjects were consented from 3/2014 to 4/2015 prior to undergoing clinical breast MRI, and those with BI-RADS 3, 4 or 5 lesions detected only on MRI were enrolled in the study. Multi-b value ($b = 0, 100, 600, 800 \text{ s/mm}^2$) DWI was performed prior to DCE in clinical breast MRI exams, and lesion ADC values were later calculated by core lab central analysis. Benign or malignant lesion outcomes were

determined from biopsy and/or 12-month follow-up. Diagnostic performance was assessed by area under the receiver operating characteristic curve (AUC), and an ADC threshold with 100% sensitivity was determined.

RESULTS

Of 142 MRI breast lesions in 103 enrolled women, 28 were excluded for incomplete outcomes and 34 for inadequate DWI quality, yielding 80 DWI evaluable lesions (14 BI-RADS 3, 62 BI-RADS 4, 4 BI-RADS 5) with definitive outcomes (28 cancer and 52 benign) in 66 women (mean age 48.9±12.3 years). Mean ADC was lower in cancers than benign lesions (1.21±0.21 vs. 1.47±0.29 x10⁻³ mm²/s; p<0.0001), with an AUC of 0.75 (95% CI 0.64-0.86) for predicting malignancy. In this cohort, an ADC threshold ≤1.53x10⁻³ mm²/s with 100% sensitivity combined with DCE BI-RADS increased specificity from 27% to 52% and PPV from 42% to 53%, which would reduce the biopsy rate by 20% (95% CI 10.9%-31.3%).

CONCLUSION

This multicenter trial confirms single site data supporting the value of DWI to improve breast MRI specificity without compromising sensitivity, warranting further testing of an ADC threshold in a larger study.

CLINICAL RELEVANCE/APPLICATION

Although image quality remains a challenge, these promising findings suggest adding DWI to conventional breast MRI could substantially decrease unnecessary biopsies without reducing cancer detection.

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/> Mitchell D. Schnall, MD, PhD - 2013 Honored Educator

RC315-17 Proton MR Spectroscopy: Lipid Metabolite Concentrations as Valuable Quantitative Imaging Biomarkers for Breast Cancer Diagnosis

Tuesday, Nov. 28 11:50AM - 12:00PM Room: Arie Crown Theater

Participants

Sunitha Thakur, PhD, MS, New York, NY (*Presenter*) Nothing to Disclose
Sandra Brennan, MBBCh, MSc, West Harrison, NY (*Abstract Co-Author*) Nothing to Disclose
Michael Weber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Ileana Hancu, PhD, Niskayuna, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Manderski, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Katja Pinker, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In breast imaging, the value of proton MR spectroscopy (MRS) for breast cancer diagnosis has been largely based on the detection of choline. MRS can also provide information on other detectable metabolites such as lipids, which might be used for breast cancer diagnosis. Therefore the aim of this study was to determine whether lipid metabolite concentrations can be used for breast cancer diagnosis.

METHOD AND MATERIALS

In this HIPAA-compliant, IRB-approved study, data of 176 women who underwent MRI with T2weighted, dynamic contrast-enhanced MRI and MRS at 1.5T for either a suspicious imaging finding or staging of a known cancer (BI-RADS 0,4/5/6) were retrospectively analyzed. In all patients single-voxel MRS data were collected using a PRESS MRS Sequence with TR/TE=2000/135ms. Quantitative analysis of all lipid resonances present in the MRS data was done using LCModel analysis. We classified all metabolites into 6 groups based methyl, methylene, and methine proton chemical shifts, such as A (0.9ppm), BC (1.3 and 1.59 ppm), DE (2.04 and 2.25 ppm), F (2.77 ppm), GH (4.1 and 4.25 ppm), IJ (5.22 and 5.31 ppm). Histopathology was used as the standard of reference. Appropriate statistical tests were used to determine associations of MRS imaging biomarkers with tumor characteristics (benign vs. malignant, tumor grade, nodal status, lymphovascular invasion (LVI)).

RESULTS

There were 176 lesions including 85 invasive ductal cancers, 10 invasive lobular cancers, 13 ductal carcinoma in situ, 6 other types of breast cancer, and 62 benign lesions. The mean and std dev of voxel size was 4.4 ± 4.6 cm. All MRS lipid resonances were successfully quantified. A, BC, DE, and IJ lipid metabolite concentrations were significantly lower in malignant compared to benign tumors (p=0.028, 0.033, 0.015, and 0.0001). There was no significant difference in lipid metabolite concentrations in malignant lesion based on histological grade, LIV and axillary lymph node metastases.

CONCLUSION

Lipid metabolite concentrations quantified with proton MRS can successfully detect breast cancer and provide a valuable imaging biomarker in addition to choline.

CLINICAL RELEVANCE/APPLICATION

Proton MRS of lipid metabolite concentrations provides a non-invasive imaging biomarker for breast cancer and has the potential to obviate the need for biopsy.

RC316

The Newly Hired Radiologist: Lessons for Aspiring, New, and Experienced Radiologists (Sponsored by the RSNA Professionalism Committee)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E353B

PR

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 0

Participants

Brandon P. Brown, MD, MA, Indianapolis, IN (*Moderator*) Nothing to Disclose
Anastasia L. Hryhorczuk, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose
Brent J. Wagner, MD, Reading, PA (*Presenter*) Nothing to Disclose
Michael C. Veronesi, MD, PhD, Zionsville, IL (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the needs and challenges faced by the radiology department and the new hire, with respect to a beginning radiologist. This includes providing guidance on how to find an expertise 'niche,' and how to divide time between clinical work, committee volunteerism, and leadership roles. 2) Examine the impact of social media and patient portals on the physician-patient interaction and identify the risks and benefits of these new opportunities for communication. 3) Identify the issues facing a private practice group when incorporating a new partner including questions of fairness/transparency, patience with colleagues, formal and informal mentorship, and communicating expectations. 4) Discuss the ways in which a radiology group can assist a new radiologist transitioning out of training, in order to bring out the best in their new colleague and help them to live up to and exceed their highest potential. *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

While residency/fellowship training, board certification, and the job search are familiar topics among the radiology community, an equally important yet oft-neglected topic is that of the newly hired radiologist. Although formal training is focused on clinical and diagnostic skills, navigating professional practice requires building relationships, identifying areas of focus, and learning how best to collaborate with partners and other clinical colleagues. For the beginning faculty member, the demands of teaching and research create additional dilemmas in how best to prioritize time. In addition, new technologies and communication norms now face the practicing radiologist. Social media and patient portals provide radiologists with new forums for interacting with the public and patients. In theory, social media can be leveraged for professional outreach, to improve public understanding of radiologists' roles and to increase departmental profiles. However, it is imperative that radiologists balance this potential with the ethical and professional considerations surrounding patient privacy and autonomy. Finally, in both academic and private practice settings, unique challenges face the new partner, challenges not previously faced and for which training might not have fully prepared them. Although the new hire is full of promise, the impact of their colleagues in helping them rise to the challenge and fulfill expectations can be essential.

Active Handout: Brent Joseph Wagner

http://abstract.rsna.org/uploads/2017/16001894/Active_RC316.pdf

Honored Educators

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RC317

Emerging Technologies: Prostate Cancer Imaging & Management

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S505AB

GU MI MR NM

AMA PRA Category 1 Credits TM: 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

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Understand current issues in prostate cancer relevant to imaging. 2) Understand the role of emerging technologies in the imaging and management of prostate cancer.

ABSTRACT

Prostate cancer is a major health issue. Imaging has made great strides in the last decade including the use of multiparametric MRI, MR-ultrasound fusion biopsies and most recently PET scanning. This refresher course explores emerging technologies in prostate cancer imaging and management.

Sub-Events

RC317A Introduction to 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

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LEARNING OBJECTIVES

1) Understand the impact of new screening guidelines on imaging of prostate cancer. 2) Understand the issues facing clinicians treating prostate cancer.

ABSTRACT

This talk will review the current status of screening for prostate cancer and how stage migration is beginning to be seen. The problems of early detection, early recurrence and early metastases will be discussed. This talk will serve as a starting off point for the subsequent talks on new technologies.

RC317B Next Generation Prostate MRI

Participants

Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand current status and uses of multi-parametric MRI. 2) Understand role of MRI in assessment of prostate cancer aggressiveness and tumor heterogeneity. 3) Understand role of computer aided diagnosis systems in evaluation of prostate cancer aggressiveness and tumor heterogeneity.

RC317C Molecular Prostate Imaging: Chemistry to Clinic

Participants

Martin G. Pomper, MD, PhD, Baltimore, MD (*Presenter*) Researcher, Progenics Pharmaceuticals, Inc; License agreement, Progenics Pharmaceuticals, Inc; Researcher, Advanced Accelerator Applications SA; License agreement, Advanced Accelerator Applications SA; Co-founder, Cancer Targeting Systems, Inc; Board Member, Cancer Targeting Systems, Inc; Researcher, Juno Therapeutics, Inc; Licensing agreement, Juno Therapeutics, Inc; Co-founder, Neurly; Board Member, Neurly; Co-founder, Theraly

Pharmaceuticals, Inc; Board Member, Theraly Pharmaceuticals, Inc; ;

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC317D PET/MRI: Is Prostate Cancer a Perfect Fit?

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

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pchoyke@nih.gov

LEARNING OBJECTIVES

1) Understand the potential value of PET/MRI in prostate cancer. 2) Review potential pitfalls in the use of PET/MRI compared to PET/CT.

ABSTRACT

PET/MRI offers the sensitivity and specificity of PET with the high contrast resolution of MRI. In the prostate this can be very useful in identifying prostate cancers and recurrent disease after treatment. This talk will review the various features of PET/MRI that make prostate cancer a 'perfect fit' for it.

RC317E Hyperpolarized C-13 MR Molecular Imaging of Prostate Cancer

Participants

Daniel B. Vigneron, PhD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company;

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC318

Interrogating Tumor Heterogeneity Using Imaging

Tuesday, Nov. 28 8:30AM - 10:00AM Room: N230B



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

Participants

Evis Sala, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Emphasize the role of oncologic imaging in the era of precision medicine. 2) Review the definitions of Radiomics and Radiogenomics. 3) Identify the gaps in imaging tumor heterogeneity and its metastatic potential.

Sub-Events

RC318A Cancer Genomics: Making Sense of Inter- and Intra-Tumor Heterogeneity

Participants

Britta Weigelt, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the results of large-scale massively parallel sequencing endeavors of human cancers. 2) Assess the inter- and intra-tumor genetic heterogeneity found in human cancers. 3) Define the implications of genetic heterogeneity on treatment.

RC318B Imaging Genomics-proteomics Interactions: New Frontiers Ahead

Participants

Evis Sala, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Provide the rationale for assessing tumor heterogeneity. 2) Review the definitions of Radiomics, Radiogenomics and Proteomics. 3) Provide insights into the role of habitat imaging in unravelling tumor heterogeneity.

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/> Evis Sala, MD, PhD - 2013 Honored Educator Evis Sala, MD, PhD - 2017 Honored Educator

RC318C Making Sense of Big Imaging Data: What Comes Next?

Participants

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

RC320

Strategies to Minimize Toxicities of Radiotherapy

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E260

RO **SQ**

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

FDA Discussions may include off-label uses.

Participants

Tarita O. Thomas, MD, PhD, Chicago, IL (*Moderator*) Nothing to Disclose

Sub-Events

RC320A Strategies to Minimize Toxicities of Radiotherapy for Head and Neck Cancer

Participants

Minh T. Truong, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify common acute and late toxicities of Head and Neck Cancer. 2) Identify factors which can potentiate radiotherapy toxicities of Head and Neck Cancer. 3) Discuss dose, fractionation and radiation techniques, radiation tolerance doses to mitigate normal tissue toxicities. 4) Identify potential treatments to ameliorate Toxicities of Radiotherapy for Head and Neck Cancer. 5) Discuss effect of acute and late toxicities on function and Quality of Life of Head and Neck Cancer patients.

ABSTRACT

RC320B Strategies to Minimize Toxicities of Radiotherapy for Pediatric Cancer

Participants

Ralph P. Ermoian, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Advocate for local and regional control options that result in less radiation exposure. 2) Outline how choices in radiation treatment modalities affects conformality of and total exposure to radiation. 3) Describes steps that can be taken during radiation therapy courses to limit cumulative radiation dose.

RC320C Strategies to Minimize Toxicities of Radiotherapy for Lung Cancer

Participants

Shankar Siva, PhD, FRANZCR, Melbourne, Australia (*Presenter*) Travel support, Astellas Group; Research Grant, Varian Medical Systems, Inc; Speaker, Bristol-Myers Squibb Company

LEARNING OBJECTIVES

1) Identify common acute and late toxicities of radiotherapy in lung cancer. 2) Identify factors which can potentiate radiotherapy toxicities of lung cancer. 3) Discuss dose, fractionation and radiation techniques, radiation tolerance doses to mitigate normal tissue toxicities. 4) Discuss novel strategies of reducing toxicity through functional lung avoidance.

RC320D Strategies to Minimize Toxicities of Radiotherapy for Liver Cancer

Participants

Michael I. Lock, MD, FRCPC, London, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review new research to understand why we need to be aware of new toxicities and safety parameters of liver radiation in the era of stereotactic body radiotherapy. 2) Discuss the selection of different technical methods of current radiation for liver. 3) Discuss the selection of different dosimetric constraint options that can be used to limit toxicity. 4) Assess patient or treatment related issues that may impact on radiation toxicity. For example, previous treatments such as Y90 or chemotherapy.

RC321

Advances in CT: Technologies, Applications, Operations—Functional CT

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E352

CT PH

AMA PRA Category 1 Credits TM: 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

RC321A Contrast Administration for Cardiovascular Imaging and Beyond

Participants

Dominik Fleischmann, MD, Palo Alto, CA (*Presenter*) Research Grant, Siemens AG;

Active Handout: Dominik Fleischmann

http://abstract.rsna.org/uploads/2017/16001080/Active_RC321A.pdf

RC321B Perfusion Techniques and Applications—Stroke and Cancer

Participants

Ting-Yim Lee, MSc, PhD, London, ON (*Presenter*) License agreement, General Electric Company

For information about this presentation, contact:

tlee@robarts.ca

LEARNING OBJECTIVES

1) Comprehend the principles of CT Perfusion imaging in stroke and cancer applications. 2) Apply the principles to discern errors that may occur in perfusion calculation. 3) Design scanning protocols for CT Perfusion imaging of stroke and cancer. 4) Apply dose saving techniques to reduce radiation dose. 5) Discuss the application of CT Perfusion imaging in stroke and cancer with examples.

Active Handout: Ting-Yim Lee

http://abstract.rsna.org/uploads/2017/16001082/Active_RC321B.pdf

RC321C Perfusion Techniques and Applications—Cardiac

Participants

Aaron So, PhD, London, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

aso@robarts.ca

LEARNING OBJECTIVES

1) Comprehend the theoretical basis and pitfalls of each myocardial CTP method (qualitative, semi-quantitative and quantitative). 2) Assess the sources and solutions of various image artifacts in myocardial CTP. 3) Evaluate the effectiveness of radiation dose reduction methods for low dose quantitative myocardial CTP. 4) Develop the optimal myocardial CTP protocol for assessing high-risk coronary artery disease. 5) Assess the recent advances in quantitative CTP for imaging myocardial edema and scar and their potential applications to guide therapy in post infarction settings.

RC322

MRI: Imaging for Radiation Treatment Planning

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S104B

MR RO PH

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

Participants

Eric Paulson, PHD, Milwaukee, WI (*Moderator*) Nothing to Disclose

Sub-Events

RC322A MRI for Anatomical Definition

Participants

Eric Paulson, PHD, Milwaukee, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the advantages of MRI simulation for anatomical delineation in both external beam radiation therapy and brachytherapy. 2) Understand the differences between images obtained during MRI simulation versus diagnostic MRI. 3) Understand the current solutions to address technical challenges of using MRI for anatomical delineation in Radiation Oncology.

ABSTRACT

MRI is rapidly emerging as a primary imaging modality in Radiation Oncology, fueled by innovations in MRI-guided treatment delivery, MRI simulation systems, and the role of MRI in individualizing and adapting radiation therapy. This course will discuss the advantages and technical challenges of using MRI for anatomical definition in radiation treatment planning. Current solutions to tailor MRI to the unique demands of Radiation Oncology will be explored. Clinical examples illustrating the use of MRI for anatomical delineation in both external beam radiation therapy and brachytherapy will be presented.

RC322B MRI for Functional Definition

Participants

Uulke A. van der Heide, PhD, Amsterdam, Netherlands (*Presenter*) Research support, Elekta AB; Speaker, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Get an overview of the most relevant functional MRI modalities available. 2) Understand how they can be used to improve target definition. 3) Understand their limitations and specific concerns for use in radiation oncology.

ABSTRACT

In addition to anatomical imaging, MRI affords a range of functional techniques. Diffusion-weighted MRI images the restriction of water mobility in tissue, thus probing microanatomy. This is used to identify tumors and monitor response to treatment. Dynamic contrast-enhanced MRI shows the tracer kinetics of contrast agents and reflects the characteristics of the microvasculature, such as flow and permeability. These and other techniques can be used to improve target definition, and to characterize tumor tissue for radiotherapy dose painting.

RC323

MR Safety

Tuesday, Nov. 28 8:30AM - 10:00AM Room: N229

MR PH SQ

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

Participants

Yunhong Shu, PhD, Rochester, MN (*Director*) Nothing to Disclose

LEARNING OBJECTIVES

1) List several MR Safety incidents and describe their root causes. 2) List a variety of commonly implanted Neurostimulators and MR Conditional Pacemakers. 3) Identify potential risks associated with scanning patients implanted with these devices using MRI in the clinical environment. 4) Describe special MR Safety hazards present in the MR interventional environment, and identify countermeasures to reduce the associated risks. 5) Describe MR Safety guidelines and recommendations to prevent accidents and injuries.

Sub-Events

RC323A Case Review of Real MR Safety Incidents

Participants

Armen Kocharian, PhD, Houston, TX (*Presenter*) Research collaboration, General Electric Company

For information about this presentation, contact:

akocharian@houstonmethodist.org

LEARNING OBJECTIVES

1) Identify main safety risk factors from incident reviews at MR Imaging sites. 2) Assess and address the MRI safety potential risks. 3) Implement preventive measures in clinical practice for improved standard of care.

Active Handout:Armen Kocharian

http://abstract.rsna.org/uploads/2017/16001094/Active_RC323A.pdf

RC323B MRI Safety of Deep Brain and Other Simulators

Participants

Yunhong Shu, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List a variety of commonly implanted neurostimulators. 2) Understand the importance of MRI as a diagnostic imaging tool for patient with implanted neurostimulator. 3) Identify the potential risks associated with scanning patient with implanted neurostimulator using MRI. 4) Describe MR safety guidelines and recommendations to prevent accidents and injuries.

ABSTRACT

A neurostimulator is a surgically placed programmable device. It delivers mild electrical signals to the targeted area through thin wires. The purpose is usually for pain relief or improving patient's ability to perform daily activities. There are a variety of commonly used neurostimulators include deep brain stimulator, spinal cord stimulator, vagus nerve stimulator and sacral nerve stimulator. MRI is clinically important for post-implantation evaluation. It is very likely that a patient will require an MRI scan after the neurostimulator is implanted. The risks of performing MRI on patients with neurostimulators are related to static magnetic field, gradient magnetic field and the RF field. The talk will provide an imaging physics overview on the potential risks and make recommendations for MR imaging safety procedure.

RC323C MRI Conditional Pacemakers: What to Do?

Participants

Anshuman Panda, PhD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

Active Handout:Anshuman Panda

http://abstract.rsna.org/uploads/2017/16001096/Handout_Panda_Pacer_RSNA_2017.pdf

RC323D MRI Safety in the MR-Guided Interventional Environment

Participants

Krzysztof Gorny, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Presentation will include overview of interventional MRI practice within context of generally accepted principles of MRI safety. 2)

Description of the practice will be provided including example protocol for safety testing of previously unlabeled equipment considered for potential use inside Zone 4.

Active Handout: Krzysztof Gorny

[http://abstract.rsna.org/uploads/2017/16001097/Active RC323D.pdf](http://abstract.rsna.org/uploads/2017/16001097/Active_RC323D.pdf)

RC324

What Physics Brings to Value-based Care: Measurement and Quantification of Quality in Imaging Practice

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S403B

PH **SQ**

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

FDA Discussions may include off-label uses.

Participants

Ehsan Samei, PhD, Durham, NC (*Moderator*) Research Grant, General Electric Company; ; Research Grant, Siemens AG; ; Advisory Board, medInt Holdings, LLC

For information about this presentation, contact:

samei@duke.edu

Sub-Events

RC324A Philosophy and Characterization of Value in Value-based Imaging

Participants

Robert Saunders JR, PhD, Washington, DC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the current programs that seek to measure the value of radiology services or medical imaging. 2) To further be able to describe the current types of measures used to assess value in radiology and medical imaging, including their limitations and challenges.

RC324B Quantification of Imaging Quality in Terms of Individualized Radiation Dose and Image Quality

Participants

Ehsan Samei, PhD, Durham, NC (*Presenter*) Research Grant, General Electric Company; ; Research Grant, Siemens AG; ; Advisory Board, medInt Holdings, LLC

For information about this presentation, contact:

samei@duke.edu

RC324C Quantification of Imaging Quality in Terms of Care Outcome

Participants

Mika K. Kortensniemi, PhD, Helsinki, Finland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mika.kortensniemi@hus.fi

LEARNING OBJECTIVES

1) To describe the challenges when pursuing to utilize heterogeneous, multidimensional and multifrequent data to estimate outcome. 2) To describe how the quantitative optimization task and methodology could be approached to reach outcome based metrics.

Active Handout: Mika Karel Kortensniemi

http://abstract.rsna.org/uploads/2017/17002331/Active_RC324c.pdf

RC325

Radiomics Mini-Course: From Image to Omics

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

BQ **PH**

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

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

RC325A Image Annotation and Semantic Labeling

Participants

Daniel L. Rubin, MD, MS, Stanford, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

daniel.l.rubin@stanford.edu

LEARNING OBJECTIVES

1) To understand the role of image annotations in capturing essential information about images in radiomics. 2) To learn about standards for capturing image annotation information, particularly Annotation and Image Markup (AIM) and DICOM-SR. 3) To see example use cases for image annotation in enabling radiomics research and clinical practice.

Honored Educators

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RC325B Image Feature Computation and Considerations

Participants

Sandy Napel, PhD, Stanford, CA (*Presenter*) 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

LEARNING OBJECTIVES

1) To understand the utility of various image feature categories (e.g., shape, edge sharpness, histogram, texture) and how image features are computed. 2) To appreciate the differential sensitivity of image features to variations in segmentation. 3) To appreciate the sensitivity of image features to acquisition protocols and image artifacts. 4) To understand how to use standard and customized workflows to compute image features for their own cohorts and for publicly available ones (e.g., TCIA).

RC325C Correlating Image Features with Multi-Omics Data

Participants

Mu Zhou, PhD, Mountain View, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the methods for and the potential value of correlating radiological images with genomic data for research and clinical care. 2) Learn how to access genomic and imaging data from databases such as The Cancer Genome Atlas (TCGA) and The Cancer Imaging Archive (TCIA) databases, respectively. 3) Learn about methods and tools for annotating regions within images and link them with semantic and computational features. 4) Learn about methods and tools for analyzing molecular data, generating molecular features and associating them with imaging features. 5) Introduction into how deep learning can revolutionize interpretation of medical images: challenges and opportunities.

ABSTRACT

Radiogenomics is an emerging field that integrates medical images and genomic data for the purposes of improved clinical decision

making and advancing discovery of critical disease processes. In cancer, both imaging and genomic data are becoming publicly available through The Cancer Imaging Archive (TCIA) and The Cancer Genome Atlas (TCGA) databases, respectively. The TCIA/TCGA provide examples of matched molecular and image data for five cancer types, namely breast, lung, brain, prostate and kidney. The data in TCGA includes various omics data such as gene expression, microRNA expression, DNA methylation and mutation data. The community is beginning to extract image features from the MRI, CT and/or PET images in TCIA, including tumor volume, shape, margin sharpness, voxel-value histogram statistics, image textures, and specialized features developed for particular acquisition modes. They are also annotating the images with semantic descriptors using controlled terminologies to record the visual characteristics of the diseases. The availability of these linked imaging-genomic data provides exciting new opportunities to recognize imaging phenotypes that emerge from molecular characteristics of disease and that can potentially serve as biomarkers of disease and its response to treatment. They also provide an opportunity to discover key molecular processes associated with distinct image features, within one cancer type and across different cancer types. This workshop will describe datasets and tools that enable research at the intersection of imaging and genomics, and that point to opportunities to develop future applications that leverage this knowledge for diagnostic decision support and treatment planning.

ABSTRACT

Radiogenomics is an emerging field that integrates medical images and genomic data for the purposes of improved clinical decision making and advancing discovery of critical disease processes. In cancer, both imaging and genomic data are becoming publicly available through The Cancer Imaging Archive (TCIA) and The Cancer Genome Atlas (TCGA) databases, respectively. The TCIA/TCGA provide examples of matched molecular and image data for five cancer types, namely breast, lung, brain, prostate and kidney. The data in TCGA includes various omics data such as gene expression, microRNA expression, DNA methylation and mutation data. The community is beginning to extract image features from the MRI, CT and/or PET images in TCIA, including tumor volume, shape, margin sharpness, voxel-value histogram statistics, image textures, and specialized features developed for particular acquisition modes. They are also annotating the images with semantic descriptors using controlled terminologies to record the visual characteristics of the diseases. The availability of these linked imaging-genomic data provides exciting new opportunities to recognize imaging phenotypes that emerge from molecular characteristics of disease and that can potentially serve as biomarkers of disease and its response to treatment. They also provide an opportunity to discover key molecular processes associated with distinct image features, within one cancer type and across different cancer types. This workshop will describe datasets and tools that enable research at the intersection of imaging and genomics, and that point to opportunities to develop future applications that leverage this knowledge for diagnostic decision support and treatment planning.

RC327

Physician Payment Reform and Radiology: Where Do We Stand and Where Are We Going?

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S102CD

HP

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

Participants

Andrew B. Rosenkrantz, MD, New York, NY (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

Andrew.Rosenkrantz@nyumc.org

LEARNING OBJECTIVES

1) To describe recent federal legislation seeking to implement healthcare payment reform by linking physician payment to the quality and value of care. 2) To recognize the specific impact of such legislation on radiologists and how radiologists can best prepare for the legislation's implementation. 3) To explore examples of how such federal policy may be applied in breast imaging, interventional radiology, and quality and safety in radiology.

ABSTRACT

Recent federal legislation aims to reform Medicare's traditional fee-for-service approach through new payment models that will eventually base the large majority of physician payments on quality and value. Of note, the Medicare Access and CHIP Reauthorization Act (MACRA) of 2015 implements a new federal Quality Payment Program (QPP) through which physicians will be paid through Advanced Alternative Payment Models or the Merit-Based Incentive Payment System (MIPS). The QPP will result in physicians being subject to potentially substantial payment bonuses or penalties depending on their performance in new physician-focused evaluation systems. The QPP will grant special considerations in performance evaluation to physicians with unique practice patterns, such as radiologists. However, physicians will need to have a robust understanding of the legislation and prepare accordingly in order to achieve favorable outcomes. This session will provide background of recent federal physician payment reform as relevant to radiology and also actions that radiology practices should pursue, both generally and in specific contexts within radiology, to ultimately attain success in the new system.

Sub-Events

RC327A MACRA and the MIPS: Impact for Radiology

Participants

Gregory N. Nicola, MD, River Edge, NJ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

gnnicola@yahoo.com

LEARNING OBJECTIVES

1) Introduce the participant to pertinent health policy language essential for understanding the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA). 2) Briefly review 3 broad clinician value based payment models outlined within MACRA: Merit-based Incentive Payment System (MIPS), Advanced Alternative Payment Models (AAPM), and Physician-focused Payment Models (MIPS). 3) Dive deeper into MIPS exploring the requirements for each of the 4 performance categories (Quality, Cost, Advancing Care Information, Improvement Activities) as they apply to the 2018 performance year.

RC327B Breast Screening Bundled Payments

Participants

Geraldine B. McGinty, MD, MBA, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

gbm9002@med.cornell.edu

LEARNING OBJECTIVES

1) Understand the goals associated with bundled payments for healthcare. 2) Understand the modeling and methodology for a breast cancer screening bundle Learn about the current state of specialty payment models.

RC327C Alternative Payment Models

Participants

Joshua A. Hirsch, MD, Boston, MA (*Presenter*) Consultant, Medtronic plc; Consultant, Globus Medical, Inc; Data Safety Monitoring Board, Johnson & Johnson;

LEARNING OBJECTIVES

View Learning Objectives under main course title

view Learning Objectives under main course title

RC327D Quality and Safety: A Policy Perspective

Participants

Kimberly E. Applegate, MD, MS, Lexington, KY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

keapple@uky.edu

LEARNING OBJECTIVES

1) To be familiar with the radiology quality and safety metrics on the cms.gov compare site. 2) To explain some of the organizational resources available to the radiologist to measure and report quality and process improvement. 3) To explore how quality in radiology will be measured under emerging physician performance evaluation models.

RC329

Quantitative MR Imaging and Clinical Applications (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S504AB

BQ **MR**

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

Participants

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

Sub-Events

RC329A Magnetic Resonance Fingerprinting: Principles and Applications

Participants

Vikas Gulani, MD, PhD, Cleveland, OH (*Presenter*) Research support, Siemens AG;

LEARNING OBJECTIVES

1) Understand the motivation behind the development of Magnetic Resonance Fingerprinting (MRF). 2) Understand basic principles and rationale in the design of an MRF acquisition, and comprehend the meaning of the output maps. 3) Identify applications to which MRF has been applied clinically thus far, and the unique insights that this work has thus far provided. 4) Understand the implications of MRF for tissue characterization, prediction of response to treatment, quantitative image analysis, radiomics, and computerized decision support. 5) Use the knowledge gained about MRF to analyze how this technology could be used in other clinical settings.

ABSTRACT

Magnetic Resonance Fingerprinting (MRF) is a new technology that enables efficient simultaneous mapping of multiple interesting MR properties, making it clinically feasible to measure T1 and T2, and thus provide a quantitative underlay to MRI. This enables a move towards a fully quantitative MR exam. We will start by laying out the rationale behind the need for quantitative MR. The approach adopted in MRF will be discussed, and the basics of such an acquisition will be explained. The initial clinical applications that have thus far been published will be shared, followed by a discussion of the implications of the technology in the future.

RC329B Radiomics for the Detection of Prostate Cancer

Participants

Masoom A. Haider, MD, Toronto, ON (*Presenter*) Consultant, Bayer AG; Advisory Board, Siemens AG; ;

LEARNING OBJECTIVES

1) Recognize the unmet needs in prostate cancer detection and surveillance. 2) Recognize the potential applications of quantitative imaging and radiomics to prostate cancer detection and surveillance. 3) Recognize what is required to have a valid imaging biomarker that can be applied to risk stratification in prostate cancer.

RC329C Free Breathing 3D Quantitative Perfusion MR Imaging of the Abdomen

Participants

Nicole Seiberlich, PhD, Cleveland, OH (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

nes30@case.edu

LEARNING OBJECTIVES

1) Describe various challenges to the collecting high-resolution, time-resolved MR images needed to quantify perfusion in the abdomen. 2) Understand different data collection and reconstruction strategies that have been recently proposed to enable this application. 3) Compare and contrast the merits of various novel acceleration methods for abdominal perfusion imaging. 4) Implement rapid perfusion quantification methods at their institution, or have the ability to contact those that can offer support in this area.

RC329D Elastography Beyond the Liver

Participants

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

LEARNING OBJECTIVES

1) Explain the basic physical principles of MR Elastography (MRE). 2) Understand the emerging applications of MRE for intracranial imaging. 3) Describe other potential applications of MRE that are being investigated, including assessing cardiac, lung, breast, renal, and pancreatic disease.

Honored Educators

Dr. Richard L. Ehman, MD, Rochester, MN, is the CEO and a stockholder of Resoundant, Inc. He is also a professor of Radiology at the University of Rochester Medical Center. Dr. Ehman is a past president of the International Society for Magnetic Resonance in Medicine (ISMRM) and a past president of the American Society of Magnetic Resonance (ASMR).

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/> Richard L. Ehman, MD - 2016 Honored Educator

RC331

Tumor Ablation Beyond the Liver: Practical Techniques for Success

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S104A



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

Participants

Debra A. Gervais, MD, Boston, MA (*Presenter*) Nothing to Disclose
Terrance T. Healey, MD, Providence, RI (*Presenter*) Nothing to Disclose
Anil N. Kurup, MD, Rochester, MN (*Presenter*) Research Grant, Galil Medical Ltd Royalties, UpToDate, Inc
Muneeb Ahmed, MD, Wellesley, MA (*Presenter*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc;
Scientific Advisory Board, Agile Devices, Inc

LEARNING OBJECTIVES

1) Describe indications for tumor ablation in extrahepatic sites. 2) Describe approaches and techniques to help prevent and manage organ specific complications. 3) Review results of tumor ablation in the lung, kidney, and bone.

ABSTRACT

Pulmonary malignancies, and specifically lung cancer, are a leading cause of death worldwide. Utilization of best current therapies results in an overall five-year relative survival rate for all stages combined to be only 15%, necessitating the use of alternative therapies. Image-guided ablation of lung malignancies is a revolutionary concept whose clinical applications are just beginning to be developed. It has some advantages over traditional radiotherapy and chemotherapy. Its safety profile is similar to percutaneous image guided lung biopsy. Almost all image-guided ablative procedures can be performed in an outpatient setting, mostly with conscious sedation. Multiple applications can be performed without any additional risks. Contraindications are few and include uncontrollable bleeding diathesis and recent use of anticoagulants. Image-guided ablation of lung malignancies is performed with two basic rationales. In the first group it is used with an intention of achieving definitive therapy. These are patients who are not candidates for surgery because of co-morbid medical contraindications to surgery, like poor cardiopulmonary reserve or patients refusing to undergo operation. This cohort could potentially derive significant benefit from a minimally invasive alternative therapy. In the second group it is used as a palliative measure as follows: (a) to achieve tumor reduction before chemotherapy (b) to palliate local symptoms related to aggressive tumor growth, such as chest pain, chest wall pain or dyspnea (c) hematogenous painful bony metastatic disease (d) tumor recurrence in patients who are not suitable for repeat radiation therapy or surgery. Image-guided ablation is expanding treatment options for the local control of non-small cell lung cancer and metastatic disease.

Honored Educators

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RC332

Mentoring Future Leaders

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S404CD

LM

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

Sub-Events

RC332A Considerations and Suggested Approaches to Implementing Formal Mentoring

Participants

Alexander M. Norbash, MD, San Diego, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize representative methods and the current state of formal systemic mentoring in academic and private radiology practices. 2) Understand both the reasons supporting and the potential advantages of formal systemic mentoring systems. 3) Appreciate the resources and manpower investments necessary to practically configure and deploy formal systemic mentoring.

RC332B Mentors, Mentees and Mentoring in Radiology

Participants

James V. Rawson, MD, Augusta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jrawson@augusta.edu

LEARNING OBJECTIVES

1) Recognize elements of mentoring relationship that should be discussed and agreed to. 2) Understand balancing the trade-offs in mentoring relationships.

ABSTRACT

Mentoring relationships can range from very structured to informal. Other features include duration and focus. Mentoring has been shown to increase faculty retention, career satisfaction, improved teaching and clinical.

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/> James V. Rawson, MD - 2017 Honored Educator

RC332C Mentoring in the Culture of Multigenerational Workforce and Diversity

Participants

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

LEARNING OBJECTIVES

1) Understand how mentor-mentee relationship and expectations are changing in the current environment of multigenerational workforce and diversity. 2) Learn what leadership skills are needed to become good mentors. 3) Understand what to do and what not to do when you are looking for a mentor.

ABSTRACT

n/a

RC350

Targeted Treatment and Imaging of Liver Cancers: Basic to Advanced Techniques in Minimally-Invasive Therapies and Imaging

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S403A

GI **OI** **IR**

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

FDA Discussions may include off-label uses.

Participants

Jinha Park, MD, PhD, Buena Park, CA (*Presenter*) Nothing to Disclose

John J. Park, MD, PhD, Los Angeles, CA (*Presenter*) Proctor, Sirtex Medical Ltd Advisory Board, Guerbet SA Speakers Bureau, Medtronic plc

Marcelo S. Guimaraes, MD, Charleston, SC (*Presenter*) Consultant, Baylis Medical Company; Consultant, Terumo Corporation; Consultant, General Electric Company; Patent holder, Cook Group Incorporated

Andrew C. Price, MD, Gilbert, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Andrew.Price@bannerhealth.com

johnnpark@coh.org

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jinha.park@gmail.com

LEARNING OBJECTIVES

1) Discuss the role of the interventional radiologist in the treatment and management of patients with primary and metastatic liver cancer as part of the multidisciplinary team. 2) Learn best practice techniques in the treatment of liver cancers, with emphasis on both locoregional and focal therapeutic approaches, and indications for treatment. 3) Explore various tips and tricks for each treatment modality and learn how to avoid complications through good patient selection, choosing the appropriate techniques, and knowing what common mistakes to avoid. 4) Learn about newer and developing techniques and devices, their potential roles and indications, and potential pitfalls. 5) Explore advanced imaging modalities in the detection of tumors and for monitoring treatment response.

ABSTRACT

Primary and metastatic liver disease may benefit from combined techniques such as bland/chemoembolization and liver ablation. The presentation will provide the rationale for the association of techniques, patient selection, tips and tricks, equipment and supplies necessary, protective techniques and how to avoid complications. Also, it will be discussed the results and current literature to support the association of techniques.

RC352

US-guided Interventional Breast Procedures (Hands-on)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E264

BR **US**

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

Participants

Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Hologic, Inc. Scientific Advisory Board
Gary J. Whitman, MD, Houston, TX (*Presenter*) Book contract, Cambridge University Press
Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Basak E. Dogan, MD, Dallas, TX (*Presenter*) Nothing to Disclose
William R. Poller, MD, Pittsburgh, PA (*Presenter*) Consultant, Devicor Medical Products, Inc; Consultant, General Electric Company;
Paula B. Gordon, MD, Vancouver, BC (*Presenter*) Stockholder, OncoGenex Pharmaceuticals, Inc ; Scientific Advisory Board, Real Imaging Ltd; ;
Annamaria Wilhelm, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Michael N. Linver, MD, Albuquerque, NM (*Presenter*) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd; Scientific Advisory Board, Seno Medical Instruments, Inc
Anna I. Holbrook, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
Eren D. Yeh, MD, Boston, MA (*Presenter*) Reader, Hologic, Inc; Reader, Statlife SAS
Gary W. Swenson, MD, Mason City, IA (*Presenter*) Nothing to Disclose
Catherine W. Piccoli, MD, Voorhees, NJ (*Presenter*) Stockholder, Qualgenix LLC;
Phan T. Huynh, MD, Houston, TX (*Presenter*) Nothing to Disclose
Jiyon Lee, MD, New York, NY (*Presenter*) Nothing to Disclose
Tanya W. Moseley, MD, Houston, TX (*Presenter*) Nothing to Disclose
Peter R. Eby, MD, Seattle, WA (*Presenter*) Consultant, Leica Biosystems Nussloch GmbH
Alexis V. Nees, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
H. Carisa Le-Petross, MD, FRCPC, Houston, TX (*Presenter*) Nothing to Disclose
Santo Maimone IV, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Susan Weinstein, MD, Philadelphia, PA (*Presenter*) Consultant, iCAD, Inc
Rachna Dutta, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Liane E. Philpotts, MD, New Haven, CT (*Presenter*) Consultant, Hologic, Inc
Jessica W. Leung, MD, Houston, TX (*Presenter*) Nothing to Disclose
Jennifer R. Kohr, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Laurie R. Margolies, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the equipment needed for ultrasound guided interventional breast procedures. 2) Review the basic principles of ultrasound guidance and performance of minimally invasive breast procedures. 3) Practice hands-on technique for ultrasound guided breast interventional procedures.

ABSTRACT

This course is intended to familiarize the participant with equipment and techniques in the application of US guided breast biopsy and needle localization. Participants will have both basic didactic instruction and hands-on opportunity to practice biopsy techniques on tissue models with sonographic guidance. The course will focus on the understanding and identification of: 1) optimal positioning for biopsy 2) imaging of adequate sampling confirmation 3) various biopsy technologies and techniques 4) potential problems and pitfalls

Honored Educators

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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/> Eren D. Yeh, MD - 2015 Honored Educator

RC353

RadLex: Standard Codes for Reporting, Analytics and Workflow

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S503AB



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

Participants

Kenneth C. Wang, MD, PhD, Baltimore, MD (*Moderator*) Co-founder, DexNote, LLC; Software support, 3D Systems, Inc

LEARNING OBJECTIVES

1) Describe the RadLex system of standard terms for radiology. 2) Access RadLex content through interactive and programmatic interfaces. 3) Identify the role of standard terminology in radiology reporting, analytics and workflows, including the use of RadLex terms in a regional lung cancer screening project. 4) Explain and utilize the RadLex Playbook and the LOINC-RSNA Radiology Playbook systems for naming and coding radiology exams.

Sub-Events

RC353A RadLex: A User's Guide

Participants

Kenneth C. Wang, MD, PhD, Baltimore, MD (*Presenter*) Co-founder, DexNote, LLC; Software support, 3D Systems, Inc

LEARNING OBJECTIVES

1) Define the purpose of the RadLex terminology system. 2) Characterize the scope and organization of RadLex terms. 3) Access RadLex content through interactive and programmatic interfaces. 4) Explain the use of RadLex terms in radiology reporting, analytics and workflows. 5) Introduce the role of RadLex terms in standardized radiology exam codes.

RC353B Cancer Care Ontario, Lung Cancer Screening Pilot for People at High Risk: The Role of Terminology and Radiology Reporting Standards

Participants

David M. Kwan, BSC, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

david.kwan@cancercare.on.ca

LEARNING OBJECTIVES

1) Understand the motivation for using RadLex for: defining clinical elements in standardizing radiology reporting templates; facilitating clinical data retrieval for population-based research; and for integrating radiology results for cancer patient. 2) Understand the challenge associated with implementing synoptic (highly structured and coded) radiology reporting templates for radiologists. 3) Understand the current reporting standards landscape for structured and synoptic radiology reporting. 4) Understand how RadLex is utilized in example IHE Radiology Profiles.

Active Handout: David M. Kwan

http://abstract.rsna.org/uploads/2017/17002187/Active_RC353B.pdf

RC353C The RSNA RadLex Playbook: Lessons from Clinical Implementation

Participants

Curtis P. Langlotz, MD, PhD, Menlo Park, CA (*Presenter*) Advisory Board, Nuance Communications, Inc; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG;

For information about this presentation, contact:

langlotz@stanford.edu

LEARNING OBJECTIVES

1) Learn from the experience of one site implementing standard exam codes. 2) Evaluate the advantages and disadvantages of using standard exam codes. 3) Analyze how exam codes affect clinical work flow. 4) Understand the choices that must be made when implementing standard exam codes.

RC353D Introduction to LOINC

Participants

Daniel J. Vreeman, MS, Indianapolis, IN (*Presenter*) Research contract, bioMerieux SA; President, Blue Sky Premise, LLC

LEARNING OBJECTIVES

1) Explain the purpose and scope of the LOINC terminology standard. 2) Identify and select the key tools for implementing codes

2) Explain the purpose and scope of the LOINC terminology; standard 2) identify and select the key tools for implementing codes from the LOINC/RSNA Radiology Playbook. 3) Apply best practices for using LOINC. 4) Understand the development process for the LOINC/RSNA Radiology Playbook.

RC354

Leveraging IT to Optimize Quality in Radiology

Tuesday, Nov. 28 8:30AM - 10:00AM Room: N227B



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

Participants

Paul J. Chang, MD, Chicago, IL (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Advisory Board, Bayer AG; Advisory Board, Aidoc Ltd; Advisory Board, McCoy

For information about this presentation, contact:

pchang@radiology.bsd.uchicago.edu

Sub-Events

RC354A IHE and Beyond: Improving Radiology Quality through IT Interoperability

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) Discuss the importance of interoperability of health IT systems within and beyond radiology. 2) Discuss how IHE efforts can promote this interoperability. 3) Describe other interoperability efforts to improve communication of health IT systems.

RC354B Business Intelligence and Analytics: Dashboards, Scorecards, and Beyond

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

For information about this presentation, contact:

pchang@radiology.bsd.uchicago.edu

LEARNING OBJECTIVES

1) The technical steps required to develop and implement dashboards and scorecards (including data/state aggregation, semantic normalization, modeling, data mining, and presentation) will be discussed. 2) Specific strategies and technologies that can be used to create dashboards and scorecards (including HL7, DICOM, ETL, web services, and SOA) will be illustrated. 3) Strategies to create a sustainable and agile architecture to support advanced business intelligence and analytics (BIA) tools will be explored.

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the enterprise. Merely "managing the practice" will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. Although the phrase "one cannot improve a process unless one can measure it" is a familiar platitude, it is an increasingly important and relevant concept. The proper leveraging of formal Business Intelligence and Analytics (BIA) is a critical, absolutely essential strategy for any radiology group. Although currently underutilized, concepts such as Key Performance Indicators (KPIs), tactical dashboards, and strategic scorecards, should be familiar tools for radiology groups attempting to "navigate disruption."

RC354C Leveraging IT to Optimize Quality in Radiology

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

For information about this presentation, contact:

pchang@radiology.bsd.uchicago.edu

LEARNING OBJECTIVES

1) Discuss how modern radiology quality expectations require a greater degree of "meaningful innovation" in imaging IT and informatics. 2) Introduced to examples of next generation IT tools and models that can help achieve both improved efficiency and quality. 3) Describe how and why radiology must redefine and re-engineer itself in order to fully take advantage of these next generation electronic based practice tools. The impact these changes in practice management can have on quality, workflow efficiency, and productivity will be discussed.

ABSTRACT

Radiology practices have benefited from the adoption of electronic-based information technology, especially with respect to practice efficiency. However, there is great opportunity to further leverage information technology to significantly improve quality within the radiology practice. However, electronic tools, such as PACs, RIS, and speech recognition (along with their associated workflow), are still relatively immature and arguably support only "commodity-level" capability. There is a critical need for a new generation of "meaningful innovation" in radiology IT that will allow radiology to maximize value to patients and other stakeholders by significantly improving both efficiency and quality. Radiologists must be "value innovators" who maximally leverage information technology to ensure their relevance and value to patient care through measureable improvements in quality, efficiency, and safety.

RCA31

PowerPoint Tips and Tricks (Hands-on)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S401AB



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

For information about this presentation, contact:

sabate@med.umich.edu

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.

ABSTRACT

Electronic presentations are very common in radiology practice. This hands-on demonstration and questions and answer session will show attendees how to optimize their presentations. Discussion of live presentation tips. Additional review of image and video display and management will be covered. Demonstrations will include tips to decrease time creating and modifying presentations. Bring your questions!

RCC31

Cybersecurity for Imaging Departments and Imagers - Threats, Vulnerabilities and Best Practices: Part 1

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S501ABC



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

Participants

James Whitfill, MD, Scottsdale, AZ (*Moderator*) President, Lumetis, LLC; Speaker, FUJIFILM Holdings Corporation;

LEARNING OBJECTIVES

1) Understand the changing environment of network and internet connected devices and software. 2) Be aware of the motivations and tactics of current threat actors. 3) Understand common security issues found in medical devices. 4) Know simple actions that can decrease risk. 5) Understand the vulnerabilities of imaging system modalities to security and privacy breaches. 6) Determine ways to protect and secure imaging systems from internal and external threats. 7) Describe institutional best-practices to maintain protection yet provide necessary accessibility for imaging modalities. 8) Do medical devices contain cybersecurity vulnerabilities, and do they affect patient safety? 9) Are medical devices subject to ransomware threats? 10) What is the role and capabilities of the DHS ICS-CERT (Industrial Control Systems Cyber Emergency Response Team) in medical device security? 11) What are some steps that can be taken to protect medical devices?

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

RCC31A Medical Device Security in a Connected World

Participants

Kevin McDonald, Rochester, MN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mcdonald.kevin@mayo.edu

LEARNING OBJECTIVES

1) Understand the changing environment of network and internet connected devices and software. 2) Be aware of the motivations and tactics of current threat actors. 3) Understand common security issues found in medical devices. 4) Know simple actions that can decrease risk. 5) Understand the steps to implement a medical device security program.

ABSTRACT

Medical devices are increasingly becoming dependent on technology and network connectivity, at a time that the electronic environment is becoming more dangerous. Because of this medical devices and systems can become easy targets for attackers attempting to access PHI, disrupt patient care or even harm a patient. When tested, these devices have been shown to have multiple vulnerabilities. These vulnerabilities range from hardcoded passwords, publicly available service passwords and no encryption of patient data. Because of this institutions using these devices need to work with their vendors to improve the security of medical devices and take actions themselves to help protect their environment and patients. There are simple steps to decrease your risk and ways, even with limited resources and skills, to start to evaluate medical devices at your institution.

RCC31B Knowing if Your Imaging Systems are Secure and Keeping Them That Way

Participants

James A. Seibert, PhD, Sacramento, CA (*Presenter*) Advisory Board, Bayer AG

For information about this presentation, contact:

jaseibert@ucdavis.edu

LEARNING OBJECTIVES

1) Understand the vulnerabilities of imaging system modalities to security and privacy breaches. 2) Determine ways to protect and secure imaging systems from internal and external threats. 3) Describe institutional best-practices to maintain protection yet provide necessary accessibility for imaging modalities.

RCC31C Cyberattacks in Healthcare: The Rising Threats to Our Patients' Health

Participants

James Whitfill, MD, Scottsdale, AZ (*Presenter*) President, Lumetis, LLC; Speaker, FUJIFILM Holdings Corporation;

For information about this presentation, contact:

jwhitfill@lumetis.com

LEARNING OBJECTIVES

1) Appreciate the evolving landscape of cyberthreats to healthcare and Radiology. 2) Understand the different targeting strategies used by cyber attackers. 3) Understand the difference between cyberthreats to patient's health and patients' health information.

MSAS32

Patients Are Expecting a Retail Experience: 5 Principles from Retail Healthcare (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S105AB

LM **OT**

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

Participants

Dana Aragon, RT, Albuquerque, NM (*Moderator*) Nothing to Disclose
Catherine Gunn, RT, Halifax, NS (*Moderator*) Nothing to Disclose
Matt Henry, Denver, CO (*Presenter*) Nothing to Disclose
Calvin Cheng, Denver, CO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Hear about consumer experiences that are being delivered in a progressive retail industry (REI, Target, Kroger). 2) Consider underlying people, processes and technologies that enable the enhanced retail consumer experience. 3) Apply these lessons within the broader healthcare industry given prevailing trends and complicated environment. 4) Identify opportunities for quick wins for clinical practices to enhance your customer's experience (both patients/consumers and referring clinicians). 5) Longer term, prepare your organization to be responsive to and benefit from the shift to patient as consumer.

MSCC32

Case-based Review of Nuclear Medicine: PET/CT Workshop-Neuro-PET/CT (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S406A

CT **HN** **NR** **NM**

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

Participants

Katherine A. Zukotynski, MD, Hamilton, ON (*Director*) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Hamilton, ON (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Apply basic anatomic, pathologic, and physiologic principles to the interpretation of PET/CT with emphasis on neurodegenerative disease and head and neck cancer. 2) Identify blind spots that can influence interpretation of these PET/CT studies. 3) Analyze factors that can improve image quality while minimizing patient risk.

Sub-Events

MSCC32A Neurodegenerative Disease

Participants

Phillip Kuo, MD, PhD, Tucson, AZ (*Presenter*) Author, MD Training at Home; Research Grant, Astellas Group; Consultant, Endocyte, Inc; Consultant, General Electric Company; Education Grant, General Electric Company; Speakers bureau, Eli Lilly and Company; Consultant, inviCRO, LLC; Consultant, Imaging Endpoints; Consultant, Progenics Pharmaceuticals, Inc;

LEARNING OBJECTIVES

[View Learning Objectives under Main Course Title](#)

MSCC32B Head and Neck Cancer

Participants

Gagandeep Choudhary, MD, MBBS, Birmingham, AL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

[View Learning Objectives under Main Course Title](#)

MSES32

Essentials of Chest Imaging

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S100AB

CH

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

FDA

Discussions may include off-label uses.

Sub-Events

MSES32A MRI of Thymic Lesions

Participants

Patricia J. Mergo, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mergo.patricia@mayo.edu

LEARNING OBJECTIVES

1) Become familiar with the MR imaging appearance of various pathologic processes in the thymus and to understand their image features in correlation with pathologic findings. 2) Distinguish the MR imaging appearance of thymic lesions from other anterior mediastinal mass lesions when possible. 3) Become familiar with MR imaging techniques that facilitate the distinction of primary thymic lesions from other mediastinal masses.

ABSTRACT

Evaluation of anterior mediastinal lesions can be difficult with CT imaging alone. MRI can add utility as a diagnostic tool in the evaluation of thymic lesions and aid in their distinction from other anterior mediastinal mass lesions. The imaging features of various lesions of the thymus are presented in correlation with their pathologic features. Specific MR imaging techniques are presented as they relate to distinction of various pathologic entities, including the use of in-phase and out-of-phase imaging, contrast-enhanced imaging and diffusion-weighted imaging, when applicable.

MSES32B Occupational Lung Diseases

Participants

Cristopher A. Meyer, MD, Cincinnati, OH (*Presenter*) Investor, Elucient Medical; Investor, NeuWave Medical, Inc

For information about this presentation, contact:

cmeyer2@uwhealth.org

LEARNING OBJECTIVES

1) Describe the pathophysiology of dust deposition and clearance as an explanation for the different manifestations of particulate and fiber inhalation. 2) List three major categories of occupational lung disease and give an example of each. 3) Recognize the importance of a new pleural effusion in a patient with pleural plaque.

Active Handout: Cristopher A. Meyer

<http://abstract.rsna.org/uploads/2017/17000057/Active MSES32B.pdf>

MSES32C Imaging of Small Airways Disease

Participants

Gerald F. Abbott, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

gabbott@mgh.harvard.edu

LEARNING OBJECTIVES

1) To know the anatomic basis of small airways imaging. 2) To know the direct and indirect imaging signs of small airways disease. 3) To know the clinico-pathologic spectrum of small airways disease.

ABSTRACT

Small airways disease manifests with both direct and indirect imaging signs which reflect the underlying proliferative or fibrotic pathologic process of various disease entities. This presentation will review the underlying anatomy of the small airways and illustrate the imaging signs encountered in a spectrum of diseases involving the small airways.

Honored Educators

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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/> Gerald F. Abbott, MD - 2015 Honored Educator

MSES3D Imaging the Pneumothorax

Participants

Judith L. Babar, MBChB, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

judith.babar@addenbrookes.nhs.uk

LEARNING OBJECTIVES

1) Accurately identify a pneumothorax and differentiate from potential mimics on chest radiography. 2) Be familiar with causes of a spontaneous secondary pneumothorax, which may be the first presenting event of occult disease. 3) Employ a pattern-based approach to facilitate accurate diagnosis of congenital and acquired causes of pneumothoraces on MDCT, in particular with respect to cystic lung disease.

ABSTRACT

Radiologists will frequently encounter a pneumothorax on a chest radiograph or CT. Spontaneous pneumothorax occurs in the absence of trauma, and can be further divided into primary (individuals without clinically apparent lung disease) or secondary (pre-existing lung disease). This presentation aims to ensure that radiologists are familiar with the imaging appearances of common and rare causes of pneumothorax, encompassing COPD, infection, interstitial pulmonary fibrosis, connective tissue disorders and cystic lung disease, which may help in providing a specific diagnosis. The role and appropriateness of the use of MDCT in the diagnostic pathway, and management of pneumothoraces will also be discussed.

MSQI32

Quality Improvement Symposium: Understanding Error and Improvement in Diagnosis

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S406B

SQ

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

Participants

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

For information about this presentation, contact:

ellakaz@umich.edu

LEARNING OBJECTIVES

1) To understand sources of error in the diagnostic imaging pathway, 2) the barriers and impediments to overcoming them, and 3) the role of team, culture and technology in minimizing error, improving communication and ultimately providing better care to our patients and their families.

ABSTRACT

The 2015 report from the Institute of Medicine on 'Improving Diagnosis in Health Care' is to diagnostic disciplines like Radiology what their 2000 report 'To Err is Human: Building a Safer Health System' was to the field of medicine. The complexity of the diagnostic process requires collaboration of patients and families with healthcare providers and staff, information gathering and clinical reasoning to deliver meaningful patient and family centered care, minimize harms that range from delays in diagnosis to inaccurate diagnosis resulting in inappropriate treatment, with physical, psychological and financial repercussions. As the IOM report notes, it's a moral, professional and public health imperative to improve the entire diagnostic process. A PDF of IOM report is available for download from the National Academies Press at www.nap.edu/catalog/21794/improving-diagnosis-in-health-care

Active Handout: Ella A. Kazerooni

http://abstract.rsna.org/uploads/2017/17000706/Active_MSQI32.pdf

Sub-Events

MSQI32A Failure Points in the Diagnostic Process

Participants

Timothy J. Mosher, MD, Hershey, PA (*Presenter*) Research Consultant, Medical Metrics, Inc; Stockholder, Johnson & Johnson

LEARNING OBJECTIVES

1) Identify common failure points in the diagnostic process. 2) Recognize the contribution of system errors to failure modes in the diagnostic process. 3) Recognize the role of cognitive errors in diagnostic errors.

MSQI32B Impediments and Barriers to the Diagnostic Process - Technology, Liability, Reimbursement, and Culture

Participants

Danny C. Kim, MD, White Plains, NY (*Presenter*) Nothing to Disclose

MSQI32C The Roles of Teamwork, Technology and Culture in Improving Diagnosis

Participants

Jeffrey Myers, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Apply principles of patient and family centered care to create a culture and environment of safety and service excellence.

ABSTRACT

Current well-intended strategies for quality, patient safety, and service excellence draw heavily on the tools of what Don Berwick refers to as "era 2." In his IHI keynote address in December 2015 he characterized era 2 - the one in which we currently find ourselves - as a time of "massive, ravenous investment in the tools of scrutiny" and "massive underinvestment in change, and learning, and in innovation." The Department of Pathology at the University of Michigan began exploring the connections between Patient and Family Centered Care (PFCC) and our goals for quality, safety and service in the fall of 2013. Using iterative pilot projects we began building a bridge from our legacy of always doing things to and for patients to a future in which we also work directly with patients and families to create unique value through multidisciplinary collaboratives. This work has transitioned to a Patients and Families Advisory Council (PFAC) that is working directly with institutional champions to understand opportunities to transform the patient experience from a pathology platform.

MSRO32

BOOST: Gastrointestinal-Oncology Anatomy (An Interactive Session)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S103AB

GI **OI** **RO**

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

Participants

Parag Parikh, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Kathryn J. Fowler, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Edward Y. Kim, MD, Seattle, WA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

fowlerk@mir.wustl.edu

LEARNING OBJECTIVES

1) Achieve a basic understanding of the anatomy pertinent to rectal cancer. 2) Understand the role of different imaging techniques in staging rectal cancer. 3) Identify features of rectal cancer as relates to T stage, nodal stage, and important prognostic indicators (such as extramural vascular invasion).

ABSTRACT

The diagnostic portion of this course will focus on imaging rectal cancer with an overview of the pertinent anatomy, radiological staging, contributions of different imaging modalities, review of prognostic features, and assessment of response by imaging.

MSRO36

BOOST: Lung-Science Session with Keynote

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S103CD

CH RO OI

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

Participants

Meng X. Welliver, MD, Columbus, OH (*Moderator*) Nothing to Disclose
Matthew M. Harkenrider, MD, Maywood, IL (*Moderator*) Nothing to Disclose

Sub-Events

MSRO36-01 Invited Speaker:

Tuesday, Nov. 28 10:30AM - 10:50AM Room: S103CD

Participants

Matthew M. Harkenrider, MD, Maywood, IL (*Presenter*) Nothing to Disclose

MSRO36-03 Therapeutic Response Prediction in Non-Small Cell Lung Cancer After Conservative Therapy: Utility of Multiparametric Approach by Quantitatively Assessed Dynamic First-Pass Contrast-Enhanced Perfusion MRI with FDG-PET/CT

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S103CD

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;
Yuji Kishida, MD, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinichiro Seki, Kobe, Japan (*Abstract Co-Author*) Research Grant, Toshiba Medical Systems Corporation
Takeshi Yoshikawa, MD, Kobe, Japan (*Abstract Co-Author*) Research Grant, Toshiba Medical Systems Corporation
Masao Yui, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation
Shigeharu Ohyu, MEng, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation
Katsusuke Kyotani, RT, MSc, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Hisashi Tachizaki, Tustin, CA (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation

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PURPOSE

To directly compare the capability for therapeutic response prediction by among quantitatively assessed dynamic CE-perfusion MRI, FDG-PET/CT and multiparametric approach by both modalities in non-small cell lung cancer (NSCLC) patients treated with chemoradiotherapy.

METHOD AND MATERIALS

43 consecutive Stage IIIB NSCLC patients (25 men, 18 women; mean age 67 year old) underwent PET/CT, dynamic CE-perfusion MRI, chemoradiotherapy, and follow-up examination. In each patient, therapeutic outcomes were assessed as therapeutic effect based on RECIST guideline. Then, all patients were divided into two groups as follows: 1) responders (CR+PR cases: n=23) and 2) non-responders (SD+PD cases: n=20). In each patient, total perfusion (TP) and tumor perfusions from pulmonary (TPP) and systemic (TPS) circulations calculated from dynamic CE-perfusion MR data and SUV_{max} on PET/CT were assessed at each targeted lesion, and averaged to determine final values. To determine each index difference between two groups, Student's t-test was performed. Then, multivariate logistic regression analysis was performed to investigate the discriminating factors of responders. In addition, ROC analysis was performed to compare diagnostic performance between multiparametric approach and each radiological index. Finally, sensitivity, specificity and accuracy were compared among all methods by McNemar's test.

RESULTS

All indexes had significant differences between responder and non-responders ($p < 0.05$). Multivariate regression analysis identified SUV_{max} (Odds ratio [OR]: 2.56) and TP (OR: 0.68) as significant differentiator of responder. ROC analysis showed area under the curve (Az) of multiparametric approach (Az=0.95) was significantly larger than that of TPP (Az=0.72, $p=0.001$). Sensitivity (95.7 [22/23] %) of multiparametric approach was significantly higher than that of TP (69.6 [16/23] %, $p=0.03$) and TPP (65.2 [15/23] %, $p=0.02$).

CONCLUSION

Multiparametric approach by dynamic CE-perfusion MRI and PET/CT can improve the capability for therapeutic response prediction as compared with each modality alone in NSCLC patients after conservative therapy.

CLINICAL RELEVANCE/APPLICATION

Multiparametric approach by dynamic CE-perfusion MRI and PET/CT can improve the capability for therapeutic response prediction as compared with each modality alone in NSCLC patients after conservative therapy.

MSRO36-04 Current Treatment Practices for Limited-Stage Small Cell Lung Cancer: A Survey of US Radiation Oncologists on Their Use of Prophylactic Cranial Irradiation

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S103CD

Participants

Matthew J. Farrell, Portland, OR (*Presenter*) Nothing to Disclose
Jehan Yahya, Portland, OR (*Abstract Co-Author*) Nothing to Disclose
Catherine Degnin, PhD, MPH, Portland, OR (*Abstract Co-Author*) Nothing to Disclose
Yiyi Chen, Portland, OR (*Abstract Co-Author*) Nothing to Disclose
John M. Holland, MD, Clackamas, OR (*Abstract Co-Author*) Nothing to Disclose
Mark A. Henderson, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Jerry J. Jaboin, MD, PhD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Matthew M. Harkenrider, MD, Maywood, IL (*Abstract Co-Author*) Nothing to Disclose
Charles R. Thomas JR, MD, Portland, OR (*Abstract Co-Author*) Nothing to Disclose
Timur Mitin, MD, PhD, Portland, OR (*Abstract Co-Author*) Nothing to Disclose

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METHOD AND MATERIALS

We surveyed practicing US radiation oncologists via an online questionnaire. Questions covered background characteristics, self-rated knowledge of several key trials, and treatment recommendations for LS-SCLC.

RESULTS

We received 309 complete responses from practicing radiation oncologists. 98% recommend PCI for patients with LS-SCLC, 96% obtain a brain MRI prior to PCI, 33% routinely obtain serial brain imaging with MRI to detect new metastases, and 35% recommend memantine for patients undergoing PCI. Recommending memantine was associated with fewer years post residency training ($p=0.0003$), fewer lung cancer patients treated per year ($p=0.045$), and fewer LS-SCLC patients treated per year ($p=0.024$).

CONCLUSION

Practice patterns among US radiation oncologists strongly align with NCCN guidelines, which recommend brain MRI and PCI for patients with LS-SCLC who show a good response to initial therapy. These practices are not directly supported by the clinical trials that shaped them, as the trials used either CT scans of the brain or no brain imaging prior to PCI. Recent Japanese studies in patients with extensive-stage and limited-stage SCLC suggest that the benefits of PCI might disappear when brain MRI is incorporated. A third of respondents prescribe memantine to patients undergoing PCI; while no trials have studied memantine in the context of PCI for LS-SCLC patients, a phase III trial did show memantine delayed cognitive decline in patients treated with whole brain radiotherapy for brain metastases. Further research and a reevaluation of guidelines are warranted to determine the best treatment for patients with LS-SCLC.

CLINICAL RELEVANCE/APPLICATION

Our survey of practicing US radiation oncologists shows strong adherence to NCCN guidelines for the use of PCI in LS-SCLC, and it establishes a practice pattern baseline for future clinical trials.

MSRO36-05 Thoracic Radiation Therapy Significantly Improve the Survival of Extensive Stage Small Cell Lung Cancer after Chemotherapy

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S103CD

Participants

Lei Deng, Oak Brook, IL (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Our study is aimed to evaluate the influence of Thoracic Radiation Therapy (TRT) on survival in extensive stage small cell lung cancer (SCLC) after chemotherapy. **Materials/Methods:** A retrospective review was conducted on extensive stage SCLC patients received chemotherapy \pm TRT from January 2007 to December 2012. Most patients received initial chemotherapy with carboplatin plus etoposide or chemotherapy with cisplatin plus etoposide. TRT was performed through three dimensional conformal Radiation Therapy (3D-CRT) or intensive modified radiotherapy (IMRT). The median thoracic radiation dose was 56 Gy (32~67 Gy) with 1.8~2.3 Gy per fractions. The effect of TRT on overall survival (OS) and progress free survival (PFS) was evaluated with Kaplan-Meier method and log-rank test. Statistically significant difference was set as $p < 0.05$. **Results:** Overall, 353 consecutive patients were enrolled. Follow-up rate was 95.5%. Patients reaching CR (complete response), PR (partial response), SD (stable disease), PD (progressive disease) after chemotherapy accounted for 2.3%, 62.6%, 21.8%, and 13.3% respectively. 130 cases of patients (36.8%) had conducted TRT. The characteristics were comparable between the TRT and non-TRT groups except that the patients conducting prophylactic cranial irradiation (PCI) were more prevalent in the TRT group. The median follow-up time for survival patients was 58.6 months. The median overall survival (OS) of the whole group was 13.3 ± 0.5 months (95% CI: 12.3-14.3) and the median progression-free survival (PFS) was 9.0 ± 0.3 months (95% CI: 8.3-9.7). TRT significantly improved the OS and PFS. The median OS was 20.0 ± 1.3 months in TRT group, while 10.6 ± 0.5 months in non-TRT group; the median PFS were 11.0 ± 0.7 months and 7.2 ± 0.3 months respectively in the two groups ($p < 0.001$). **Conclusion:** For all extensive stage SCLC patients with different brain metastasis status and response after chemotherapy, TRT can significantly improve OS and PFS and decrease the loco-regional recurrence rate.

MSRO36-06 A Pilot Study Comparing the Value of 18F-Alfatide PET/CT and 18F-FDG PET/CT in Predicting Chemoradiotherapy Sensitivity in Patients with Advanced Non-Small Cell Lung Cancer

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S103CD

Participants

Shuanghu Yuan, PhD, Jinan, China (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Both 18F-alfatide positron emission tomography/computed tomography(PET/CT) and 18F-fluorodeoxyglucose (18F-FDG) PET/CT were potential in predicting therapy sensitivity, in this study, we recruited patients with advanced NSCLC to detect and compare the potential predictive value of them on the CRT sensitivity of patients with advanced non-small cell lung cancer (NSCLC). **Materials/Methods:** According to the design of Natural Science Foundation of China (NSFC) 81372413, twenty-four patients with advanced NSCLC accepted 18F-alfatide PET/CT before radiotherapy (T1), another thirty-nine patients underwent 18F-FDG PET/CT at both T1 and during CRT (40Gy of radiotherapy, T2). Logistic regression analysis was used to evaluate the correlations between PET parameters and CRT sensitivity providing an odds ratio (OR), 95% confidence interval (CI) and p value. Propensity score matching (PSM) approach was used to control confounding. **Results:** Logistic regression analyses showed that Karnofsky Performance Status (KPS) score was correlative with CRT sensitivity. After PSM, controlling KPS scores, twenty-four pairs of patients were matched. The results showed that SUVmax obtained from baseline 18F-alfatide PET/CT was associated with CRT sensitivity in both univariate and multivariable logistic regression analysis (OR: 0.532, 95% CI: 0.305–0.927, $p=0.026$; OR:0.376, 95% CI: 0.165-0.860, $p=0.021$), but the baseline 18F-FDG PET/CT was not. Univariate analysis showed that the percent change in MTV of 18F-FDG PET/CT between T1 and T2 was correlative with CRT sensitivity (OR: 1.039, 95% CI: 1.003-1.077, $p=0.036$). When patients' KPS score was considered simultaneously, it was still related to CRT sensitivity (OR:1.038, 95% CI: 1.001-1.077, $p=0.045$). **Conclusion:** 18F-alfatide PET/CT may be better than 18F-FDG PET/CT in predicting CRT sensitivity, and 18F-FDG PET/CT is potential in monitoring the tumor response to CRT in patients with advanced NSCLC.

MSRO36-07 Tumor Ablation versus Stereotactic Body Radiation Therapy (SBRT) for Treatment of Stage 1 Non-Small Cell Lung Cancer: A Propensity Score Matching Analysis

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S103CD

Awards

Student Travel Stipend Award

Participants

Jing Wang, BA, Providence, RI (*Presenter*) Nothing to Disclose

Aaron W. Maxwell, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

Elaine M. Tran, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

Richard N. Jones, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

Jaroslav Hepel, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

Thomas A. Dipetrillo, MD, Providence, RI (*Abstract Co-Author*) Research Consultant, Source Product Engineering Co Research Consultant, Accelerated Technologies

Damian E. Dupuy, MD, Providence, RI (*Abstract Co-Author*) Research Grant, NeuWave Medical Inc Board of Directors, BSD Medical Corporation Stockholder, BSD Medical Corporation Speaker, Educational Symposia

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PURPOSE

To compare patient- and treatment-level outcomes among patients with stage 1 non-small cell lung cancer treated with thermal ablation or stereotactic body radiation therapy (SBRT).

METHOD AND MATERIALS

This HIPAA-compliant study was performed following institutional review board approval with a waiver for informed consent. A retrospective review of the electronic medical record at our institution was performed to identify patients with biopsy-proven stage I non-small cell lung cancer who underwent treatment with thermal ablation or SBRT. A one-to-one propensity score-matched analysis was performed to identify intermodality differences in rates of overall disease progression, local tumor recurrence, and new metastatic disease. Overall survival was also compared between groups. Patient age, sex, tumor size, tumor stage, smoking history, and Charlson Comorbidity Index were used as matching variables. Statistical significance was set a priori at $\alpha < 0.05$.

RESULTS

A total of 249 patients met inclusion criteria, with 150 treated with thermal ablation and 99 treated with SBRT. 84 patients in each group were deemed satisfactory for matching. In the unmatched dataset, ablation patients were significantly older (75.33 years old vs 63.53 years, $p < .001$) and more likely to be current tobacco users. (23.3% vs 12.1%, $p = 0.027$). Following propensity score matching, these differences became nonsignificant; all other matching factors were insignificant pre- and post-matching. Ablation and SBRT showed no significant difference in overall disease progression (47.6% for ablation vs 39.3% for SBRT, $p = 0.276$). Ablation patients had a significantly higher local tumor recurrence rate (45.2% vs 20.2%, $p = .001$) but had a lower metastasis rate (2.4% vs 19.0%, $p < .001$). Overall mortality rates were comparable (15.5% for ablation vs 11.9% for SBRT, $p = .501$).

CONCLUSION

Among patients with stage I non-small cell lung cancer, thermal ablation and SBRT showed comparable rates of disease progression and overall survival using a propensity score-matched analysis. Observed local tumor recurrence rates were higher with ablation, while new metastatic disease occurred more frequently with SBRT.

CLINICAL RELEVANCE/APPLICATION

Thermal ablation yields comparable long-term clinical outcomes to stereotactic body radiation therapy among patients with stage I non-small cell lung cancer.

MSRO36-08 Participants

Role of Postoperative Radiotherapy (PORT) in Stage pN2 Non-Small-Cell Lung Cancer(NSCLC) Receiving Pneumonectomy

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S103CD

Wenhui Wang, Zhengzhou, China (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): For patients with resected stage pN2 NSCLC, adjuvant chemotherapy followed by PORT is the standard treatment option. However, for those who received pneumonectomy, the use of PORT has no definitive evidence about its effectiveness. This study is to evaluate the effect of PORT on survival and explore the role of PORT for such population. **Materials/Methods:** Between Jan. 2003 and Mar. 2015, patients with stage pN2 NSCLC who underwent pneumonectomy were retrospectively reviewed. Those who received adjuvant chemotherapy with or without PORT were included in this study. Platinum-based doublet chemotherapy of 4 cycles was used. Radiotherapy was performed by 3D-CRT/ IMRT to the total dose of 50-60 Gy. The effect of PORT on survival was evaluated by Kaplan-Meier method and log-rank test. Pearson chi-Square test was used to compare the constituent ratios between groups. Statistically significant difference was set as $p < 0.05$. **Results:** Among 108 patients with stage pN2 NSCLC who underwent pneumonectomy, 64 patients received adjuvant therapy, including 14 patients receiving sequential adjuvant chemotherapy and PORT, and 50 patients receiving chemotherapy alone. The characteristics of patients between the two groups were comparable ($p > 0.05$), which included gender, age, KPS, tumor site, preoperative lung function and pathological type, and et al. Of all the 64 patients, the median follow-up time was 25.5 months. The 1-, 3- and 5-year cancer specific survival (CSS) rates were 79.4%, 47.2% and 37%, respectively. The 1-, 3- and 5-year CSS rates were ----- in the PORT group, which were significantly better than those of ----- in the control group ($p = 0.041$). The median CSS time has not reached yet in the PORT group and was 34 months in the control group. The overall survival (OS) and distant metastasis free survival (DMFS) trended to be significantly increased in the PORT group than those in the control group ($p = 0.084$ and $p = 0.074$, respectively). However, the local recurrence free survival (LRF5) between the two groups was not statistically different ($p = 0.481$). Grade 3 or more radiation induced acute or chronic pneumonitis and esophagitis were not observed. There was no radiation toxicity related death. **Conclusion:** For patients with stage pN2 NSCLC after pneumonectomy and adjuvant chemotherapy, PORT may be considered as the treatment option, since it is safe and can improve the CSS, and trends to improve the OS and DMFS. Further verification of our result is needed in the future study.

MSR036-09 Dosimetric Comparison on the Accuracy of Dose Calculation Algorithms Measured in Inhomogeneous Phantom in the Case of Lung SBRT

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S103CD

Participants

Sarahatul Bahiah Yusoff, Singapore, Singapore (*Presenter*) Nothing to Disclose

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ABSTRACT

Purpose/Objective(s): Substantial dose inaccuracies can be shown in inhomogeneous regions due to loss of electronic equilibrium from loss of tissue or dose degradation at tissue interfaces. Lung SBRT typically is high dose in nature and therefore requires a sharp dose fall-off from the planning target volume (PTV) to the organs at risk (OAR). This study aims to evaluate the dosimetric comparison between dose distributions calculated with Acuros XB (AXB) grid-based Linear Boltzmann Transport Equation (LBTE) algorithm and X-ray Voxel Monte Carlo (XVMC) model based algorithm for patients undergoing lung SBRT. **Materials/Methods:** 12 Intensity Modulated Radiation Therapy (IMRT) and 12 Volumetric Modulated Arc Therapy (VMAT) treatment plans were created on the 0.1 cm CT study set slices of the inhomogeneous phantom targeting a 13.7cm³ PTV within the 598.1cm³ cedar insert (lung), 45 Gy at 9Gy/fraction was prescribed with 5 coplanar 6MV IMRT beams or 2 dynamic conformal arcs. Treatment planning variations included having more and different constraints onto the mock OARs. Plans were first optimized and calculated with AXB and then recalculated with XVMC utilising 0.3cm³ grid size. Dosimetric comparison for the 2 algorithms were performed and evaluated using independent software in terms of dose volume histogram (DVH) statistics related to PTV coverage and OARs doses, homogeneity (HI) and conformity (CI) indices. Dosimetric validation was performed with ion chamber measurements. **Results:** DVH results showed positive gains for IMRT calculated plans as compared to VMAT. AXB IMRT calculated plans yielded a minimum 95.0% coverage and global maximum of 113.0% for PTV; mean and maximum doses for lung at 20.8% and 114.0%; HI and CI at 0.123 and 1.017. XVMC IMRT calculated treatment plans yielded a minimum 94.8% coverage and global maximum of 125.8% for PTV, mean and maximum doses for lung at 20.2% and 128.5%; HI and CI of 0.245 and 1.022. Dosimetric validation showed that both algorithms agreed with measurements to within 3%. **Conclusion:** Both AXB and XVMC calculated treatment plans were able to meet our departmental requirements for treating lung SBRT cases. However, our experience found that AXB IMRT calculated plans showed optimal plans with better PTV coverage with lesser dose gradients, lowest lung dose as well as better HI and CI. This study confirms that AXB algorithm adequately accounts for doses within tissue inhomogeneities.

PS31

Tuesday Morning Plenary Session

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E451B



AMA PRA Category 1 Credits TM: 1.50
ARRT Category A+ Credit: .75

Participants

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;
Melissa C. Martin, MS, Signal Hill, CA (*Presenter*) Nothing to Disclose

Sub-Events

PS31A RSNA/AAPM Physics Symposium: Machine Learning in Radiology: Why and How?

Participants

Paul E. Kinahan, PhD, Seattle, WA (*Moderator*) Research Grant, General Electric Company; Co-founder, PET/X LLC

LEARNING OBJECTIVES

1) To learn what machine learning is, and how it is evolving. 2) To learn the current and potential impacts of machine learning and AI on radiology. 3) To learn how radiology can utilize machine learning and AI to improve outcomes.

PS31B Harnessing Artificial Intelligence

Participants

Keith J. Dreyer, DO, PhD, Boston, MA (*Presenter*) Nothing to Disclose

PS31C Assistive AI for Cancer Treatment

Participants

Antonio Criminisi, PhD, Cambridge, United Kingdom (*Presenter*) Employee, Microsoft Corporation

For information about this presentation, contact:

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RCA32

3D Printing (Mimics) (Hands-on)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S401AB



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, Stratasy, 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
Anji Tang, Boston, MA (*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, including 'wrapping' and 'smoothing' to enable the accurate printing of the desired anatomy, pathology, and model customizations using Computer Aided Design (CAD) software. 5) To become exposed to Standard Tessellation Language (STL) file format and interfacing with a 3D printer.

ABSTRACT

3D printing is gaining traction and momentum in the clinical setting, with constantly evolving advances in printing and software technologies. Recently, 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 used for clinical applications are created. 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. Musculoskeletal, body, neurological, and vascular systems and related pathologies will be segmented as part of this course and practically usable models will be created as part of this course to reflect the expanding applications of 3D printing. The purpose of this hands-on course is to convert a set of DICOM files into a 3D printed model through a series of simple 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 files in Standard Tessellation Language (STL). It is the STL format that is read by the 3D printer and used to reproduce a part of the patient's anatomy by depositing material in a layer-by-layer fashion. This 90 minute session will begin with a DICOM file and review the commonest tools and techniques required to create a customized printable STL model. 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 Educator Carlos H. Torres, MD, FRCPC - 2017 Honored Educator

RCB32

Learn Image Segmentation Basics with Hands-on Introduction to ITK-SNAP (Hands-on)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S401CD

IN

AMA PRA Category 1 Credits™: 1.50

ARRT Category A+ Credit: 1.75

Participants

Philip A. Cook, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Guido Gerig, Brooklyn, NY (*Presenter*) Nothing to Disclose

Andreas M. Rauschecker, MD, PhD, Philadelphia, PA (*Presenter*) Research Consultant, Enlitic, Inc

Jeffrey Rudie, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Paul Yushkevich, PhD, Philadelphia, PA (*Presenter*) Investigator, KinetiCor, Inc

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LEARNING OBJECTIVES

1) To use a free interactive software tool ITK-SNAP to view and manipulate 3D medical image volumes such as multi-parametric MRI, CT and ultrasound. 2) To label anatomical structures in medical images using a combination of manual and user-guided automatic segmentation tools.

ABSTRACT

Quantitative analysis of medical imaging data is increasingly relevant in a growing number of radiological applications. Almost invariably, such quantitative analysis requires some structures of interest (organs, tumors, lesions, etc.) to be labeled in the image. Labeling anatomical structures is a complex task, particularly when the imaging data is complex, such as in the case of multi-parametric MRI or fusion of different imaging modalities. ITK-SNAP is a free, open-source, and easy to use interactive software tool that allows users to view multiple image volumes of the same anatomy and label structures using information from all volumes concurrently. For example, ITK-SNAP allows users to label tumors (core, edema, necrosis) using a combination of T1-weighted, contrast-enhanced T2-weighted, T2-weighted and FLAIR MRI. ITK-SNAP provides easy to use user-guided automatic segmentation functionality rooted in statistical machine learning and deformable modeling algorithms, as well as built in tools for manual editing and correction of segmentations. ITK-SNAP runs on Windows, MacOS and Linux platforms. During this hands-on course, the participants will use ITK-SNAP to label organs and tumors in various imaging modalities. After completing the course, participants will be well equipped for performing quantitative analyses of medical image data using ITK-SNAP and other compatible free software tools.

RCC32

Cybersecurity for Imaging Departments and Imagers-Threats, Vulnerabilities and Best Practices: Part 2

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S501ABC



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

Participants

Christopher J. Roth, MD, Durham, NC (*Moderator*) Nothing to Disclose

Sub-Events

RCC32A What You Can Do for Your Organization to Combat Insider and External Threats

Participants

Lee Kim, JD, Arlington, VA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand what you can do to improve the security posture of your organization. 2) Learn about human threats to the confidentiality, integrity, and availability of information and what you can do to combat these threats. 3) Gain knowledge about insider threats within healthcare organizations and external threats that pose a risk to not just information security, but patient safety. 4) Discover how your healthcare organization can transform its security program with all hands on deck, thereby achieving holistic security throughout the organization.

ABSTRACT

Information security is not just an IT department initiative. Anyone who can create, receive, maintain, or transmit information should be safeguarding the information, regardless of the medium (paper, electronic, film, hardcopy). Much emphasis has been placed on external cyber-attacks, such as ransomware and distributed denial of service attacks. This emphasis needs to be sustained, as these cyber-attacks are projected to significantly increase in the future, but organizations also need to be keenly cognizant of the insider threat—the enemy within. By way of explanation, an insider is an individual with trusted access, regardless of whether he or she is an employee, intern, contractor, consulting, visiting researcher, or otherwise. An insider who breaches that trusted access is an insider threat actor. Insider threat is a significant problem that has plagued healthcare organizations, including the radiology departments within them, due to the rich amounts of information about patients. This presentation will explore how the "everyday worker" within an organization can make a significant, positive difference in the security posture of a healthcare organization with regard to insider threat and external threats—and how this intelligence can integrate into an organization's enterprise-wide security program.

Active Handout: Lee Kim

<http://abstract.rsna.org/uploads/2017/17002572/rsna-lk-2017-v2.5.pptx>

RCC32B The US Government and Medical Device Security

Participants

Robert Timpany, Idaho Falls, ID (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Understand US Government efforts in Medical Device Cybersecurity

RCC32C Highest Yield Privacy and Security Best Practices for Imagers: Minicourse Summary

Participants

Christopher J. Roth, MD, Durham, NC (*Presenter*) Nothing to Disclose

SPCP31

Israel Presents: Radiology in Israel— Experience from the Land of Innovation

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E353C

OT

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

FDA

Discussions may include off-label uses.

LEARNING OBJECTIVES

1) To present Radiology in Israel as a hub for technology development. 2) To highlight the interaction between technology development and clinical use. 3) To present examples of innovative approaches in diagnostic and interventional radiology.

Sub-Events

SPCP31A Overview of Radiology in Israel

Participants

Jacob Sosna, MD, Jerusalem, Israel (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To present a brief history of Radiology in Israel. 2) To describe the structure of Radiology services in Israel. 3) To highlight the close interaction between Imaging technology innovation centers and radiologists.

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/> Jacob Sosna, MD - 2012 Honored Educator

SPCP31B Advanced Technologies for the Evaluation of Crohn's Disease: Video Capsule Endoscopy, DWI in MRE and Biological Biomarkers

Participants

Marianne M. Amitai, MD, ramat Gan, Israel (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To present technological innovations in detecting inflammation and intestinal damage in Crohn's Disease. 2) To highlight the interaction between Diffusion Weighted Imaging in Magnetic Resonance Enterography and inflammatory biomarkers with Video Capsule Endoscopy, in Crohn's Disease patients. 3) To present the new treatment paradigm in Crohn's Disease based on the detection of Small Bowel Mucosal Healing and Deep Remission using advanced technologies. 4) To improve knowledge in quantitative indices of Video Capsule Endoscopy (the Lewis score) and Magnetic Resonance Enterography (MaRIA, Clermont, and Lemann indices).

SPCP31C Medical Computer Vision Applications Using Deep Learning Algorithms

Participants

Eyal Klang, Ramat Gan, Israel (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To enrich radiologists' knowledge of computer vision deep learning algorithms. 2) To provide intuitive understanding of deep learning convolutional neural networks (CNN). 3) To present deep learning solutions for computer-aided diagnosis in radiology.

ABSTRACT

The amount of digital visual data in the world is rapidly increasing. Categorization of these data using machine learning has recently attracted much interest, mainly due to the introduction of the convolutional neural network (CNN), a deep learning technology. CNN is a variation of artificial neural networks (ANN), which are loosely based on the processes in biological neural networks. The CNN algorithm trains a network using large databases of categorized images. After training, newly entered images can be automatically categorized when passed through the optimized network. CNN technology shows near-human accuracy in several image classification tasks. The field of radiology has large accumulations of digital databases, as hundreds of millions of multi-slice examinations are performed each year. The worldwide market size of radiological interpretation is estimated at tens of billions of dollars. Not surprisingly, IBM and many recently established start-up companies are targeting this market - trying to develop artificial intelligence solutions for medical image analysis. Radiology will likely change in the coming years, and radiologists should become familiarized with this new technology to adjust for possible changes in clinical practice and research. The purpose of this presentation is to provide an intuitive explanation of ANN and CNN.

SPCP31D Cutting-Edge Interventional Oncology

Participants

S. Nahum Goldberg, MD, Ein Kerem, Israel (*Presenter*) Consultant, AngioDynamics, Inc; Research support, AngioDynamics, Inc; Consultant, Cosman Medical, Inc;

SPCP31E Seeing the Bigger Picture: Israel's National Image Sharing Initiative

Participants

Arnon Makori, MD, Tel Aviv, Israel (*Presenter*) Medical Advisory Board, Carestream Health, Inc

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LEARNING OBJECTIVES

1) To present the Israeli National Image Sharing Initiative. 2) To list goals and benefits of an Image Sharing project. 3) To understand the technological challenges facing the implementation of a National Image Sharing system. 4) To be familiarize with the different types of Image Sharing solutions and standards. 5) To identify policies and best practices in the deployment process of Image Sharing system.

ABSTRACT

In the era of value driven health care, Image Sharing (IS) plays a vital role by enabling a secure patient centric access to imaging studies and reports across organizations. By creating a consolidated infrastructure IS systems aim to eliminate the fragmented nature of healthcare. Image Sharing systems provide an immediate 'on the fly' access to previous imaging studies, from multiple providers, enhancing quality of care. In addition, teleradiology and remote consultation are also being facilitated by IS promoting the collaboration between caregivers. This presentation will outline the Israeli National Image Sharing Initiative, a government driven project, aiming to connect over 45 general hospitals and 4 Health Maintenance Organizations (HMO) that provide care to 8.7 million people. Due to information security regulation a decentralized system architecture was achieved by coupling the IS to the national Health Information Exchange (HIE) system. The selection of an advance, state of the art, zero footprint client will lead to a highly improved clinical workflow integration. Currently the Image Sharing Initiative deployment is in its initial deployment phase and is planned to be complete within the next 2 years.

SPCP31F Hyperbaric Oxygen Therapy in Traumatic Brain Injury Patients

Participants

Sigal Tal, MD, Zefiin, Israel (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the usage of hyperbaric oxygen chamber treatment (HBOT). 2) Describe the mechanism of treatment and the role of hyperbaric oxygen in HBOT. 3) Identified minor TBI. 4) Describe the value of perfusion MRI for evaluated the results of treatment. 5) Describe the value of DTI for evaluated the results of treatment.

ABSTRACT

Background Recent clinical studies in patients with chronic neurological impairment due to stroke or traumatic brain injury (TBI) present evidence that hyperbaric oxygen therapy (HBOT) can induce neuroplasticity. **Objective** To assess the neurotherapeutic effect of HBOT in patients suffering from prolonged post-concussion syndrome (PPCS) due to TBI using brain microstructure imaging. **Methods** Fifteen patients afflicted with PPCS were treated with 60 daily HBOT sessions. Imaging evaluation was performed using Dynamic Susceptibility Contrast-Enhanced (DSC) and Diffusion Tensor Imaging (DTI) MR sequences. Cognitive evaluation was performed by objective computerized battery (NeuroTrax). Results HBOT was initiated 6 months to 27 years (10.3±3.2 years) from injury. After HBOT, DTI analysis showed significantly increased fractional anisotropy values and decreased mean diffusivity in both white and gray matter structures. In addition, the cerebral blood flow and volume were increased significantly. Clinically, HBOT induced significant improvement in the memory, executive functions, information processing speed and global cognitive scores. **Conclusions** The mechanisms by which HBOT induces brain neuroplasticity can be demonstrated by highly sensitive MRI techniques of DSC and DTI. HBOT can induce cerebral angiogenesis and improve both white and gray microstructures indicating regeneration of nerve fibers. The micro structural changes correlate with the neurocognitive improvements.

SPCP31G Novel Applications of 3D Printing

Participants

Arye Blachar, MD, Tel Aviv, Israel (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review and present 3D printing technology. 2) Familiarize Radiologists with various applications of the technology and their benefits. 3) Demonstrate our experience with 3D printing showing various cases.

ABSTRACT

Medical 3D Printing Innovative Clinical Application Along the development of 3D printing technology in the past 2 decades, medical dedicated software were developed to convert DICOM files and create 3D printed models (STL files), as first step into 3D surgical planning process. Segmentation, surgical planning in CAD and Patient Specific Instrument's (PSI) design, model & PSI printing, are allowing surgical accuracy by better surgical planning and visualization, improved understanding of surgical challenge in complex cases and producing accurate PSI surgical tools. Development of new Medical 3D printing materials is allowing to mimic human tissues and enables to plan and prepare for surgery on models with real tissues feel-like and textures. Exploring the benefits of this new interface printing applications and new materials, Sourasky Medical Center 3D hub in Israel have used the 3D applications in more than a dozen different surgical disciplines, on many different clinical cases: Patient specific bio-mimic vessel models, created to simulate angiogram catheterization with vessels walls properties compatible with human, and practice stent and coil's placements, preventing anticipated ruptures; Bio-mimic printed kidneys allowed to plan and simulate tumor resections preserving healthy kidney tissues; Bones printed simulated tumor resections, bone deformities, and allowed growth plates and joint sparing; Deformed infant skulls printed to plan and simulate complex reconstructions; Brain and base of skull tumor models printed with

adjacent vasculature for better understanding of surgical approach, anticipating fatal bleeding. And many more such examples. All clinical applications used, as mentioned above, are sharing the same benefits of surgical accuracy, shortened surgical time and less complications. Still, process is not optimal as it relays on multiple software, data loss through conversions, and no standardization. However, 3D printing technology is evolving rapidly, with developmental focus on bridging between radiology and printing. Much of the effort goes into printing directly from DICOM files, and imaging companies push to integrate CAD and printing features. This new 3D platform is revolutionary in the surgical arena, and calls for a new dialog between radiologists and surgeons.

SPCP31H MRgFUS: Spectrum of Clinical Applications

Participants

Yael Inbar, MD, Ramat Gan, Israel (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To present MR guided focused ultrasound technology. 2) To present a spectrum of current clinical applications and future horizons. 3) To present our experience using this technology, from the early days of research to the widely accepted technology of today.

SPCP31I Closing Remarks from RSNA

Participants

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

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/> Richard L. Ehman, MD - 2016 Honored Educator

SSG01

Breast Imaging (Ultrasound Diagnostics)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E451A

BR **US**

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

FDA Discussions may include off-label uses.

Participants

Donna M. Plecha, MD, Strongsville, OH (*Moderator*) Research Grant, Hologic, Inc;
Susan Weinstein, MD, Philadelphia, PA (*Moderator*) Consultant, iCAD, Inc

Sub-Events

SSG01-01 A Multi-center Study of ABUS for the Diagnosis of Breast Cancer in China

Tuesday, Nov. 28 10:30AM - 10:40AM Room: E451A

Participants

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PURPOSE

Mammography (MAM) is the first choice of breast screening. However, its practicability is limited in Asian due to dense breast. Meanwhile, hand held ultrasound (HHUS) has obvious operator dependence and poor repeatability. Automated Breast Ultrasound System (ABUS) is a potential method to alleviate current challenges. This study aims to evaluate the initial effectiveness of ABUS by comparing it with Hand Held Ultrasound (HHUS) and Mammography (MAM) in a hospital-based multi-center study.

METHOD AND MATERIALS

Women between the ages of 30 to 69 who visited breast surgeons for the first time without visible, suspicious signs of breast cancer were eligible for our study. All participants underwent HHUS and ABUS, and women in the older group (40 to 69 years old) also received MAM. Image interpretations were done without knowledge of clinical or other imaging results. Lesions classified as BI-RADS 4 or 5 were considered to be "suspicious", and BI-RADS 1 to 3 lesions were assessed as "benign". So far, 1010 eligible women had been enrolled and 656 in the older group. Taking breast as the unit of analysis, we had acquired 2020 HHUS results, 2020 ABUS results and 1312MAM results. The consistency rates and Kappa statistics were calculated to assess the reliability of ABUS compared with HHUS or MAM.

RESULTS

The average subject age was 45.32 (SD 9.756) in the whole group and 50.82 (SD 7.489) in the older group. Of all the 2020 breasts, HHUS detected 395 suspicious lesions and ABUS detected 356 suspicious lesions. Among the 395 suspicious lesions detected by HHUS, ABUS detected 327; In the older group, ABUS detected 275 suspicious lesions and MAM detected 259 suspicious lesions. Among the 259 suspicious lesions detected by MAM, only 41 lesions were undetected by ABUS. Among the 275 lesions detected by ABUS, only 57 were not detected by MAM. Specifically, the consistency rate between HHUS and ABUS was 95.2%, and that between ABUS and MAM was 92.53%. The Kappa value between ABUS and HHUS was 0.8414 and that of ABUS and MAM in the older group was 0.7696.

CONCLUSION

Fairly good reliability was observed in comparisons between ABUS and HHUS or MAM in our initial analysis. It is feasible for all the radiologists with a short term of training of ABUS to have similar lesion interpretation as HHUS or MAM by specialists. ABUS is a promising modality in breast imaging.

CLINICAL RELEVANCE/APPLICATION

ABUS is a promising modality in breast imaging.

SSG01-02 Tumor Doubling Time of Breast Cancer Measured By Ultrasonography: Correlation with Tumor Subtype, Ki-67 Value and Nuclear Grade

Tuesday, Nov. 28 10:40AM - 10:50AM Room: E451A

Participants

Kazuaki Nakashima, MD, Nagaizumi, Japan (*Presenter*) Nothing to Disclose
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Kaoru Takahashi, MD, Nagaizumi, Japan (*Abstract Co-Author*) Nothing to Disclose
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Takashi Sugino, MD, Nagaizumi, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate tumor doubling time (DT) of breast cancers using ultrasonography and compare DT with tumor subtypes and histopathological findings.

METHOD AND MATERIALS

We included 262 patients with invasive breast carcinomas who received serial ultrasonography (US) at least twice during preoperative period from April 2014 to September 2016. The mean interval between initial and second US was 56.5 days (range, 12-119). Ultrasound examinations were performed by four experienced ultrasonographers. Tumor diameters were measured in three directions and tumor volumes were approximated by ellipsoids. The DT was calculated according to the Collins method from the interval between US examinations and the change in tumor volume. We also compared DT with tumor subtypes, Ki-67 values and nuclear grades. Tumor subtypes were defined as luminal (ER+/HER2-), luminal-HER2 (ER+/HER2+), HER2 (ER-/HER2+), and triple negative (ER-/HER2-).

RESULTS

The mean tumor volume at initial and second US were 2994 mm³ and 3299 mm³, respectively. The observed volume did not change in 94 of 262 (36%) tumors between initial and second US and increased in 124 of 207 (60%) luminal, 12 of 15 (80%) luminal-HER2, 9 of 13 (69%) HER2, and 23 of 27 (85%) triple-negative tumors. Triple-negative tumors showed volume increase more frequently than luminal tumors ($p = 0.011$). Mean DT of luminal tumors was longer than that of triple-negative tumors (190 and 128 days, respectively; $p = 0.042$). Volume-increased tumors had significantly higher Ki-67 values than those of volume-stable tumors (all subtypes, 31 vs 18; $p < 0.001$, luminal, 24 vs 17; $p = 0.002$) and higher nuclear grades (all subtypes, 1.77 vs 1.41; $p = 0.001$, luminal, 1.50 vs 1.29; $p = 0.022$). In triple-negative tumors, Ki-67 values of short DT (< 90 days) tumors were significantly higher than those of long DT (> 90 days) tumors (mean, 83 and 41, respectively; $p = 0.005$).

CONCLUSION

The difference of tumor growth rate depending on breast cancer subtype, Ki-67 value and nuclear grade was confirmed by measuring DT using ultrasonography.

CLINICAL RELEVANCE/APPLICATION

Considering breast cancer subtypes and other pathological factors are helpful in predicting tumor growth rate and planning surgical waiting time or neoadjuvant chemotherapy.

SSG01-03 The Importance of Peritumoral Comparisons by Ultrasound Tomography: Radiomics and Breast Mass Discrimination

Tuesday, Nov. 28 10:50AM - 11:00AM Room: E451A

Participants

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PURPOSE

Ultrasound tomography (UST) provides quantitative whole breast imaging that may improve the specificity of breast cancer screening and diagnoses by combining reflection (REF), attenuation (ATT) and speed of sound (SS) imaging. We assessed whether multiple image analyses of radiomics could improve discrimination of benign from malignant masses.

METHOD AND MATERIALS

This HIPAA compliant, IRB approved trial accrued 115 patients with 161 breast masses. Sequential coronal REF images and quantitative transmission imaging of SS (m/sec) and ATT (dB/cm/MHz) were generated at 2mm spacing. For each mass, an experienced breast radiologist characterized tumor-peritumoral regions on a 5-point BIRADS-like margin boundary (MB) score ranging from well circumscribed to highly spiculated. Masses were outlined by a hand-drawn vs. simple ellipse ROI that generated an intra-tumoral (IT) and an outer radial peri-tumoral (pT) ROI (see Figure). Extensive radiomics parameters were analyzed to address quantitative and textural differences between benign and malignant masses and their IT:pT comparisons. Supervised learning techniques were applied to generate classifier models.

RESULTS

68 cancers, 55 fibroadenomas and 38 cysts were analyzed. Cancers had more irregular margins (N=47/68 with MB \geq 4) than cysts or fibroadenomas (0 total with MB \geq 4) (p<0.0001). Using only the radiologist's MB score with a cut-point of MB \geq 3, a sensitivity (SEN) of 82%, specificity (SPE) of 91%, and a positive predictive value (PPV) of 88% was noted. 520 radiomic features were reduced to 47 with the greatest information gain, of which more pT than iT metrics were preserved. Morphological metrics from the hand-drawn contour gave similar results to the MB. Combining radiomics from the elliptical ROI and MB data using a support vector machine classifier gave SEN=82%, SPE=95%, and PPV=97%.

CONCLUSION

Radiomics and supervised learning techniques can improve radiologists' discrimination of breast masses by quantifying iT and pT textural detail to potentially improve biopsy PPV for an ongoing UST screening trial.

CLINICAL RELEVANCE/APPLICATION

A rapidly implemented ROI tool during future breast cancer screening by whole breast UST can gather sufficient radiomics data to support reductions in call-backs and biopsies. UST radiomics requires validation by a large number of breast masses.

SSG01-04 Associations Between the Ultrasound Features of Invasive Breast Cancer and Breast Cancer Specific Survival

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E451A

Participants

Brooke Lawson, MD, Dundee, United Kingdom (*Presenter*) Nothing to Disclose
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PURPOSE

Pre-operative prognostic information is useful when treating women with breast cancer especially with regard to assessing the appropriateness of neoadjuvant chemotherapy. The aim of this study is to identify associations between the ultrasound (US) features of invasive breast cancer and breast cancer specific survival (BCSS).

METHOD AND MATERIALS

287 consecutive women within a single breast service (mean age 63 yrs) with US visible invasive breast cancers were documented prospectively between January 2010 and December 2012. The US features of the lesions were evaluated retrospectively from the recorded images according to the BI-RADS US lexicon by a breast radiologist blinded to outcomes. Survival, including cause of death, was ascertained from local and national sources. Kaplan-Meier survival curves were generated and statistical significance ascertained using the Log-Rank test.

RESULTS

Twenty seven breast cancer deaths and 31 non-breast cancer deaths occurred in the sample. Mean follow-up in those alive is 5.5 years. Distal acoustic enhancement was associated with a 72% 5 year BCSS compared to 93% and 97% for those with distal shadowing or no distal effect (p<0.0001). Skin involvement (either direct invasion or skin thickening over the mass) was associated with 78% 5 year BCSS compared to 94% in women without skin involvement (p=0.0001). Women in the highest tertile of US lesion diameter had a 5 year BCSS of 83% compared to 96% for women in the middle and smallest tertiles (p=0.0004). Mass shape, echogenicity and margin characteristics, orientation or BIRADS score were not associated with BCSS.

CONCLUSION

The presence of distal acoustic enhancement and skin involvement at US have strong associations with breast cancer death and these factors should be taken into account along with lesion size and other conventional prognostic features when considering management of women with invasive breast cancer. Our study is limited by a small sample size and relatively short follow-up. Further studies evaluating larger number of patients to assess patient outcomes will be of value.

CLINICAL RELEVANCE/APPLICATION

Distal acoustic enhancement and skin involvement at US seem to be poor prognostic factors strongly associated with breast cancer death, meriting consideration in initial management of breast cancer.

SSG01-05 Optoacoustic Imaging Detects Changes in Breast Parenchyma in Relation to Hormonal Status of Healthy Female Volunteers: An Important Step in Clinical-Translation

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E451A

Participants

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PURPOSE

Optoacoustic imaging (OPUS) is an emerging clinical imaging modality that allows the assessment of tissue oxygenation through surrogate measures of oxy/deoxy and total hemoglobin. One of the first steps in establishing the clinical utility of an imaging technique is to evaluate its technical ability to depict the appearances of normal tissue and the impact of normal physiology on the imaging readout. The aim of our study was to evaluate the ability of OPUS to detect tissue oxygenation and vascularity changes in relation to hormonal status.

METHOD AND MATERIALS

Following IRB approval this prospective study was performed between January and July 2016. 22 pre-menopausal and 8 post-menopausal volunteers were recruited. Pre-menopausal volunteers were scanned using OPUS (700, 800 and 850 nm wavelengths) in the proliferative/follicular (day 5-14) and secretory phases (day 21-28) of the menstrual cycle. Repeatability data was available in 16 volunteers. Regions of interest for quantitative analysis were drawn on the most superficial region of fibroglandular tissue as determined by ultrasound in the left breast. Statistical analysis of the mean signal intensity of the ROIs was performed in GraphPad Prism (ANOVA, linear regression and t tests).

RESULTS

Optoacoustic intensity rose significantly at all wavelengths: the mean values at 700, 800 and 850nm rose from 14.45, 14.47, 13.14 in the proliferative phase to 18.37, 18.14, 17.18 in the secretory phase ($p < 0.01$). Post-menopausal volunteers showed similar optoacoustic features and values to the proliferative/follicular phase. Our hand-held probe showed high test-retest correlation ($r = 0.72-0.81$).

CONCLUSION

OPUS shows comparable repeatability to other hand-held breast imaging modalities and sensitively detects the expected changes in breast parenchyma vascularity during the menstrual cycle in healthy volunteers.

CLINICAL RELEVANCE/APPLICATION

When developing a new technique to evaluate breast disease e.g. optoacoustic imaging, it is important to establish the baseline variation of normal and use known physiological changes and repeatability data to refine and validate quantification of image intensity.

SSG01-06 Shear Wave Velocity of the Lesion in Preoperative Breast Ultrasonography: Association with Disease-Free Survival of Patients with Primary Operable Invasive Breast Cancer

Tuesday, Nov. 28 11:20AM - 11:30AM Room: E451A

Participants

Youichi Machida, MD, PhD, Chuo Ward, Japan (*Presenter*) Nothing to Disclose
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Hidemi Okuma, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Eisuke Fukuma, Kamogawa, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the relationship between shear wave velocity (SWV) of the lesion in preoperative breast ultrasonography (US) and disease-free survival in patients with primary operable invasive breast cancer.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board. The requirement for informed consent was waived. A total of 195 consecutive newly diagnosed invasive breast cancer patients (age 33-83 years; mean 54.0 years) who had undergone preoperative breast US with SWV measurement of the lesion and surgery between May 2012 and May 2013 were identified. SWV was measured at the center and three marginal zone in breast lesions using a 5 × 5 mm region of interest, and the maximum value was used. For 35 patients who underwent primary systemic therapy (PST), the maximum SWV before PST was used. Cox proportional hazards modeling was used to identify the relationship between clinical-pathologic factors and disease-free survival.

RESULTS

Fourteen recurrences occurred at 6-47 months (mean 22.3 months) after surgery. Larger lesion size (hazard ratio [HR] = 1.034; 95% confidence interval [CI]: 1.002, 1.066; $P = 0.037$), negative estrogen receptor status (HR = 0.335; 95% CI: 0.112, 0.999, $P = 0.049$), negative progesterone receptor status (HR = 0.274; 95% CI: 0.095, 0.789, $P = 0.016$), overexpression of human epidermal growth factor receptor-2 (HR = 4.109; 95% CI: 1.375, 12.282, $P = 0.011$), positive PST (HR = 6.754; 95% CI: 2.342, 19.481, $P < 0.001$), and higher maximum SWV (HR = 1.616; 95% CI: 1.113, 2.348, $P = 0.012$) were associated with poorer outcomes at univariate analysis. At multivariate analysis, positive PST (HR = 6.502; 95% CI: 2.248, 18.802, $P = 0.001$) and higher maximum SWV (HR = 1.583; 95% CI: 1.102, 2.275, $P = 0.013$) were associated with poorer disease-free survival.

CONCLUSION

Higher maximum SWV in preoperative US was significantly associated with poorer disease-free survival of patients with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION

SWV in preoperative US of primary operable invasive breast cancer could be useful for assessing disease-free survival after surgery.

SWW in preoperative US of primary operable invasive breast cancer could be useful for assessing disease-free survival after surgery.

SSG01-07 Breast Ultrasound Utilization in the Emergency Setting: Can We Do Better?

Tuesday, Nov. 28 11:30AM - 11:40AM Room: E451A

Participants

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PURPOSE

To assess the clinical utility of breast ultrasound (US) performed in the emergency department (ED) for suspected breast abscess and to determine factors associated with confirmed abscess.

METHOD AND MATERIALS

Retrospective analysis of 581 consecutive breast US to evaluate for abscess in a large safety-net ED over a 15 month period was performed. Imaging results, demographics, laboratory data, and physical exam findings were reviewed. Breast abscess, defined by the presence of a fluid collection with clinical signs and symptoms of infection, was confirmed by a combination of US results, clinical findings, laboratory data, and when possible, the presence of purulent fluid.

RESULTS

Of the 581 US performed for suspected abscess, final diagnoses included: abscess (26%, n=150), malignancy (5%, n=27), granulomatous mastitis (5%, n=31), normal (21%, n=122) and other (including indeterminate, 43%, n=251). Clinical factors predictive of abscess on multivariable analysis included physical exam findings (induration, fluctuance, erythema, and drainage), smoking, and race. Based on these factors, the area under the curve (AUC) was 0.83 (CI 0.80-0.87) for the detection of abscess. The presence of temperature > 38 degrees Celsius and leukocytosis were not significant. Of 49 US performed for pain in the absence of additional physical exam findings, only 1 was positive for an abscess. Additional studies were recommended in 308 US, with 248 due to technical inadequacy or the need for mammographic evaluation. Six breast cancers were either not demonstrated or not diagnosed on US performed in the ED.

CONCLUSION

Breast US in the ED is overutilized and has limited clinical value given the low positivity rate, the need for repeat exams, and the risk of missed cancers. Use of both clinical findings and patient demographics can improve patient selection for and diagnostic utility of US to reduce unnecessary exams. Patients with a low likelihood of abscess should be imaged in a more optimal setting.

CLINICAL RELEVANCE/APPLICATION

This study will help clinicians better utilize emergent breast US services.

SSG01-08 Utility of Real-Time Breast Ultrasound Examination after Second Opinion Review of Submitted Studies in a Comprehensive Cancer Center

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E451A

Participants

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PURPOSE

To determine if real-time diagnostic breast ultrasound evaluation after reinterpretation of submitted static ultrasound images at a comprehensive cancer center impacts clinical management, specifically by detecting additional cancer and preventing unnecessary biopsy.

METHOD AND MATERIALS

Retrospective HIPAA compliant IRB-approved review was performed of submitted breast ultrasound studies between January 2013 and May 2014 for 209 patients seeking second opinions for which real-time ultrasound re-evaluation (RTUR) at our institution was recommended to characterize lesions depicted on the submitted static images. Each case was evaluated for concordance between the original report and diagnostic RTUR. Second-opinion review and subsequent RTUR resulting in recommendation and performance of new biopsies was subdivided into benign, high-risk, and malignant based on histopathology obtained at our institution. Statistical analysis of new recommendations for biopsy and biopsies averted after RTUR was performed.

RESULTS

Mean patient age was 57 years (range, 17-91). Average time between outside exam and RTUR was 31 days (range, 2-90). Following RTUR, 49 additional biopsies of lesions not originally recommended for biopsy were performed in 43/209 patients (20.1%; 95% CI

14.6-25.6%). 12/49 (24.5%) biopsies yielded cancer in 11/209 patients (5.3%; 95% CI 3.8-6.8%) and 4/49 (8.2%) high-risk lesions in 4/209 patients (1.9%; 95% CI 0-3.8%). 41 biopsies in 32 patients originally recommended were canceled after RTUR. One biopsy was subsequently performed due to ipsilateral multifocal carcinoma. Of 31/209 (14.8%; CI 10.0-19.6%) patients with biopsies averted, 20/31 (64.5%) had 1-year follow-up and 17/31 (54.8%) 2-year follow-up showing stability of RTUR findings. Overall, change in management after RTUR in 68/209 patients (32.5%; 95% CI 26.1-38.9%) yielded 12 additional cancers, 4 high-risk lesions and averted biopsy of 40 lesions.

CONCLUSION

RTUR after reinterpretation of submitted static ultrasound images at a comprehensive cancer center resulted in 49 additional biopsies, detecting 12 additional cancers, 4 high-risk lesions and averted 40 biopsies in 68 patients. RTUR led to a change in management in approximately 1/3 of patients.

CLINICAL RELEVANCE/APPLICATION

Real-time ultrasound re-evaluation after second opinion review of outside breast ultrasound studies can detect additional cancers and high-risk lesions and avert unnecessary biopsies.

SSG01-09 Shear Wave Elastography of the Breast Lesions: Quantitative Analysis of the Heterogeneous Elasticity Improves the Diagnosis Performance

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E451A

Participants

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PURPOSE

To evaluate whether addition of quantitative analysis of the heterogeneous elasticity (Ehetero) could improve the diagnosis performance of shear wave (SW) elastography in breast cancers.

METHOD AND MATERIALS

From October 2015 to February 2017, 239 patients with 255 breast lesions (126 benign, 129 malignant) were enrolled in this study. All lesions were evaluated with ultrasound Breast Imaging Reporting and Data System (BI-RADS) and VirtualTouch IQ shear wave elastography. Three region of interests (ROI) were placed over the highest stiffness or lowest stiffness area of the lesions to measure the SW velocity (SWV), respectively, and low SW quality area was avoided. Ehetero was determined as the difference between the averaged highest SWV and lowest SWV. The cut-off values for SWVmax and Ehetero were 5.06 m/sec and 1.44 m/sec, respectively. The diagnosis performances including area under the receiver operating characteristic curve (AUC), sensitivity, specificity, positive and negative likelihood ratio were determined for BI-RADS, SWVmax and Ehetero.

RESULTS

Ehetero showed the highest AUC (0.953; 95% confidence interval [CI]: 0.924 - 0.983), which was significantly higher than SWVmax (0.938; 95% CI: 0.908 - 0.968) ($P<0.001$) and BI-RADS (0.705; 95% CI: 0.662 - 0.748) ($P<0.001$), with a positive likelihood ratio of 19.53 (95% CI: 8.9 - 42.7) and a negative likelihood ratio of 0.07 (95% CI: 0.04 - 0.10). The sensitivity of Ehetero was 93.02% (95% CI: 87.2% - 96.8%), which was significant higher than SWVmax (83.72%, 95% CI: 76.2% - 89.6%) ($P<0.001$), while there was no significant difference for the specificity between Ehetero (95.24%, 95% CI: 89.9 - 98.2) and SWVmax (92.86%, 95% CI: 86.9 - 96.7) ($P=0.375$). Twelve of the Ehetero positive cancers were misdiagnosed by SWVmax and none of the SWVmax positive cancers was misdiagnosed by Ehetero. When to downgrade BI-RADS category 4a lesions, 3 of 12 malignancies would be misdiagnosed by using SWVmax along, while only 1 would be misdiagnosed by using Ehetero.

CONCLUSION

Quantitative analysis of the heterogeneous elasticity can improve SW elastography sensitivity in breast cancer detection, without losing of specificity.

CLINICAL RELEVANCE/APPLICATION

When using elastography to downgrade BI-RADS category 4a breast lesions, addition of quantitative analysis of the heterogeneous elasticity could decrease misdiagnosis.

SSG02

Cardiac (Coronary Artery Disease: Techniques)

Tuesday, Nov. 28 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

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Sub-Events

SSG02-01 Inter-observer Agreement for the Coronary Artery Disease Reporting and Data System (CAD-RADS)

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S504AB

Participants

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PURPOSE

To prospectively evaluate the inter-observer agreement of readers who used CAD-RADS to classify coronary CT angiography (CCTA) exams, including assessment categories and modifiers.

METHOD AND MATERIALS

Four junior readers with less than 5 years' experience, and four senior readers with greater than 5 years' experience prospectively evaluated 50 CCTA cases using the CAD-RADS lexicon. All readers assessed image quality using a five-point Likert scale, with mean Likert score ≥ 4 designating high image quality, and < 4 designating moderate/low image quality. All readers were blinded to medical history and invasive coronary angiography findings. Inter-observer agreement for CAD-RADS assessment categories and modifiers were assessed using intra-class correlation (ICC) and Fleiss' Kappa (κ). As a secondary endpoint, inter-observer agreement of high-risk plaque (modifier "V") was examined, including spotty calcification (SC), napkin ring sign (NRS), low attenuation plaque (LAP), and positive remodeling (PR).

RESULTS

Inter-observer agreement among all readers for CAD-RADS assessment categories was very strong (ICC 0.958, 95% CI 0.938-0.974). Agreement among senior readers (ICC 0.925, 95% CI 0.884-0.954) was marginally stronger than for junior readers (ICC 0.904, 95% CI 0.852-0.941). High image quality was associated with stronger agreement (ICC 0.944, 95% CI 0.886-0.974) than moderate/poor image quality (ICC 0.887, 95% CI 0.775-0.95). Overall inter-observer agreement for high-risk plaque (modifier "V") was fair (κ 0.40). There was fair inter-observer agreement for each high-risk plaque feature (κ 0.29 for SC, κ 0.25 for NRS, κ 0.24 for LAP, and κ 0.34 for PR).

CONCLUSION

Reproducibility of CAD-RADS assessment categories and modifiers is strong, except for high-risk plaque (modifier "V") which demonstrates fair agreement. A trend towards lower concordance was observed among junior readers and among cases with moderate/poor image quality.

CLINICAL RELEVANCE/APPLICATION

There is strong inter-observer agreement for classifying coronary CTA exams using the CAD-RADS lexicon, supporting its utility in clinical practice.

SSG02-03 Diagnostic Efficacy of Model-Based Iterative Reconstruction Algorithm in Assessment of Coronary

Artery in Comparison with Standard Hybrid-Iterative Reconstruction Algorithm: Dose Reduction and Image Quality

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S504AB

Participants

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PURPOSE

To evaluate the image quality and radiation dose exposure of low-dose coronary CTA (cCTA) study, reconstructed with the new model-based iterative reconstruction algorithm (IMR), compared with standard iDose4 cCTA in patients with suspected coronary artery disease (CAD).

METHOD AND MATERIALS

Fifty-four patients with indication for coronary CT study were prospectively enrolled. Twenty-nine patients (study group) underwent 256-MDCT (iCT elite, Philips) cCTA using low-dose protocol (100kV; automated tube-current modulation with a range of 100-330 mAs; CM volume of 50mL) combined with prospective ECG-triggering acquisition and IMR (Philips). A control group of 25 patients underwent 256-MDCT (Brilliance iCT, Philips) with a standard prospective ECG-gated protocol (100kV; automated modulation with a range of 200-400 mAs; iDose4 reconstruction) with the same amount of CM. On both CT examinations ROIs were manually placed in the lumen of the coronary arteries to calculate intravessels density, standard deviation of pixel value and signal-to-noise ratio (SNR); subjective image quality was also evaluated by 2 radiologists using a 4-point scale score. Finally radiation dose exposure were quantified as DLP, CDTIvol and ED.

RESULTS

No differences were found in patients characteristics. Mean values of mAs were significantly lower for IMR-cCTA (144 mAs) compared to iDose-cCTA (437 mAs), $p < 0.001$. Despite the significant reduction of 60% in radiation dose exposure (DLP: IMR-cCTA 76.7mGy*cm vs iDose-cCTA 195.1mGy*cm; p -value < 0.002), we found no differences in the mean attenuation values of the coronary arteries (mean density in LAD: 441.8 HU IMR-cCTA vs 425.6 HU iDose-cCTA; $p = 0.34$). We observed a significant higher value of SNR and CNR in study group due to a lower noise level. Qualitative analysis did not reveal any significant differences in diagnostic quality of the two groups (mean score: IMR-cCTA 3.30 vs iDose-cCTA 3.21; $p = 0.47$).

CONCLUSION

Low-dose cCTA study combined to IMR reconstruction allows to correctly evaluate coronary arteries disease, offering high quality images and significant radiation dose exposure reduction, as compared to standard cCTA protocol, with 66 sec of reconstruction time.

CLINICAL RELEVANCE/APPLICATION

Low-dose IMR-cCTA study is a valid imaging tool for the assessment of coronary arteries in patients with suspected CAD, allowing a radiation dose sparing of 60%.

SSG02-04 A Tailored Tube-Voltage Adapted Contrast Media Injection Protocol for Coronary CT Angiography

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S504AB

Participants

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PURPOSE

While traditionally most CT studies had been performed with a standard 120kVp setting, x-ray tube acquisition parameters are increasingly individualized to the patient body habitus and type of examination. On current generation CT systems this is often accomplished by automated tube voltage selection (ATVS) algorithms. We propose a simple, kVp-tailored contrast media (CM) injection protocol for coronary CT angiography (CCTA) involving ATVS.

METHOD AND MATERIALS

Based on results of a previous phantom study, patients referred for non-emergent CCTA were prospectively enrolled. CCTA exams were performed on a 3rd generation dual-source CT scanner. Based on ATVS, patients were divided into 7 groups and scanned in

10 kVp increments at kVp levels ranging from 70 to 130 kVp. CM (370mgI/mL iopromide) was injected constantly for 12 seconds, adapting the iodine delivery rate (IDR) to the kVp level. Average CM volumes were as follows: 35mL at 70 kVp, 39mL at 80 kVp, 45mL at 90 kVp, 50mL at 100 kVp, 56mL at 110 kVp, 60mL at 120 kVp, and 70mL at 130 kVp. An attenuation value of 250 Hounsfield Units (HU) in the left main coronary artery was considered diagnostic. Contrast-to-noise ratio (CNR) was calculated for each protocol. Subjective image quality was assessed using a 5-point Likert scale.

RESULTS

Diagnostic vessel attenuation was achieved with all protocols in all patients. Mean vessel attenuation was 377 HU at 70 kVp, 355 HU at 80 kVp, 326 HU at 90 kVp, 325HU at 100 kVp, 320 HU at 110 kVp, 306 HU at 120 kVp, and 286 HU at 130 kVp. The 70kVp protocol achieved the highest average attenuation (377 HU), significantly higher than protocols ≥ 110 kVp ($P < 0.001$). The 80kVp protocol rendered the highest CNR (20.3), comparable to 70kVp and 90kVp (17.9 and 14.3, respectively; $P > 0.05$), while significant differences were found with ≥ 100 kVp protocols ($P > 0.01$). No significant differences were found in subjective image quality ($P = 0.691$).

CONCLUSION

The proposed kVp-tailored CM injection protocol allows for substantial reductions in CM administration while maintaining diagnostic vessel attenuation in CCTA.

CLINICAL RELEVANCE/APPLICATION

Individual tailoring of CM volume administration to the acquisition potential selected by automated tube voltage selection algorithms is feasible, relatively straightforward, and decreases the amount of CM administration required for diagnostic CCTA exams.

SSG02-05 Diagnostic Accuracy Comparison of Low and High Tube Voltage Coronary CT Angiography using Tailored Contrast Medium Injection Protocols

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S504AB

Participants

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PURPOSE

To compare the diagnostic accuracy between third-generation dual-source coronary CT angiography (CCTA) using ≤ 100 versus > 100 kilovolt peak (kVp) x-ray tube settings and kVp-tailored contrast medium injection protocols with invasive coronary catheter angiography (ICA) as the reference standard.

METHOD AND MATERIALS

We analyzed data of 120 patients (mean age=62.6 years, mean BMI=29.0 kg/m²) who had undergone both invasive catheter angiography as well as CCTA. Subjects were divided into two cohorts (n=60 each) based on CT acquisition x-ray tube voltage (mean kVp=84.3 and 116.5, respectively). The contrast media volume was tailored to the kVp level: 70kVp=40 mL, 80kVp=50 mL, 90kVp=60 mL, 100kVp=70 mL, 110kVp=80 mL, and 120kVp=90 mL. Quantitative contrast-to-noise ratio (CNR) was measured. Two radiologists evaluated image quality and analyzed studies for the presence of significant coronary stenosis ($> 50\%$ luminal narrowing) in a segment-based fashion.

RESULTS

Sensitivity and specificity for ≤ 100 versus > 100 kVp CCTA were: per-patient=93.9 and 92.6% versus 90.9 and 92.6%, per-vessel=91.5 and 97.8% versus 94.0 and 96.8%, and per-segment=90.0 and 96.7% versus 90.7 and 95.2%, respectively, without significant differences (all $P > 0.04$). Quantitative image quality was slightly higher ($P > 0.18$) using lower kVp settings (mean CNR=12.0 and SNR=9.8) versus higher kVp CCTA (mean CNR=11.1 and SNR=8.9). No significant differences were found for subjective image quality among the cohorts ($P = 0.38$). Contrast media requirements were reduced by 38.1% in the low versus high kVp cohort (53.6 vs 86.6 mL, $P < 0.001$). Radiation dose in ≤ 100 kVp was 59.6% less than > 100 kVp examinations (4.3 versus 10.6 mSv, $P < 0.001$).

CONCLUSION

Third-generation dual-source CCTA using kVp-tailored contrast injection protocols can be robustly performed at ≤ 100 kVp in an overweight population while maintaining diagnostic accuracy for coronary stenosis detection compared to > 100 kVp image acquisition, substantially reducing radiation and contrast dose.

CLINICAL RELEVANCE/APPLICATION

CCTA with tube potential ≤ 100 kV and tailored contrast material administration allows for comparable diagnostic accuracy for

stenosis detection but substantial dose savings both in terms of radiation and contrast agent compared to standard image acquisition.

SSG02-06 Single Heart-Beat Coronary CT Angiography on 256-Slice CT Scanner: Comparison of Image Quality between Free Breathing and Breath Holding

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

Participants

Jie Meng, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the difference of image quality of single heart-beat coronary CT angiography (CTA) on 256-slice CT scanner between free breathing and breath holding.

METHOD AND MATERIALS

208 subjects underwent coronary CTA from Dec. 2016 to Feb. 2017 using GE Revolution CT scanner, who were randomly divided into two groups. Subjects of free breathing group were instructed to smoothly breath during scanning. Subjects of breath holding group were instructed to hold breath during scanning. Auto-gating technique was used to determine acquisition cardiac phase and parameters. Collimation was set to 256×0.625mm, 224×0.625mm or 192×0.625mm depending on the size of heart. Single heart-beat acquisition was performed, with tube rotation time 0.28s, tube voltage 100kV, auto-mA and noise index 25. Vessel tracking was used to trigger acquisition on ascending aorta. Acquisition began 9.9s after reaching the threshold of 70HU. The tube exposure for 0.4 to 0.7s. Iohexol 370mgI/ml contrast-media was injected by Ulrich Mississippi injector. Total amount of contrast-media was 40 to 50ml per subject, calculated as 0.86ml/kg. The injection ran 12s. An experienced radiologist independently made 5-scale score for RCA, LAD and LCx. Higher score indicated better image quality. Fisher's exact test was used to assess score difference between two groups.

RESULTS

187 subjects (112 males and 75 females) were included for analysis. 21 were excluded, including 18 unable to reach high injection rate, two uncomfortable feeling and one machine failure. Free breathing group had 79 subjects (63.2±10.1 yo, BMI 24.0±0.19). The score of RCA, LAD and LCx was 4.09±0.92, 4.35±0.75 and 4.35±0.77, respectively. Breath holding group included 108 cases (62.4±9.2 yo, BMI 24.0±3.2). The score was 4.01±0.79, 4.34±0.69 and 4.29±0.79, respectively. The scores between these two groups were not significantly different, where the P value was 0.074, 0.735 and 0.865, respectively.

CONCLUSION

When performing single heart-beat coronary CTA using 256-slice CT scanner, the image quality was consistent between free breathing and breath holding method.

CLINICAL RELEVANCE/APPLICATION

Free breathing has the potential to replace breath holding in clinical practice to improve patient cooperation using fast single heart-beat coronary CTA on state-of-art scanner.

SSG02-07 Non-Invasive Evaluation of Coronary Artery Stenosis: In-Vitro Comparison of a Spectral Photon Counting CT and Spectral Dual Layer CT

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

Participants

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PURPOSE

To evaluate if Spectral Photon Counting CT (SPCCT) can enable a better visualization of the arterial lumen in comparison with conventional integrating detector spectral CT (IDSCT) by means of improved spatial resolution and reduced blooming artifacts from calcifications.

METHOD AND MATERIALS

A Plexiglas phantom with 3.0-6.0 mm diameter holes and PVC inserts simulating calcified plaques with remaining lumen between 1.0-3.5 mm was filled with different concentrations of iodine (Iomeron 400, Bracco: 7.1-21.4 mg/ml resulting in 210 to 600 HU enhancement) and scanned on a IDSCT (IQon, Philips) with Standard (SR) and High Resolution (HR) modes and on a SPCCT prototype (Philips), all at 120 kV and 100 mAs. The visibility of the lumen in presence of artificial calcified plaque (CaP) was evaluated by 2 readers for each acquisition on conventional HU and iodine density images using a 5-point Likert scale: 1= Lumen cannot be seen, 2= Lumen seen but diameter and permeability cannot be evaluated, 3= Lumen seen but diameter is hard to evaluate; 4= Lumen seen with smooth edges but can be evaluated; 5= Lumen clearly seen with sharp edges and can easily be evaluated.

RESULTS

Inter-observer reliability was very good (weighted kappa=0.9). On conventional HU images, lumen evaluation improved significantly with SPCCT (median score = 5) compared to IDSCT both in SR (median score = 2, p < 0.01) and HR (median score = 3, p < 0.01) for all CaP sizes. Changing the iodine concentrations did not change results for IDSCT. Significantly lower grades were found on SPCCT with the lowest iodine concentration compared to the highest one (median score = 3 vs 5, p = 0.02) due to high image

noise because iterative reconstruction used on IDSCT was not yet available on SPCCT. On Iodine density images, there was no significant improvement with SPCCT compared to IDSCT SR and HR again due to higher image noise in SPCCT.

CONCLUSION

Evaluation of residual lumen in stenosed coronary arteries with calcified plaques can be significantly improved by using SPCCT.

CLINICAL RELEVANCE/APPLICATION

SPCCT will have the potential to significantly improve the important, but still challenging, non-invasive evaluation of coronary arteries stenosis, especially in presence of calcified plaques.

SSG02-08 Improved Coronary Visualization in High Temporal Resolution Dual-Source Dual-Energy Coronary CT Angiography

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S504AB

Participants

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PURPOSE

Dual energy acquisition may provide additional information over single energy coronary CTA and a high temporal resolution (quarter-scan, 66 msec) reconstruction is available when using dual source CT. However, the 66 msec reconstruction obtained using a third generation dual source scanner may suffer from blurring artifact as the high kVp data obtained using 150kVp has very little contrast enhancement to guide the fusion of the low and high kVp scans. We compared image noise and image quality obtained using a new prototype reconstruction method (SAF) to the standard method (QAR) in a cohort of subjects undergoing dual energy coronary CT.

METHOD AND MATERIALS

Subjects with familial hypercholesterolemia underwent cardiac DECT as part of a research protocol. Two spatial-frequency selective algorithms were used for reconstructing dual-energy mixed image datasets at 66-ms temporal resolution including the standard method (QAR), as well as a new prototype (SAF) method that reduces the relative contribution of the high-energy spectra and applies a sharper spatial filter. Per-vessel and overall imaging quality were evaluated by two readers based on a 4 point Likert scale. Imaging noise of two algorithms measured using the standard deviation in an ROI in the ascending aorta.

RESULTS

84 vessels in 21 subjects were evaluated. Compared with QAR, the image quality of the LAD and right coronary artery was significantly improved using SAF (2.95 ± 0.59 vs. 2.38 ± 0.74 , $p=0.003$; 3.14 ± 0.72 vs. 2.71 ± 0.90 , $p=0.013$). However, left main and left circumflex imaging scores were similar (2.29 ± 0.72 vs. 2.29 ± 0.46 , $p=1.000$; 2.90 ± 0.70 vs. 2.62 ± 0.86 , $p=0.166$). SAF provided better overall image quality than QAR on a per-patient basis as well (2.57 ± 0.75 vs. 2.95 ± 0.50 , $p=0.033$). Image noise was increased using SAF, but this was not significantly different [$57 \text{ HU}(50-60)$ vs. $46 \text{ HU}(42-55)$, $p=0.126$].

CONCLUSION

A new high temporal resolution reconstruction method for dual source dual energy CT results in improved image quality, although image noise is non-significantly increased. This method may allow increased adoption of dual energy acquisitions for coronary CT, particularly in patients with higher heart rates.

CLINICAL RELEVANCE/APPLICATION

A new high temporal resolution reconstruction for dual-source dual-energy CT results in improved image quality. This may enable increased adoption of dual energy coronary CT, particularly in patients with higher heart rates.

SSG02-09 Deep Learning Analysis of the Left Ventricular Myocardium in Cardiac CT Images Enables Detection of Functionally Significant Coronary Artery Stenosis Regardless of Coronary Anatomy

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S504AB

Participants

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PURPOSE

Fractional flow reserve (FFR), performed during invasive coronary angiography (ICA), is the current reference standard to determine the functional significance of a coronary stenosis. Coronary Computed Tomography Angiography (CCTA) derived virtual FFR is a promising but time and computationally expensive non-invasive alternative that can reduce the number of unnecessary ICA procedures by modeling coronary artery flow dynamics. We propose a method for fully automatic identification of patients with significant coronary artery stenosis based on deep learning analysis of only the left ventricle (LV) myocardium in CCTA.

METHOD AND MATERIALS

The study included resting CCTA scans (Philips Brilliance iCT, 120kVp, 210-300mAs) of 166 consecutive patients (59.2 ± 9.5 years, 128 males) who underwent invasive FFR (0.79 ± 0.10). FFR provided the reference for presence of a functionally significant stenosis (cut-off 0.78). Automatic analysis first segmented the LV myocardium using a multiscale convolutional neural network (CNN). Next, the segmented myocardium was represented with a number of encodings generated by a convolutional auto-encoder (CAE). To detect local ischemic changes, the LV myocardium was divided into a number of spatially connected clusters. Per-cluster statistics of the encodings were subsequently used by a support vector machine classifier to identify patients with functionally significant stenosis. CCTA scans of 20 patients were used to train the CNN, and an additional 20 scans were used to train the CAE. Accuracy of patient classification was evaluated using the remaining 126 CCTA scans in 50 ten-fold cross-validation experiments. In each experiment, patients were randomly assigned to training and test sets.

RESULTS

Classification of patients resulted in an area under the receiver operating characteristic curve of 0.74 ± 0.02 . At sensitivity levels 0.60, 0.70 and 0.80, the corresponding specificity was 0.77, 0.71 and 0.59, respectively.

CONCLUSION

The results demonstrate that fully automatic analysis of only the LV myocardium in resting CCTA scans, without assessment of the anatomy of the coronary arteries, can be used to identify patients with functionally significant coronary artery stenosis.

CLINICAL RELEVANCE/APPLICATION

Deep learning analysis of the LV myocardium could increase the specificity of the clinically used visual stenosis assessment in CCTA and reduce the number of patients undergoing unnecessary ICA.

SSG03

Chest (Dual energy/Radiomics)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S404CD

CH CT

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

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSG03-01 Assessment of Regional Xenon-Ventilation, Perfusion, and Ventilation-Perfusion Mismatch Using Dual-Energy Computed Tomography in Asthma-COPD Overlap Syndrome (ACOS): A Comparison with COPD

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S404CD

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PURPOSE

To assess the regional ventilation (V) and perfusion (Q) status in patients with ACOS using combined xenon V and iodine Q dual-energy CT (DECT).

METHOD AND MATERIALS

Fourteen patients with ACOS and fifty-two patients with COPD underwent combined V and Q DECT. Virtual noncontrast image, V and Q maps were anatomically co-registered. After the normalization of V and Q values of each pixel, V/Qratio map was generated. In visual analysis, regional V and Q were determined as decreased, normal or increased, and V/Qratio pattern was determined as matched (-11), or reversed mismatched (V/Qratio<-1) on each maps, in combination of the regional disease patterns including emphysema with or without bronchial wall thickening, bronchial wall thickening and normal on VNC, at each segment. V/Qratio patterns and regional disease patterns were compared between two groups. Quantified CT parameters for V and Q were compared with pulmonary function test in ACOS patient.

RESULTS

The most common structural change in ACOS patients was emphysema with bronchial wall thickening (52.1%), and followed by bronchial wall thickening (27.1%), which were more frequently seen in ACOS patients than in COPD patients (p < 0.001). These segments commonly showed matched V/Qratio pattern in ACOS patients, while they commonly showed reversed mismatched V/Qratio pattern in COPD patients (p < 0.001). The segments with other structural changes commonly showed matched V/Qratio pattern in two groups. The matched V/Qratio patterns in ACOS patients commonly associated with decreased V and Q, while those in COPD patients commonly showed normal or increased V and Q. Quantified mean V, VQratio and standard deviation of V/Qratio were moderately correlated with 6MWT.

CONCLUSION

Regional V, Q and V-Q relationship can be assessed with combined V and Q DECT in ACOS patients. Regional structural abnormality and V and Q status may be different between the patients with ACOS and COPD.

CLINICAL RELEVANCE/APPLICATION

Regional structural abnormalities, ventilation and perfusion status can be assessed simultaneously with combined xenon ventilation and iodine perfusion DECT in ACOS patients.

SSG03-02 Investigation of Regional Pulmonary Perfusion in Acute Lung Injury with Dual-Energy CT

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S404CD

Participants

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PURPOSE

To investigate the ability of contrast-enhanced dual-energy CT (DECT) for assessing regional perfusion in a model of acute lung injury (ALI), using dynamic: first-pass perfusion CT (DynCT) as the gold standard. To evaluate if changes in lung perfusion caused by prone ventilation are similarly demonstrated by DECT and DynCT.

METHOD AND MATERIALS

IRB-approved study, compliant with guidelines for humane care of laboratory animals. An ALI protocol was applied to 6 landrace pigs. Perfused Blood Volume (PBV) and Pulmonary Blood Flow (PBF) were respectively quantified by DECT and DynCT, in supine and prone positions. The lungs were segmented in equally-sized regions of interest, namely, dorsal, middle, and ventral. PBV and PBF values were normalized by lung density. Regional air-fraction (AF) was assessed by triple-material decomposition DECT. Per animal: correlation between PBV and PBF was assessed with Pearson's R. Regional differences in PBV, PBF, and AF were evaluated with one-way ANOVA and post hoc linear trend analysis ($\alpha=5\%$).

RESULTS

Mean correlation coefficient between PBV and PBF was 0.70 (range: 0.55 to 0.98). Higher PBV and PBF values were observed in dorsal vs ventral regions. Dorsal-to-ventral linear trend slopes (DVLTS) were -10.24 ml/100g/zone for PBV ($p<0.001$) and -223.0 ml/100 g/min/zone for PBF ($p<0.001$). Prone ventilation also revealed higher PBV and PBF in dorsal vs ventral regions. DVLTS were -16.16 ml/100 g/zone for PBV ($p<0.001$) and -108.2 ml/100 g/min/zone for PBF ($p<0.001$). By contrast, AF was lower in dorsal vs ventral regions in supine position, with DVLTS of +5.77%/zone ($p<0.05$). Prone ventilation was associated with homogenization of AF distribution among different regions ($p=0.74$).

CONCLUSION

DECT-PBV is correlated with DynCT-PBF in a model of ALI, and able to demonstrate regional differences in pulmonary perfusion. Perfusion was higher in the dorsal regions, irrespectively to decubitus, with more homogeneous lung aeration in prone position.

CLINICAL RELEVANCE/APPLICATION

Our results support DECT-PBV as a surrogate for regional pulmonary perfusion in ALI. Clinically important questions, such as the effectiveness of new drug regimens or ventilation strategies on lung perfusion in ALI could be assessed with DECT-PBV, with lesser radiation burden and extended z-axis coverage as compared with DynCT-PBF.

Honored Educators

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

SSG03-03 Radiomics for Predicting NSCLC Recurrence after Surgery: Quantitative Analysis of the Tumor and Peritumoral Lung Parenchyma on MDCT

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S404CD

Participants

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PURPOSE

Surgery is the standard treatment for early-stage non-small cell lung cancer (NSCLC); however, 30%-55% of patients develop recurrence despite resection. We aimed to define recurrence predictors for surgically treated early-stage NSCLC by applying Radiomics analysis to presurgical MDCT images.

METHOD AND MATERIALS

78 early-stage (stages I-IIIa) NSCLC patients who underwent surgery between 2008 and 2013 were retrospectively enrolled. A

follow-up of 3 to 5 years was considered. Tumor recurrence (TR), local recurrence (LR) or distant metastasis (DM), was defined on follow-up MDCT scans. On presurgical MDCT scans we semiautomatically contoured a region of interest (ROI) for the tumor (GTV; gross tumor volume), the peritumoral lung parenchyma (PTV; peritumor volume, 2 cm around the tumor), and the entire lobe(s) where the tumor resided. 88 statistical, morphological, and textural features were extracted from each ROI and analyzed with software developed at our institution. Significant features for univariate Cox analysis were first selected ($P < 0.05$). All possible pairs were then used to build bivariate Cox regressions. Only the pairs that satisfied the proportional hazard hypotheses and whose Pearson's correlation coefficient was between -0.3 and 0.3 were kept. Histopathology, T-stage (T) and N-stage (N) were added as clinical covariates to the best pairs of features. Finally, stepwise regression and performance evaluation methods (bootstrap, k-fold validation, elastic nets) were applied to obtain the best model in terms of receiving operator characteristic curve and area under the curve (AUC).

RESULTS

46 patients remained disease-free; 13 had LR, 19 had DM. The best performances in predicting TR were obtained by combining covariates to morphological and textural features derived from GTV (histopathology+ROI volume+gray level co-occurrence matrix joint maximum) and PTV (N+ROI diameter+zone size) with AUC values of 0.769 and 0.767, respectively. Model based on the lobe analysis (histopathology+ROI center of mass) resulted in AUC value of 0.615.

CONCLUSION

Radiomics, especially utilizing GTV and PTV on presurgical MDCT images, has the potential to predict patient prognosis in surgically treated early-stage NSCLC.

CLINICAL RELEVANCE/APPLICATION

Prognosis prediction in NSCLC using Radiomics and MDCT images could be a useful tool for stratifying patients better at different recurrence risk and defining a personalized treatment.

SSG03-04 Dual-Energy Spectral CT Perfusion Imaging for Differentiating Various WHO Subtypes of Thymic Epithelial Tumors: A Preliminary Study

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S404CD

Participants

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PURPOSE

To analyze some conventional computed tomography (CT) features, the quantitative parameters of perfusion and spectral of different WHO subtypes of thymic epithelial tumors(TET) using dual-energy spectral CT.

METHOD AND MATERIALS

81 patients with anterior mediastinal lesions underwent spectral CT perfusion imaging ($n=48$) and conventional CT enhancement scan ($n=33$) using Discovery CT750 HD scanner from June 2014 to March 2017 were enrolled in this study. Some morphological features (calcification; multiple nodular ,MN) and the maximal contrast-enhanced range (CEmax) derived from conventional CT scan, the quantitative metrics of perfusion (blood flow, BF; blood volume, BV; mean transit time, MTT; and permeability surface, PS), and spectral scan (water concentration, WC; iodine concentration, IC; normalized iodine concentration, NIC; and spectral HU curve slope, K) on the optimal arterial phase and venous phase of lesions were analyzed. Data statistics was performed using Kruskal-Wallis rank sum test and Spearman's rank correlation analysis.

RESULTS

The mean age of 81 patients with TET was 52.2 ± 9.5 years (31-77 years). Calcification (22/81, 27.2%) could be found in each WHO types, while MN (12/44, 27.3%) only be found in A,AB,B1 and B2 TET. The CEmax values of A and AB TET were significant higher than those of other types ($P < 0.05$). The WC values of A TET in arterial and venous phases were significant higher than those of B1,B2,B3 TET and TC ($P < 0.05$), whereas BF,BV and other spectral parameters showed opposite trends, but without significant correlation between these groups ($P > 0.05$). The PS values of low-risk TET(LRT, including A,AB,B1 TET) and high-risk TET(HRT, , including B2,B3 TET) were significant lower than those of TC, and mild correlation between these three groups were found ($r=0.352$, $P < 0.05$). The BF,BV and all spectral parameters values of LRT*(A,AB) were significant lower than those of HRT* (B1,B2,B3) and TC. In addition, moderate and mild correlation were found for NIC in arterial phase and venous phase among above three groups, respectively ($r=0.422$, $P < 0.05$; $r=0.363$, $P < 0.05$). However, there were no significant difference between HRT*and TC.

CONCLUSION

The quantitative parameters of perfusion and spectral of dual-energy spectral CT perfusion imaging, combined with some conventional CT imaging features, have an important value in identifying different TET pathologic types.

CLINICAL RELEVANCE/APPLICATION

none

SSG03-05 Prediction of Pathological Nodal Involvement by CT-Based Radiomic Features of Primary Tumor in Clinical N0 Peripheral Lung Adenocarcinomas

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S404CD

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PURPOSE

To investigate the potential of CT based radiomic features of primary tumor to predict pathological nodal involvement in clinical N0 peripheral lung adenocarcinomas.

METHOD AND MATERIALS

One hundred and eighty-seven patients with clinical N0 peripheral lung adenocarcinomas who underwent preoperative CT scan and subsequently received lobectomy or pneumonectomy with systematic lymph node dissection were retrospectively reviewed. 219 quantitative 3D features (known as "radiomic features") of the primary lung tumor were extracted; meanwhile, 8 radiological CT features (known as "semantic features") of the primary tumor were evaluated by three radiologists. Univariate and multivariate logistic regression analysis were used to explore the role of semantic features and radiomic features of primary tumor in predicting pathological nodal involvement. The areas under the ROC curves (AUCs) were compared between multivariate logistic regression models.

RESULTS

Of the 187 clinical N0 peripheral lung adenocarcinoma patients, 153 had pathological N0 status and 34 had pathological lymph node metastasis. On univariate analysis, fissure attachment and 17 radiomic features were significantly associated with pathological nodal involvement. Multivariate analysis revealed that semantic features of pleural retraction ($p=0.048$) and fissure attachment ($p=0.023$) were significant predictors of pathological nodal involvement (AUC=0.659); radiomic features of F185 (Histogram SD Layer 1) ($p=0.0001$) was independent prognostic factors of pathological nodal involvement (AUC= 0.73). The logistic regression model produced from combining radiomic feature (F185) and semantic feature (pleural retraction) showed the highest AUC of 0.758 (95% CI: 0.685-0.831), and the AUC value computed by 5-fold cross-validation method was 0.741 (95% CI: 0.0.735 - 0.748).

CONCLUSION

There are significant relationships between semantic features, radiomic features of primary lung tumor and pathological nodal involvement in clinical N0 peripheral lung adenocarcinomas. Prospective identification of predictors for nodal involvement may aid in selecting an appropriate population for lymph node dissection.

CLINICAL RELEVANCE/APPLICATION

Combined evaluation of semantic and radiomic features significantly improves prediction of the risk of a node's involvement with malignancy, and this modality could be easily added to clinical use due to its non-invasive nature.

SSG03-06 Somatic Mutations Drive Distinct Imaging Phenotypes in Lung Cancer

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S404CD

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PURPOSE

Tumors are characterized by somatic mutations that drive biological processes, which are ultimately reflected in the tumor phenotype. Quantitative radiomics non-invasively characterizes tumor phenotypes by using a large panel of automatic image characterization algorithms. However, precise genotype-phenotype interactions through which somatic mutations influence radiographic phenotypes remain largely unknown. Here, we present an integrated analysis of four independent datasets of 763 lung adenocarcinoma patients with somatic mutation testing and quantitative computed tomography (CT) image analytics.

METHOD AND MATERIALS

In univariate analysis, we selected 26 variance retaining independent and stable features by using feature reproducibility (ICC) and PCA based analysis and statistically compared their distributions between mutated and non-mutated cases. We developed multivariate radiomic signatures capable of distinguishing between tumor genotypes in a discovery cohort (n=353) by using mRMR feature selection method and random forest classifier. The performance of the signatures was then validated in the validation cohort (n=352) using AUC. All analyses were performed using Matlab-R2012b and R-3.0.2.

RESULTS

We found sixteen and ten radiomic features to be significantly associated with EGFR and KRAS mutations respectively. We found a

we found sixteen and ten radiomic features to be significantly associated with EGFR and KRAS mutations respectively. We found a radiomic signature related to radiographic heterogeneity that could strongly discriminate between EGFR+ and EGFR- cases (AUC=0.69). Combining this signature with a clinical model of EGFR status (AUC=0.70) significantly improved the prediction accuracy (AUC=0.75). The highest performing signature was capable of distinguishing between EGFR+ and KRAS+ tumors (AUC=0.80) and when combined with a clinical model (AUC=0.81), substantially improved its performance (AUC=0.86). A KRAS+/KRAS- radiomic signature also showed significant, albeit lower, performance (AUC=0.63) and did not improve the accuracy of a clinical predictor of KRAS status.

CONCLUSION

These results suggest that certain somatic mutations drive distinct radiographic phenotypes that can be predicted using radiomics. Such radiomic-based tests can be applied non-invasively, repeatedly, and at low cost, providing an unprecedented opportunity for precision medicine applications.

CLINICAL RELEVANCE/APPLICATION

To establish a link between somatic mutations and the imaging phenotype in a large cohort of adenocarcinoma patients.

SSG03-07 Nodule Texture Predicts Response to Nivolumab Based Immunotherapy for Non-Small Cell Lung Cancer

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S404CD

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PURPOSE

Nivolumab, a PD-1 inhibitor has shown clinical efficacy in patients with non-small cell lung cancer (NSCLC). It has been approved for treatment of patients with chemotherapy refractory, advanced NSCLC. The current standard clinical approach to evaluating tumor response is sub-optimal in defining clinical benefit from immunotherapy drugs. We sought to evaluate whether computer extracted radiomic features of nodule texture and shape from a baseline CT scan are predictive of response to nivolumab based immunotherapy.

METHOD AND MATERIALS

A cohort of 31 consecutive patients who were treated with nivolumab were included in the study. Patients who did not receive nivolumab after 2 cycles due to lack of response or progression as per RECIST were classified as 'non-responders'; patients who had radiological response per RECIST or had clinical benefit (defined as stable disease >10 cycles) were classified as 'responders'. The study team was provided with CT images from 10 patients who responded to nivolumab, 10 who did not and 11 Cases were blinded for validation. A total of 669 intra-tumoral texture (Gabor, Laws, Haralick) features were extracted and the top 4 features predictive of response on the training set (N = 20) were identified. Within the space of the top features, the optimal decision boundary for separating the training instances was identified via a Quadratic Discriminant Analysis (QDA) approach. The decision boundary was then used to evaluate the test cases (N = 11).

RESULTS

The top ranked features were the entropy, Kurtosis, and Variance of the Gabor texture feature and Variance of the Law-Laplacian feature. The QDA classifier trained with these top 5 features resulted in a 72.72% prediction accuracy on the test set.

CONCLUSION

Radiomic texture features extracted from the nodule on baseline CT scans were found to be predictive of response for NSCLC patients treated with immunotherapy. Multi-site validation is needed to establish the role of these features as predictive biomarker for response to immunotherapy in NSCLC patients.

CLINICAL RELEVANCE/APPLICATION

Our work suggests that we could better identify which patients are most likely to respond to and hence benefit from immunotherapy. From an economic perspective, identifying patients who are not likely to respond to immunotherapy could mean that expensive checkpoint inhibitor drugs would not be needlessly administered to these patients.

SSG03-08 Differentiation of Primary Lung Cancers and Benign Lung Nodules Using CT-Based Radiomic Features

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S404CD

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PURPOSE

To evaluate whether computed-tomography (CT) based radiomic features could differentiate between lung cancers and benign lung nodules.

METHOD AND MATERIALS

120 patients with peripheral lung nodules (≤ 3 cm) that were non pure ground-glass, and did not display obvious calcification or fat on pre-contrast CT images enrolled in this study. All patients received surgery and the lesions were histologically confirmed (55 adenocarcinomas, 3 squamous cell carcinomas, 20 pulmonary sclerosing hemangiomas, 20 tuberculomas and 22 pulmonary hamartochondromas). 867 radiomic features were extracted from whole-lesion volumetric 3D analysis, and 92 of these which were considered as mutually independent features were included in the analysis. Each feature between lung cancer and benign lesion were compared using two-sample t test or nonparametric Mann-Whitney U test. In order to eliminate errors generated in the process of multiple tests, q-value after the false discovery rate (FDR) correction less than 0.05 was considered statistically significant. Lasso regression model was used for data dimension reduction and feature selection. Multivariate logistic regression model was built to identify independent factors of differentiating lung cancers and benign lung nodules. Receiver operating characteristic curves (ROC) were generated and the area under the curve (AUC) calculated with histopathology as outcome, then optimal threshold criteria were used to estimate sensitivity and specificity.

RESULTS

53 radiomic features showed significantly statistical differences between lung cancers and benign lung nodules ($q < 0.05$), including 5 First-order statistical features, 23 Texture-based features, 8 LAWS Texture features, 10 Laplace of Gaussian features, and 7 3D Wavelet decomposition. The model generated by 6 radiomic features demonstrated excellent performance in differentiation between lung cancers and benign lung nodule, with an AUC value of 0.908 (95% CI: 0.859 - 0.958) by 10 fold cross-validation. Using the cut-off value of 0.665, the proposed CT-based radiomic feature predictors achieved 81.0% sensitivity, 85.5% specificity and 70.0% accuracy.

CONCLUSION

CT based radiomic features has the potential to differentiate primary lung cancers and benign lung nodules.

CLINICAL RELEVANCE/APPLICATION

CT-based radiomic analysis could provide useful information in the differentiation between lung cancers and benign lung nodules without adding additional cost.

SSG03-09 Radiomic Prediction of Survival in Patients with Rheumatoid Arthritis-Associated Interstitial Lung Disease Based on Hyper-Curvature Model

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S404CD

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PURPOSE

To evaluate the comparative performance of a radiomic hyper-curvature (RHC) model of lung CT images in the prediction of the overall survival of patients with rheumatoid arthritis -associated interstitial lung disease (RA-ILD).

METHOD AND MATERIALS

We retrospectively collected 72 RA-ILD patients with thin-section lung CT and serial pulmonary function tests. The lung regions were extracted from the CT images using our previously developed method, after which the bronchi and aerated lungs were separated using histogram thresholding, region growing and mathematical morphology. To characterize the patients' lungs, we computed 120 RHC features that characterize the principal curvatures, curvedness, light/dark blobs, lines and sheets, and curvature scales of the bronchi and the aerated lungs. An elastic-net penalty method was used to select and combine these RHC features with a Cox proportional hazards model for predicting the survival of the patient. Evaluation was performed by use of bootstrapping with 2,000 replications, where concordance index (C-index) was used as a measure of prediction performance. The performances of the gender, age, and physiology (GAP) model; gender, age, and the RHC model; and GAP and RHC, were compared with that of the RHC by use of two-sided t-test.

RESULTS

Bootstrap evaluation yielded the following C-index values for the combinations of clinical and radiomic features: (a) GAP model: C-index 78.3%, [95% confidence interval (CI): 70.1, 86.5]; (b) RHC model: 80.8% [CI: 71.9, 89.7], $P < 0.0001$ in comparison with (a); (c) gender, age, and RHC: 83.8% [CI: 77.1, 90.5], $P < 0.0001$ in comparison with (b); and (d) GAP and RHC: 87.3% [CI: 81.3, 93.1], $P < 0.0001$ in comparison with (c). Kaplan-Meier survival curves of patients stratified to low- and high-risk groups based on the RHC showed statistically significant ($P < 0.0001$) difference.

CONCLUSION

The RHC model yielded higher performance than that of GAP model in the prediction of overall survival. Addition of gender and age as well as GAP to the RHC further improved the performance of the RHC. Thus, RHC can be an effective imaging biomarker for predicting overall survival of patients with RA-ILD.

CLINICAL RELEVANCE/APPLICATION

Radiomic hyper-curvature features that are automatically calculated from lung CT images can provide an effective prognostic imaging biomarker for precise management of patients with RA-ILD.

SSG04

Gastrointestinal (Liver Tumor Imaging)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E352

BQ **GI** **MR** **OI**

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

Participants

Alice W. Fung, MD, Portland, OR (*Moderator*) Speaker, Guerbet SA
Bachir Taouli, MD, New York, NY (*Moderator*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA
Debra A. Gervais, MD, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSG04-01 Correlation of Molecular Transporter Receptor Expression with Hepatobiliary Phase Signal Intensity in Hepatocellular Adenoma Subtypes on Gd-EOB-DTPA-Enhanced MR Imaging

Tuesday, Nov. 28 10:30AM - 10:40AM Room: E352

Awards

Student Travel Stipend Award

Participants

Justin Tse, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Bita Naini, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic plc; Speaker, Medtronic plc; Consultant, Johnson & Johnson; Research Grant, Johnson & Johnson; Consultant, Bayer AG; Research Grant, Bayer AG ; Speaker, Bayer AG
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To correlate hepatobiliary phase signal intensity (SI) of hepatocellular adenoma subtypes (HCAs) on Gd-EOB-DTPA-enhanced MR with molecular transporter expression.

METHOD AND MATERIALS

In this IRB and HIPAA compliant study, the study cohort comprised of 49 histologically-subtyped HCAs from 21 consecutive patients: 14 inflammatory, 20 hepatocyte nuclear factor-1A-mutated (HNF-1A), 1 B-catenin-activated (BCA), and 14 unclassified (UC). Quantitative MR imaging features, including the SI ratio of the HCA relative to liver on the pre-contrast, arterial, portal venous, equilibrium, and hepatobiliary phases up to 20 minutes were calculated and reviewed by 2 abdominal radiologists. The histologic expression of organic anion-transporting peptide (OATP1B1/3) and multidrug resistant protein (MRP3) of 17 HCAs were compared to the surrounding liver semi-quantitatively using ImageJ software. Continuous variables were assessed using ANOVA and Student's t-test with Bonferroni correction for multiple comparisons.

RESULTS

On hepatobiliary phase, all 49 HCA lesions were hypointense to liver parenchyma with a nadir and plateau SI ratio by 10 minutes. At 20 minutes, the lowest SI ratio was from HNF-1A lesions (0.47 ± 0.09), followed by inflammatory (0.73 ± 0.18 , $p < 0.001$), UC (0.73 ± 0.06 , $p < 0.0001$), and then BCA (0.82). On corresponding histology, HNF-1A ($n=7$) and inflammatory ($n=7$) HCA subtypes showed reduced OATP1B1/3 staining, with an expression ratio of 0.09 ± 0.03 and 0.40 ± 0.09 respectively ($p < 0.001$), while BCA ($n=1$) had an increased expression ratio (1.2). UC lesions ($n=2$) showed complete absent OATP1B1/3 staining. There were no specific staining patterns identified with MRP3. Hepatobiliary phase SI demonstrated a strong correlation with OATP1B1/3 expression ($r=0.83$), but had no correlation with MRP3 expression ($r=0.06$). Atoll sign was identified in 2 inflammatory HCAs and correlated with histology to represent a band of cellular overexpression of OATP1B1/3.

CONCLUSION

In our HCA cohort, there was a strong correlation between OATP1B1/3 expression and differential hepatobiliary phase SI, suggesting that Gd-EOB-DTPA uptake may be mediated by OATP1B1/3, but not MRP3.

CLINICAL RELEVANCE/APPLICATION

Because HCAs demonstrate a strong correlation with molecular transporter receptor expression, Gd-EOB-DTPA-enhanced MR may help non-invasively determine HCA genotypic subtype and guide management.

SSG04-02 The Role of Baseline Tumor Enhancement and Apparent Diffusion Coefficient in Predicting Short-Term Response to Treatment in Liver Colorectal Metastatic Lesions: A Volumetric Approach

Tuesday, Nov. 28 10:40AM - 10:50AM Room: E352

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To examine usefulness of magnetic resonance (MR) defined volumetric pretreatment enhancement and apparent diffusion coefficient (ADC) to predict short-term response to treatment in patients with liver colorectal metastases

METHOD AND MATERIALS

Liver MR images of 489 patients with colorectal liver metastases (2004-2015) were reviewed retrospectively in this HIPAA compliant study. Fifty-seven patients (154 liver lesions) fulfilled inclusion criteria and were categorized on the basis of the intervention into conventional chemotherapy group (41 lesions), hepatic trans-arterial chemoembolization or TACE group (98 lesions) and Y-90 radioembolization group (15 lesions). Baseline volumetric lesion enhancement in the portal venous phase (PVP), ADC (b value >500) and tumor necrotic volume were calculated employing a prototype software developed by Siemens Healthcare (MR Onco-Treat). Percent change in the largest transverse diameter at 3 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), student t test and receiver operator characteristic curve analysis were used.

RESULTS

In all three groups a lower pretreatment ADC value, but not enhancement in the PVP or tumor necrotic volume, was significantly predictive of partial response to treatment (conventional chemotherapy: $939.7 \times 10^{-6} \text{ mm}^2/\text{s}$ vs. $1305.4 \times 10^{-6} \text{ mm}^2/\text{s}$; $p=0.01$; optimal threshold, 1125 %; sensitivity, 75%; specificity, 69%; TACE: $1100.7 \times 10^{-6} \text{ mm}^2/\text{s}$ vs. $1400.4 \times 10^{-6} \text{ mm}^2/\text{s}$; $p<0.01$; optimal threshold, $1244 \times 10^{-6} \text{ mm}^2/\text{s}$; sensitivity, 70.4%; specificity, 80%; Y-90 radioembolization: $895.6 \times 10^{-6} \text{ mm}^2/\text{s}$ vs. $1140.9 \times 10^{-6} \text{ mm}^2/\text{s}$; $p=0.03$; optimal threshold, indefinable).

CONCLUSION

Volumetric baseline ADC could be used as a predictor of response to treatment in patients with colorectal liver metastases. Accordingly, a higher baseline ADC portends a worse outcome.

CLINICAL RELEVANCE/APPLICATION

Baseline volumetric ADC could be used to predict prognosis and tailor treatment strategies individually in patients with metastatic hepatic colorectal 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/> Ihab R. Kamel, MD, PhD - 2015 Honored Educator

SSG04-03 Gadoxetic Acid-Enhanced MRI Outperformed Multidetector CT in Diagnosing Small Hepatocellular Carcinoma Measuring Up to 2 cm: A Systematic Review and Meta-Analysis

Tuesday, Nov. 28 10:50AM - 11:00AM Room: E352

Participants

Hanyu Jiang, Chengdu, China (*Presenter*) Nothing to Disclose
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Jie Chen, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

A systemic review and meta-analysis of the diagnostic performance of gadoxetic acid disodium-enhanced magnetic resonance imaging (Gd-EOB-DTPA-enhanced MRI) and multidetector computed tomography (MDCT) was performed in diagnosing small hepatocellular carcinoma (HCC) measuring up to 2 cm ($\leq 2 \text{ cm}$).

METHOD AND MATERIALS

Two investigators searched multiple databases for studies in which the performances of either Gd-EOB-DTPA-enhanced MRI or MDCT were reported with sufficient data to construct 2 * 2 contingency tables for diagnosing HCCs up to 2 cm on a per-lesion or per-patient level. Diagnostic performances were quantitatively pooled by a bivariate random-effect model with further meta-regression and subgroup analyses.

RESULTS

Twenty-seven studies (fourteen on Gd-EOB-DTPA-enhanced MRI, nine on MDCT and four on both) were included, enrolling a total of 1735 patients on Gd-EOB-DTPA-enhanced MRI and 1781 patients on MDCT. Gd-EOB-DTPA-enhanced MRI demonstrated significantly higher overall sensitivity than did MDCT (0.92 vs 0.66, $p < 0.001$), without substantial loss of specificity (0.89 vs 0.91, $p = 0.354$). Area under the summary receiver operating characteristic curve was 0.9712 with Gd-EOB-DTPA-enhanced MRI and 0.8538 with MDCT. Regarding Gd-EOB-DTPA-enhanced MRI, sensitivity was significantly higher for studies originated from non-Asian countries than Asian countries (0.96 vs 0.93, $p = 0.01$), for retrospective studies than prospective studies (0.95 vs 0.91, $p < 0.01$), and for those with Gd-EOB-DTPA injection rate ≥ 1.5 ml/s than that of < 1.5 ml/s (0.97 vs 0.90, $p < 0.01$).

CONCLUSION

Gd-EOB-DTPA-enhanced MRI demonstrated higher sensitivity and overall diagnostic accuracy than MDCT, and thus should be the preferred imaging modality for diagnosing small HCCs measuring up to 2 cm.

CLINICAL RELEVANCE/APPLICATION

Early detection of small HCCs up to 2 cm can improve long-term patient survival. However, limited diagnostic accuracy has been demonstrated by traditional non-invasive imaging modalities including ultrasonography, multiphasic CT and MRI with non-specific contrast agents for the diagnosis of small HCCs. Fortunately, the introduction of MDCT and Gd-EOB-DTPA, a liver-specific hepatobiliary contrast agent, has led to better detection and characterization of small HCCs.

SSG04-04 MRI of Hepatocellular Carcinoma in Non-Alcoholic Fatty Liver Disease: Signal Characteristics and Inter-Rater Agreement

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E352

Participants

Scott M. Thompson, MD, PhD, Rochester, MN (*Presenter*) Nothing to Disclose
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PURPOSE

To determine the MRI features of hepatocellular carcinoma (HCC) in the setting of non-alcoholic fatty liver disease (NAFLD)

METHOD AND MATERIALS

In this IRB-approved retrospective review from 1/1/2001 to 12/31/2016, consecutive patients with NAFLD and pathology proven HCC, biopsy proven hepatic steatosis (≤ 6 months from MRI) and/or hepatic fat signal fraction $\geq 5\%$ at MRI were selected. HCC and liver parenchyma signal characteristics were independently reviewed by three abdominal radiologists and final features determined by majority. Inter-rater agreement was determined by prevalence-adjusted kappa. Hepatic fat signal fraction (FS %) was independently calculated. FS% was compared by HCC and liver MRI signal characteristics.

RESULTS

49 patients (80% male; mean age 63.3 ± 11.9 years) with mean (\pm SD) HCC tumor size at MRI of 4.6 ± 3.2 cm were included. HCC features included arterial phase hyperenhancement (APHE) (96%), portal venous phase washout (PVWO) (67%), delayed phase washout (DPWO) (82%), capsule (73%), T2W hyperintensity (90%), T1W hypointensity (65%), diffusion hyperintensity (93%), hepatic steatosis (65%) and cirrhotic morphology (43%). Mean FS% was $8.8 \pm 8.4\%$. Mean FS% by none, mild, moderate and severe steatosis at imaging: 0.9%, 8.3%, 20.1% and 27.5%, respectively ($p < 0.001$). Mean FS% by mild, moderate and severe steatosis at pathology: 6.6% 11.2% and 21.8%, respectively ($p < 0.001$). Inter-rater agreement was 0.80-0.84 for APHE, 0.47-0.63 for PVWO, 0.63-0.79 for DPWO, 0.35-0.63 for capsule, -0.22-0.22 for hepatic steatosis and 0.43-0.55 for cirrhosis. Agreement between pathology and MRI was 0.59 for cirrhosis. Hepatic FS% by HCC features: 9.1% (APHE) v. 2.1% (No APHE; $p < 0.02$), 6.9% (PVWO) v. 12.5% (No PVWO; $p < 0.05$) and 9.6% (T2W hyperintense) vs. 1.4% (T2W iso/hypointense; $p < 0.001$).

CONCLUSION

A high proportion of HCCs occur in NAFLD without imaging evidence of cirrhosis ($\sim 60\%$) and are therefore not eligible for LIRADs categorization. Up to 20% of HCCs in NAFLD do not demonstrate washout and higher FS% is associated with absent PVWO but not DPWO. Inter-rater agreement is fair to very good for major HCC features at MRI but poor to moderate for hepatic steatosis and cirrhotic liver morphology in patients with NAFLD.

CLINICAL RELEVANCE/APPLICATION

In patients with NAFLD, many HCCs occur in the absence of cirrhotic liver morphology and may not demonstrate portal venous washout, thereby impacting the noninvasive imaging diagnosis of HCC.

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/> Sudhakar K. Venkatesh, MD, FRCR - 2017 Honored Educator

SSG04-05 Microvascular Invasion of Hepatocellular Carcinoma Predicted By T1 Mapping at Gd-EOB-DTPA Enhanced Magnetic Resonance Imaging: The Role of Texture Analysis

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E352

Participants

Jie Chen, Chengdu, China (*Presenter*) Nothing to Disclose
Xin Li, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Bin Song, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To explore the value of texture analysis on T1 mapping at Gd-EOB-DTPA enhanced MRI in predicting and grading microvascular invasion (MVI) of hepatocellular carcinoma (HCC).

CONCLUSION

Texture analysis for T1 mapping at Gd-EOB-DTPA enhanced MRI held promise for predicting and grading MVI of HCC.

CLINICAL RELEVANCE/APPLICATION

Texture parameters of T1 mapping at Gd-EOB-DTPA enhanced MRI is related to tumor heterogeneity and the cellular uptake of Gd-EOB-DTPA, and therefore, can be used for HCC aggressiveness evaluation.

SSG04-06 Extent of Portal Invasion in Patients with HCC: The More, the Worse?

Tuesday, Nov. 28 11:20AM - 11:30AM Room: E352

Participants

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PURPOSE

Portal vein invasion (PVI) is known to have a significant impact on the prognosis of patients with hepatocellular carcinoma (HCC). Nevertheless, the degree of invasion can vary from sub-/segmental invasion to complete occlusion of the main trunk of the portal vein (PV). The purpose of this study was to evaluate whether the degree of invasion correlates with an impaired prognosis.

METHOD AND MATERIALS

763 patients with HCC were extracted from the clinical registry of our tertiary referral center as an ongoing effort to reevaluate the extent of PVI in all patients treated between 01/2005 - 06/2016. PVI was diagnosed by contrast enhanced CT or MRI. The extent of PVI was documented by the Liver Cancer Study Group of Japan-classification ranging from Vp0-Vp4: Vp0 = no PVI; Vp1 = segmental; Vp2 = right anterior or right posterior PV; Vp3 = right or left PV; Vp4 = main trunk. Median overall survival (OS) was calculated for each Vp-group.

RESULTS

PVI was present in 259 patients, 504 patients showed no sign of PVI. The patients with PVI were classified Vp1 to Vp4 in 12, 35, 88, and 124 cases. The corresponding median OS yielded 5.2, 5.6, 3.9, and 4.6 months for Vp1-Vp4, respectively. There was no significant difference between these PVI-subgroups ($p > 0.05$). Median OS without PVI was 37.7 months and was therefore significantly longer compared to the patients with any form of PVI ($p < 0.001$).

CONCLUSION

PVI in patients with HCC is associated with a dismal prognosis. However, the extent of PVI itself has no significant impact.

CLINICAL RELEVANCE/APPLICATION

Even a minor PVI leads to a very poor prognosis which has to be taken into account for treatment planning.

SSG04-07 Role of Diffusion Weighted Imaging in Differentiation of Pyogenic Hepatic Abscess from Necrotic Hepatic Metastatic Neoplasm

Tuesday, Nov. 28 11:30AM - 11:40AM Room: E352

Participants

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Ailian Liu, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To analyze the efficacy of DWI in the differentiation of pyogenic hepatic abscess from necrotic hepatic metastatic neoplasm

RESULTS

ADC values in cavity of pyogenic hepatic abscess were significantly lower with than necrotic hepatic metastatic neoplasm(1.61 ± 0.77 vs $2.55 \pm 0.52 \times 10^{-3} \text{mm}^2/\text{s}$, $P = 0$), which ADC value under the ROC curve (0.869), with a sensitivity of 96.3%, and a specificity of 73.2%. ADC values in cyst wall of two group were not significant(1.44 ± 0.52 vs $1.47 \pm 0.29 \times 10^{-3} \text{mm}^2/\text{s}$, $p = 0.627$). ADC values in normal hepatic parenchyma of two group were not significant(1.61 ± 0.45 vs $1.62 \pm 0.5 \times 10^{-3} \text{mm}^2/\text{s}$, $p = 0.865$)

CONCLUSION

ADC values in cavity proved to be helpful in differentiation of pyogenic hepatic abscess from necrotic hepatic metastatic neoplasm.

CLINICAL RELEVANCE/APPLICATION

When pyogenic hepatic abscess and hepatic metastatic neoplasm can not be identified for enhanced examination or some patients are unable to perform enhanced examinations due to renal insufficiency or contrast agent allergies, DWI examination proved to be helpful.

SSG04-08 Quantitative Liver Function Reserve Analysis for Hepatocellular Carcinoma with Preoperative Gd-EOB-DTPA enhanced MR Imaging: Validation with Indocyanine Green Tests and Functional Liver Volume

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E352

Participants

Mengqi Huang, MD, Guang Zhou, China (*Presenter*) Nothing to Disclose
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Shiting Feng, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the feasibility of functional liver volume for quantitative liver function reserve analysis in patients with hepatocellular carcinoma by preoperative Gd-EOB-DTPA enhanced magnetic resonance imaging (MRI)

RESULTS

The functional liver volume parameters FV, FV/W and T1HPB /LV (mean value: 879.93, 14.24, 0.18, respectively) were significantly correlated with ICG-R15 ($\rho = -0.552, -0.486, -0.579$; $p = 0.006, 0.019, 0.004$). T1/LV had the highest correlation with ICG-R15 among all the MRI functional quantitative parameter. The mean value of rLV, rFV, rFV/W, rT1/LV calculated using virtual resection protocol were 805.89 ml and 546.24, 9.13, 0.29, respectively. Based on Gd-EOB-DTPA liver function reserve analysis, all the patients received standard resection successfully. The Child scores one week after surgery were ranged from 5 to 8 (Child A: $n = 18$, Child B: $n = 4$), except 1 patient suffered severe hepatic insufficiency.

CONCLUSION

It is feasible to assess liver function reserve in patients with HCC before surgery by functional liver volume assessment in Gd-EOB-DTPA MRI combined with volumetric T1 mapping.

CLINICAL RELEVANCE/APPLICATION

Instead of ICG test, we provide a new method to assess the liver function reserve using preoperative Gd-EOB-DTPA enhanced MRI and may facilitate the determination of adopting optimize surgery approach.

SSG04-09 Characterization of Malignancy of Hepatocellular Carcinoma Using Deep Feature with Contrast-Enhanced MR

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E352

Participants

Wu Zhou SR, Shenzhen, China (*Presenter*) Nothing to Disclose
Qiyao Wang Sr, MSc, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
Hairong Zheng, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

This study proposes a systematic method to automatically extract deep feature from the arterial phase of Contrast-enhanced MR of hepatocellular carcinoma (HCC) using convolution neural network (CNN) in order to characterize its malignancy. Meanwhile, the performance of deep feature is objectively compared with that of texture features for malignancy characterization.

METHOD AND MATERIALS

Consecutive 46 patients with 46 histopathologically proved HCC were included in the study from September 2011 to October 2015

(43male, 3 female, aged 53.09 ± 12.45 years ranged 27 to 76 years). Gd-DTPA enhanced MR imaging were conducted with a 3T MR scanner. Of the 46 HCCs, one was Edmonson I, twenty were Edmonson II, twenty-four were Edmonson III and one was Edmonson IV (Low grade: I and II; High grade: III and IV). Firstly, each 3D tumor in the arterial phase was multiply resampled in three orthogonal views (Axial, Coronal and Sagittal) independently to increase training sets. Then, each view was performed with CNN to generate corresponding deep feature. Furthermore, a multi-kernel feature learning (MKL) method was investigated to fuse deep features derived from the three orthogonal views in a kernel space. Finally, experiments were conducted to evaluate the performance of the proposed method for malignancy characterization, and also objectively compared with the texture feature-based method with respect to the Axial view. 4-fold cross-validation with 10 repetitions on the 46 HCCs was used to test the proposed framework, in which 33 were randomly selected for training and the remaining 13 for testing.

RESULTS

In Axial view, deep feature (Accuracy: $91.08\% \pm 6.83\%$, Sensitivity: $89.17\% \pm 7.22\%$, Specificity: $92.58\% \pm 8.47\%$) clearly outperformed texture feature (Accuracy: $82.50\% \pm 12.70\%$, Sensitivity: $88.89\% \pm 11.15\%$, Specificity: $74.55\% \pm 22.01\%$) in terms of accuracy, sensitivity and specificity. Furthermore, the accuracy of fusion of deep feature from three orthogonal views using the MKL framework ($97.95\% \pm 5.12\%$) was much better than that of deep feature in single orthogonal views (axial: $91.08\% \pm 6.83\%$, Coronal: $76.15\% \pm 10.54\%$, Sagittal: $85.38\% \pm 5.68\%$) for malignancy characterization.

CONCLUSION

Deep feature was verified to be more powerful than the texture feature for malignancy characterization of HCCs.

CLINICAL RELEVANCE/APPLICATION

Deep features outperform texture feature for malignancy characterization of HCC, which may be extensively used for lesion characterization in clinical practice.

SSG05

Genitourinary (Multiparametric Prostate MRI)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S102CD

BQ GU MR OI

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

Participants

Aytekin Oto, MD, Chicago, IL (*Moderator*) Research Grant, Koninklijke Philips NV; Research Grant, Guerbet SA; Research Grant, Profound Medical Inc; Medical Advisory Board, Profound Medical Inc; Speaker, Bracco Group; ;
Antonio C. Westphalen, MD, Mill Valley, CA (*Moderator*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC
Matthew S. Davenport, MD, Cincinnati, OH (*Moderator*) Royalties, Wolters Kluwer nv; ;

Sub-Events

SSG05-01 Feasibility of Quantitative Dynamic Contrast Enhanced MRI Using Low Dose Gadolinium: Comparative Performance with Standard Dose in Prostate Cancer Diagnosis

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S102CD

Participants

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PURPOSE

We investigated whether administration of low doses of Gd for dynamic contrast enhanced (DCE) MRI can be effective as a standard dose in distinguishing prostate cancer (PCa) from benign tissue.

METHOD AND MATERIALS

Patients ($n=16$) with histologically confirmed PCa underwent preoperative 3T MRI using endorectal and phased array surface coils. DCE-MR images were acquired using two mDixon sequences at 8.3s temporal resolution with a low dose 0.015 and standard dose 0.085 mmol/kg of gadobenate dimeglumine (Multihance, Bracco) bolus injections. Low dose images were acquired for 3.5 min, followed by a 5 min gap before acquiring high dose images for 8.3 min. The data was analyzed by fitting signal intensity with an empirical mathematical model to obtain maximum intensity projection (MIP) and signal enhancement rate (a). Correlations of these parameters between low and standard doses of Gd administered were calculated. Receiver operating characteristic (ROC) analysis was performed to evaluate whether these parameters could distinguish between PCa and benign tissue using whole mount prostatectomy specimens as reference standard.

RESULTS

A moderately significant Pearson correlation for DCE parameters: MIP (0.53) and a (0.58) was found between low and standard doses of Gd. PCa showed significantly increased a compared to benign tissue for low (10.0 ± 5.8 vs 5.1 ± 2.9 s⁻¹), but not for standard dose (4.3 ± 2.2 vs 3.4 ± 1.5 s⁻¹). The ratio of low dose a to high dose a was significantly greater for PCa (2.8 ± 2.3) than for normal prostate (1.6 ± 0.9), suggesting changes in water exchange and T2* effects associated with cancer. Area under the ROC curve for differentiating PCa from benign tissue using a was higher for low dose (0.77, $p < 0.05$) compared to standard dose (0.63, $p > 0.05$). However, there were no significant differences between MIP calculated for PCa and normal tissue at both low (33 ± 12 vs $29 \pm 16\%$) and standard doses (110 ± 49 vs $94 \pm 43\%$).

CONCLUSION

Quantitative DCE-MRI with low Gd dose better distinguishes PCa from benign prostate tissue than standard Gd dose, based on signal enhancement rate. This may be due to water exchange and T2* effects. Further study is needed to find the optimal dose for PCa diagnosis using DCE-MRI.

CLINICAL RELEVANCE/APPLICATION

Prostate cancer diagnosis may be feasible with quantitative DCE-MRI with low dose Gd contrast.

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/> Aytekin Oto, MD - 2013 Honored Educator Aytekin Oto, MD - 2017 Honored Educator

SSG05-02 Pharmacokinetics Analysis and Prognostic Implications of Hypovascular Prostate Adenocarcinoma on Multiparametric MRI

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S102CD

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PURPOSE

To compare dynamic contrast-enhancement (DCE) parameters and pharmacokinetics analysis of hypo and hypervascular prostate cancer (PCa) as predictors of patient outcome.

METHOD AND MATERIALS

54 men who underwent 1.5T multiparametric (mp) endorectal prostate magnetic resonance imaging (MRI) from January/2012 to March/2014 were enrolled in this HIPAA-compliant, IRB-approved retrospective study. Lesions with signal intensity at least 10% lower than the normal peripheral zone on DCE analysis were called hypovascular (group-1); all others were considered iso or hypervascular (group-2). 2-compartment Tofts model was used for pharmacokinetics analysis. Patients' outcomes (biochemical failure - BF, metastasis, death) were recorded after a minimum 3-year follow-up. Only the index lesion was analyzed. Demographics, Gleason score, PSA, lesion size, mean ADC, Ktrans, Kep, slope and patients outcomes between the groups were compared using the t-test or the Mann-Whitney test. Logistic regressions were used to compare how DCE characteristics, i.e. group-1 or group-2 features, predicted outcomes.

RESULTS

Twelve lesions (22.2%) were hypovascular and 42 (77.8%) were iso/hypervascular. Age (0.40), follow-up time (0.24), mean ADC, and Gleason score (0.08) did not differ between groups. Group-1 had a higher PSA (87.6 vs 24.8; $p=0.01$) and larger lesions (33.1 vs 19.1 mm; $p<0.001$). Pharmacokinetics parameters were lower for group 1, confirming their hypovascular nature (Ktrans, 0.041 vs 0.083; $p=0.03$ and Kep, 0.067 vs 0.177; $p=0.04$). At multivariate analysis, the hypovascular pattern (group-1) was a predictor of poor outcome (BF or worse, OR=8.08, $p=0.02$ and metastases or death, OR=8.3, $p=0.05$).

CONCLUSION

Hypovascular tumors represent a small proportion of PCa, but the feature is an independent predictor of poor outcome.

CLINICAL RELEVANCE/APPLICATION

Hypovascular PCa have worse prognoses, indicating a major role for lesion characterization with dynamic contrast enhancement.

SSG05-03 3T Multiparametric MRI: Comparison of Performance With and Without Endorectal Coil for Prostate Cancer Detection, PI-RADS v2 Lesion Scoring and Staging with Whole Mount Histopathology Correlation in 429 Patients

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S102CD

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PURPOSE

To investigate prostate cancer (PCa) detection & compare the radiological & pathological characteristics of the lesions on 3T multiparametric MRI (mpMRI) with & without endorectal coil (ERC) with whole mount histopathology (WMHP) correlation.

METHOD AND MATERIALS

In this HIPAA-compliant, IRB-approved case control study, we evaluated a cohort of 429 men with prostate cancer who underwent 3T mpMRI from 7/2009 to 12/2016, prior to robotic prostatectomy. The subcohorts with & without ERC were evaluated. Tumor

detection rate was calculated for total & index PCa lesions. The MRI characteristics of true positive PCa lesions, including PIRADSV2 scoring, prostate volume, tumor volume & ADC value & pathology findings including tumor location & staging were evaluated between two groups. Chi-square & Independent sample T tests assessed the significance of discrete & continuous variables using SPSS v24.

RESULTS

A total of 871 consecutive WMHP localized lesions (54.2% clinically significant) in 429 patients with a mean age of 65.4±7 were included in the study cohort. The ERC & non ERC subcohorts comprised 260 patients with 529 lesions & 169 patients with 342 lesions, respectively. Tumor detection rates for overall, ERC & non ERC subcohorts were 49.5% (431/871), 50.3% (266/529) & 48.2% (165/342), & 77.6% (333/429), 78.5% (204/260) & 76.3% (129/169) for overall & index lesions, respectively (p >0.05). The ERC & non-ERC subcohorts detected 35.9% (66/184) & 48.4% (76/157) of anterior lesions (p =0.019), 58% (200/345) & 48.1% (89/185) of posterior lesions (p=0.025), 37.3% (41/110) & 54.4% (62/114) of transition lesions (p=0.010) & 53.7% (225/419) & 45.2% (103/228) of peripheral lesions (p=0.033). The individual lesion ADC, PIRADSV2 score, pathological staging, tumor volume & prostate volume were similar between two groups (p>0.05).

CONCLUSION

3T mpMRI with & without ERC had similar performance for overall & index PCa detection, PI RADS v2 scoring & staging. However, the ERC subcohort had significantly higher detection rates of clinically significant posterior & peripheral PCa lesions & lower detection rates of anterior & transition PCa lesions compared to non ERC subcohort.

CLINICAL RELEVANCE/APPLICATION

Although performance of 3T mpMRI with & without ERC is similar, ERC enables improved detection of posterior & peripheral lesions.

SSG05-04 PIRADS 2 Lexicon Deep Dive: Association between Lexicon Terms and Predictive Values

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S102CD

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PURPOSE

To determine the association between PIRADS v2 lexicon terms and histopathological outcomes in a blinded randomized setting to assess the discriminatory power of these terms.

METHOD AND MATERIALS

120 prostate MRI in patients with subsequent TRUS/MRI biopsy were evaluated in a blinded and randomized setting by two radiologists (>6 years of prostate MRI experience) using a dedicated review software. Lesions were marked and each lesion was characterized with respect to PI-RADS lexicon terms for shape and border. Lexicon terms describing diffusion weighted imaging were included for comparison. Positive and negative predictive values (PPV, NPV) were calculated for each of the terms and reported. A combination of high PPV/NPV was considered favorable for malignant features, a combination of low PPV/NPV for benign features.

RESULTS

A total of 134 lesions were identified of which 82 (61.2%) were positive for prostate cancer on histopathology. Separated by PI-RADS-Score, 5 PI-RADS 1, 37 PI-RADS 2, 14 PI-RADS 3, 29 PI-RADS 4 and 49 PI-RADS 5 lesions were marked and described. Terms denoting the lesions' shape performed as following (PPV/NPV): "round" 36.4%/54.3%, "oval" 40.2%/66.7%, "lenticular" 39.7%/75.0%, "lobulated" 40.3%/73.3%, "water dropshaped" 41.5%/90.9%, "wedge shaped" 35.3%/38.9%, "linear" (benign) 34.1%/9.1%, "irregular" 40.6%/66.7%. Terms describing the lesion s' borders as following: "circumscribed" 32.3%/55.1%, "non-circumscribed" 41.0%/83.3%, "indistinct" 39.4%/62.9%, "obscured" 48.4%/84.6%, "irregular" 40.9%/73.7%, "spiculated" 39.1%/100.0%, "encapsulated" 31.6%/11.8%, "organized chaos" 31.6%/11.8%, "erased charcoal" 41.7%/85.7%. DWI-associated terms: "restricted diffusion" 72.2%/83.8%, "DWI hyperintensity" 83.7%/87.1%, "ADC hyperintense" 37.9%/0.0%, "ADC isointense" 24.8%/10.3%, "ADC hypointense" 88.9%/79.6%.

CONCLUSION

Almost all DWI specific terms had a favorable PPV/NPV profile. In contrast PI-RADS lexicon terms describing lesions shape and border - with the exception of "encapsulated", "organized chaos" and "linear" to describe benign lesions - tended to have less favorable PPV/NPV mostly with a potential to describe but not exclude tumor (high PPV, low NPV). Values for the respective terms indicate areas of improvement, suggesting refinement of these terms.

CLINICAL RELEVANCE/APPLICATION

This study identifies PI-RADS lexicon strengths and weaknesses of PI-RADS terms to be addressed in further iterations of the lexicon with a potential to improve the reporting accuracy.

SSG05-05 Are Post-Contrast Images Really Helpful on Multiparametric MRI for Detection of Clinically Significant Prostate Cancer

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PURPOSE

To evaluate the incremental value of contrast-enhanced images for clinically significant prostate cancer detection on multiparametric MRI (mpMRI) prior to biopsy.

METHOD AND MATERIALS

IRB approved, prospective study. In an 8 months period, all men who underwent prostatic mpMRI in our institution without a prior diagnosis of clinically significant prostate cancer were enrolled. Patients performed mpMRI on a 3-Tesla scanner with a phased array coil using a routine protocol: T2-weighted, diffusion-weighted and dynamic post-contrast enhancement sequences. Two radiologists read images independently, first without, and subsequently including the post-contrast series. The analysis was performed on a sextant basis, and graded on 5-points scale for cancer suspicion. Sensitivity, specificity, PPV, NPV and accuracy for both readers were calculated using biopsy with imaging fusion ultrasound/mpMRI as the gold standard. The level for statistical significance was set at $p < 0.05$.

RESULTS

Of 449 patients enrolled in our study, 102 were submitted to prostate biopsy with US/MRI imaging fusion. Median time between MRI and biopsy was 15 days. Positivity for different levels of suspicion on mpMRI, comparing images without and with contrast, showed no statistically significant difference for both readers (p -values > 0.05). Sensitivity ranged from 64.5 to 77.7%, specificity from 58.9 to 67.0%, PPV from 23.9 to 25.6%, NPV from 91.8 to 92.8% and accuracy from 60.6 to 65.5%, also with no statistically significant difference between both protocols.

CONCLUSION

Our study shows that detection of clinically significant prostate cancer on mpMRI protocols with and without contrast-enhanced sequences were similar.

CLINICAL RELEVANCE/APPLICATION

A prostate MRI performed without contrast is desirable due to its lower cost, faster scanning time and increased safety for a broader range of patients.

SSG05-06 Influence of the Location and Zone of Tumor in Prostate Cancer Detection and Localization on 3T Multiparametric MRI Based On PI-RADS V2 on 39 Sector Segmentation: Correlation with Whole Mount Histopathology (WMHP) in 415 Consecutive Cases

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S102CD

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PURPOSE

To determine 3T mp-MRI for detection & localization of prostate cancer (PCa) using PI-RADS v2 scoring and segmentation stratified by location & zone correlated with whole mount histopathology (WMHP)

METHOD AND MATERIALS

With IRB & HIPAA compliance, we included 415 consecutive men with 3T mp-MRI within 90 days of robotic prostatectomy (RALP) & WMHP. A GU pathologist detected, graded & outlined each PCa lesion. Jointly a GU radiologist & pathologist classified each focus on mp-MRI with each PCa lesion on WMHP as true or false positive. Two other GU radiologists re-reviewed each mpMRI & assigned PI-RADS v2 scores to all previously detected mp-MRI foci and PI-RADS v2, 39 prostate sector model (for location and zone) in

consensus. Both a rigid (RS) & adjusted sector (AS) matching models were utilized to account for fixation related issues.

RESULTS

We analyzed 863 PCa foci & 16,185 prostate sectors. 3T Mp-MRI detected more PCa lesions in the midgland (54.9 % all & 83.1 % index lesions) than in base (42.1% all [p=0.04] & 64.0 % index lesions [p=0.02]) or apex (41.9% all lesions [p=0.001] and 71.4% index lesion [p=0.006]). There was no difference in detection between overall peripheral and transitional zone PCa (50.4 % vs 43.2 % (p=0.2)) or index PCa 79.1 % vs 73.1 % (p=0.2). The highest of PCa localization sensitivity was for midgland PCa vs. base or apical PCa. AS was higher than RS localization for overall (70.8% vs 36.0%) & index midgland PCa match (71.3% vs 43.7%). 3T Mp-MRI had greater sensitivity (p<0.05) of PZ PCa vs. TZ PCa localization for overall PCa (30.28% vs 24.53% by RS, 58.9% vs 51.2 % by AS match) and for index lesions (37.0% vs 29.2% by RS, and 58.4% vs 50.5% by AS match). 3T mp-MRI had similarly high specificity (93.8-98.3.%) for overall and index tumor localization when using both rigid adjusted sector match approaches.

CONCLUSION

Using 3T mp-MRI and the PI-RADS v2, achieved 83.1% sensitivity for detection of index PCa in the mid gland with 98.3.% specificity. Sectoral localization of PCa within the prostate was moderate and was best with an AS vs RS match.

CLINICAL RELEVANCE/APPLICATION

In this largest study to evaluate influence of the location and zone of tumor in PCa detection and localization on 3T mp-MRI with WMHP correlation. We have demonstrated excellent sensitivity and specificity for prostate cancer detection but moderate performance for intraprostatic sectoral localization, which may have implications for focal therapy.

SSG05-07 Comparison of Subjective and Quantitative Shape Analysis for Differentiation of Transition Zone Prostate Cancer (TZ PCA) From Benign Prostatic Hyperplasia (BPH)

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S102CD

Participants

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PURPOSE

TZ PCa overlaps in appearance with BPH nodules on MRI. Shape features favoring TZ PCa in PI-RADS version 2 include: non-circumscribed/spiculated margin with absent hypointense rim and lenticular shape. Reproducibility of these findings may be limited and have not been compared to quantitative analysis. This study compares subjective and quantitative shape analysis for differentiation of TZ PCa from BPH.

METHOD AND MATERIALS

With IRB approval, 22 TZ PCa were compared to 30 consecutive BPH nodules (15 stromal/15 glandular) identified using MRI-radical prostatectomy (RP) mapping. Two blinded radiologists (provided with location of lesions) subjectively evaluated: shape (round/oval vs lenticular), margin (smooth/lobulated or spiculated/irregular) and presence of hypointense rim on T2W-MRI. Radiologists manually contoured lesions which were quantitatively assessed for: circularity (roundness), convexity (lens shape) and number of skeleton branches/junctions (spiculations). Comparisons were performed using logistic regression, accuracy assessed with ROC and inter-observer agreement calculated.

RESULTS

There was no difference in size comparing TZ PCa to BPH (17.8 ± 6.4 vs. 18.7 ± 7.7 mm), p=0.64. Lenticular shape, irregular/spiculated margin and lack of hypointense rim were associated with TZ PCa (p<0.001). Inter-observer agreement was weak to moderate (K=0.32-0.48). Area under ROC curve (AUC) and sensitivity/specificity of shape and margin to diagnose PCa were: 0.77; 32.2%/100.0% and 0.89; 81.8%/96.7%. Hypointense rim showed AUC=0.89 with sensitivity/specificity of 70.3%/93.3% for diagnosis of BPH. There were significant differences in circularity and convexity (p<0.001) with no difference in number of branches comparing PCa to BPH (p=0.36). There was excellent agreement between readers with low mean difference. Circularity and convexity were accurate for diagnosis of PCa with AUC and SENS/SPEC of: 0.98; 95%/90% and 0.85; 73%/97%.

CONCLUSION

Lenticular shape is specific but insensitive for diagnosing TZ PCa with weak inter-observer agreement. Comparatively, quantitative shape features (circularity and convexity) showed higher accuracy and inter-observer agreement. Irregular/spiculated margin and lack of hypointense rim are accurate features of TZ PCa.

CLINICAL RELEVANCE/APPLICATION

Quantitative shape analysis improves accuracy and reproducibility for diagnosis of TZ PCa compared to subjective analysis.

SSG05-08 Validation of a Prospective Quantitative Evaluation of Gleason Score Prediction Using Prostate Diffusion Weighted Imaging: A Single Institution Experience in 293 Men with a Clinical Suspicion of Prostate Cancer

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S102CD

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PURPOSE

To evaluate the potential of prostate diffusion weighted imaging (DWI) for Gleason score (GS) prediction in men with a clinical suspicion of prostate cancer.

METHOD AND MATERIALS

A total of 315 men with a suspected prostate cancer (PCa) based on elevated PSA (2.5 - 20.0 ng/ml) were enrolled in single institutional registered clinical trials between March 2013 and March 2017. Three tesla biparametric MRI (bpMRI) was performed using surface array coils and consisted of T2-weighted imaging (T2w) and three separate epi read-out based diffusion weighted imaging (DWI) acquisitions (5 b values 0-500 s/mm², 2 b values 0-1500 s/mm², 2 b values 0-2000 s/mm²). The probability of a suspicious lesion containing Gleason grade 4 was prospectively assigned based on the apparent diffusion coefficient (ADC_m) maps calculated using a monoexponential fit and 5 b-values in the range of 0 to 500 s/mm². This probability was expressed as a Gleason grade score (GGS): 1. unlikely- ADC_m above or equal to 850 x 10⁻⁶ mm²/s, 2. probable: ADC_m below 850 x 10⁻⁶ mm²/s 3. highly probable- ADC below 750 x 10⁻⁶ mm²/s. All bpMRI reports were reported and/or approved by one reader before biopsy.

RESULTS

Two hundred ninety three (293/315, 93%) men completed bpMRI and subsequent biopsy procedure. GGS could not be assigned in 7 men (2%, 7/293) due to susceptibility artefacts. GGS of 1, 2, and 3 were found in 53% (152/286), 17% (48/286), and 30% (86/286) of men, respectively. PCa with GS of 3+3, 3+4, >3+4 was present in 14% (41/286), 24% (69/286), and 30% (86/286) of men, respectively, while targeted and systematic biopsy cores were free of cancer in 97 men (34%, 97/293). In 58% (88/152) and 18% (28/152) of men with GGS 1 no PCa and GS 3+3 was found, respectively, in contrast to 2% (2/86) and 8% (7/86) of men with GGS 3 (p<0.001). The negative predictive values of GGS 1 for GS >3+4 was 88% while positive predictive value of GGS 3 was 60%. The corresponding values for GS equal to or higher than 3+4 were 76% and 90% for GGS 1 and GGS 3, respectively.

CONCLUSION

Our newly developed system for GS prediction demonstrated high negative and positive predictive values for clinically significant prostate cancer in men with a clinical suspicion of prostate cancer.

CLINICAL RELEVANCE/APPLICATION

Prostate diffusion weighted imaging (DWI) performed as a part of biparametric MRI, T2-weighted imaging and DWI acquired using "low" and "high" b values, has a potential to predict the Gleason score.

SSG05-09 Characteristics of PI-RADS 4 Lesions within the Prostatic Peripheral Zone: A Retrospective Diagnostic Accuracy Study Evaluating 170 Lesions

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S102CD

Participants

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PURPOSE

To assess whether lesion shape, margination within the peripheral zone, or PI-RADS v2 diagnostic criteria impact accuracy in the detection of clinically significant cancer within the peripheral zone.

METHOD AND MATERIALS

This was an IRB-approved, HIPAA-compliant, retrospective diagnostic accuracy study to evaluate a subset of peripheral zone (PZ) lesions identified on multiparametric prostate MRI (mpMRI) at our large academic medical center. Our prospectively maintained mpMRI database was queried for all PI-RADS 4 (PR4) lesions reported over a 16-month period. Following pre-determined exclusion criteria, 170 PR4 PZ lesions (149 mpMRIs) were reviewed by two faculty abdominal radiologists, blinded to inter-reader assessment and pathologic outcome. Readers classified each lesion based on shape, margination within the PZ, and basis for PR4 score. Lesions were classified as: PR4 by a DWI score of 4, PR4 by a DWI score of 3 + early enhancement, or not meeting PR4 criteria. Lesions not meeting PR4 criteria (n=22) were excluded from the analysis of the remaining variables. All lesions within the study met the reference standard of MR-Ultrasound fusion biopsy. The primary outcome measure was detection of Gleason ≥ 7 prostate cancer. Logistic regression analysis and chi² testing were used for statistical analysis.

RESULTS

Oval shaped lesions were most strongly associated with clinically significant prostate cancer with a PPV of 59.4% (19/32 [p=0.03]). PR4 lesions with a DWI score of 4 were more likely to represent clinically significant prostate cancer than those with a DWI score of 3 + early enhancement (p=0.04). Lesions that did not meet PR4 criteria were statistically less likely to represent Gleason ≥ 7 prostate cancer (p=0.02).

CONCLUSION

PR4 PZ lesions with an oval shape or DWI score of 4 are more likely to represent clinically significant prostate cancer than the population of all PR4 lesions. Additionally, strict adherence to PI-RADS v2 criteria in classifying PZ lesions leads to exclusion of

lesions that are statistically less likely to represent clinically significant cancer.

CLINICAL RELEVANCE/APPLICATION

This study highlights a subset of PR4 lesions within the PZ that are associated with a higher probability of clinically significant prostate cancer. These findings may help radiologists in determining the suspicion of a given prostatic lesion and may help urologists in management of discordant targeted biopsies.

SSG06

Health Service, Policy and Research (Quality)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S104B

HP SQ

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

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Sub-Events

SSG06-01 Clinical Access to Radiology Reports: The Value of the Radiologist

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S104B

Awards

Student Travel Stipend Award

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PURPOSE

The value of radiology is an important topic as hospitals look to curb costs and improve patient outcomes. The radiology report is considered, at least by radiologists, to be instrumental in the imaging value chain. Additionally, in bundled payment schemes, the proportion of funds allotted to different specialties depends on perceived value. The radiology report is considered, by many, to be instrumental in the imaging value chain. Yet, few studies have identified who actually views the reports (i.e., who considers the reports valuable). We sought to determine if reports are viewed and by whom.

METHOD AND MATERIALS

Through our institutional clinical research center, image ordering data were retrospectively identified for a one month time period at a single quaternary care academic medical institution, as well as its satellite inpatient hospitals and outpatient clinics. Provider credentialing data was matched to the ordering data. Statistical analysis was then performed.

RESULTS

31,493 imaging orders occurred for 18,547 unique patients over a one month time period. At 5 months follow-up, 24,204 (77%) of all reports were viewed while 7,289 (23%) were never viewed. Outpatient providers were significantly ($p < 0.001$) more likely to never view the report (33% of the time) compared to both emergency room and inpatient providers (17% and 11%, respectively). Departments significantly more likely to not view study reports included orthopedics (31%), neurology (28%), and internal medicine (28%).

CONCLUSION

Review of radiology reports varies by department and provider level. Over one in five reports were never viewed, which has both cost and safety implications for the healthcare system, as well as further questions the value of the radiologist to those departments or providers with high non-viewing rates.

CLINICAL RELEVANCE/APPLICATION

These findings may allow for targeted value improvement projects to expand the radiologist's role and provide more value to the healthcare system.

SSG06-02 A Checklist Manifesto: Effectiveness of Checklist Use in Hands-on Simulation Examining Competency in Contrast Reaction Management and Conflict Resolution

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S104B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To assess the performance of a contrast reaction management (CM) checklist for optimal management of a contrast reaction scenario and conflict resolution using high-fidelity hands-on simulation in a randomized case-controlled study to prevent mortality and morbidity.

METHOD AND MATERIALS

A safety checklist (CL) was designed depicting the 5 most common adverse events after administration of intravenous contrast and their step-by-step management. After IRB approval, informed written consent was obtained from all participants. Forty-three radiology residents (PGY2-5) were randomized into CL (n=22) and control (n=21) groups, stratified by PGY. Both teams received CRM training 2-6 months prior to the study. Participants took written multiple choice question (MCQ) tests 2 months prior and immediately after the high-fidelity simulation scenario which were videotaped and independently evaluated by 3 graders. Built into the scenario was a confederate suggesting an improper medication treatment. The two groups were compared using the Wilcoxon rank-sum test.

RESULTS

Both groups scored similarly on the MCQ tests before the simulation (77% vs. 80%, $p=0.4$). The CL group overall scored significantly higher than the control group in their overall management of a severe contrast reaction (85% vs. 65%, $p=0.002$), particularly in first line treatment of bronchospasm (96% vs. 90%, $p=0.03$) and correct route and dose of epinephrine administration (77% vs. 46%, $p=0.02$). The CL group also tended to score higher at resolving the conflict when challenged by an authority with incorrectly suggested management (48% vs. 39%, $p=0.08$). There was no significant difference in MCQ test scores after the scenario between the groups (87% vs. 85%, $p=0.6$), though there was a trend towards more improvement in the CL group than the control group ($p=0.07$).

CONCLUSION

A standardized CM checklist is able to reduce the number of treatment errors during a severe contrast reaction management simulation, particularly the proper administration of epinephrine and treatment of bronchospasm. This could be used by radiologists, technologists, and nurses to improve patient safety for both CM and teamwork skills.

CLINICAL RELEVANCE/APPLICATION

Less experience in contrast reaction management (CM) can result in morbidity and mortality. A standardized CM checklist approach has potential to save lives in the event of a severe contrast reaction.

SSG06-03 Evaluation of Educational Sessions and the Use of the Radiology Support, Communication, and Alignment Network Platform in Reducing Inappropriate Imaging for Uncomplicated Low Back Pain

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S104B

Participants

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Christie M. Lincoln, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of this study is to evaluate the impact of educational sessions informing referring physicians on imaging guidelines for low back pain (LBP) on reducing inappropriate lumbar spine MRIs for uncomplicated LBP through the use of American College of Radiology's (ACR's) Radiology Support, Communication, and Alignment Network (R-SCAN) platform.

METHOD AND MATERIALS

Educational presentations were given at 3 clinics in April to May of 2016, which highlighted American College of Physicians and Choosing Wisely Campaign imaging guidelines for LBP, the R-SCAN platform, and its clinical decision support (CDS). Pre-implementation period was defined as June 1st, 2015 to March 31st, 2016. Post-implementation period was defined as June 1st, 2016 to March 31st, 2017. Wilcoxon signed rank test compared the mean monthly MRI orders from all 3 clinics during pre- and post-implementation period. Paired t-test compared the ACR Appropriateness Criteria Rating of MRIs ordered during pre- and post-implementation period. Chi-square test compared the proportion of appropriate MRIs based on the InterQual criteria and the criteria used by Center for Medicare and Medicaid Services on claims data (CMS-NQF criteria). Chi-square test additionally compared the frequency of physical therapy referrals for LBP during pre- and post-implementation. A p value < 0.05 was considered statistically significant.

RESULTS

The average monthly number of lumbar spine MRI orders for LBP per clinic following implementation was 6.13, which was

significantly lower than the average of 10.33 prior to implementation ($p=0.013$). The mean ACR Appropriateness Criteria Rating of lumbar spine MRI following implementation was 5.79, which was significantly higher than the mean rating of 4.67 prior to implementation ($p=0.014$). There were no significant differences in the proportion of physical therapy referrals and appropriate MRIs based on InterQual or CMS-NQF criteria before and after implementation.

CONCLUSION

The R-SCAN platform may be an effective tool to encourage collaboration between radiologists and referring physicians in reducing the proportion of inappropriate lumbar spine MRIs in patients with uncomplicated LBP.

CLINICAL RELEVANCE/APPLICATION

The R-SCAN platform allows referring clinicians to gain familiarity with the CDS process and prepare them for potential implementation of federal reimbursement requirements for CDS consultation in the era of value-based health care.

SSG06-04 Does the Probability that Radiologists Categorize Liver and Kidney Masses as Indeterminate for Malignancy Depend on the Organ, the Radiologist, or Exam Volume?

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S104B

Participants

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PURPOSE

Imaging findings indeterminate for malignancy are commonly detected in the liver and kidney. We explored whether the probability of categorizing indeterminate findings for an individual radiologist was related to the organ, the radiologist or their exam volume.

METHOD AND MATERIALS

The radiology department at our main hospital uses a standardized assessment scheme to categorize imaging findings in the liver and kidneys as benign, indeterminate for cancer, or suspicious for cancer on all US, MR and CT exams. We generated galaxy plots to estimate the probability that an individual radiologist would categorize an indeterminate finding in the liver (i.e. X axis) and kidney (i.e. Y axis) by exam volume. Dashed lines within each plot represent the mean probability across all radiologists. Estimates for high volume radiologists have higher precision, represented by smaller ellipses, than low volume radiologists. We included all exams performed between July 2013 and June 2015. We excluded non-abdominal imaging radiologists and those who interpreted less than 100 exams from analyses for individual modalities.

RESULTS

26 radiologists detected indeterminate masses in the liver or kidney on 7% (370/5,534) and 7% (353/5,068 kidney) of US exams, 3% (350/10,637) and 2% (182/10,659) of MRI exams, and 4% (1,294/ 32,199) and 3% (1,119 / 32,368) of CT exams. The probability that a radiologist would categorize an indeterminate mass in the kidney was directly correlated to the probability in the liver for all modalities; in other words most ellipses lay along a straight line from the bottom left corner through the intersection of the dashed lines. In general, high volume radiologists (i.e. small ellipses) had lower probability of assigning indeterminate masses in either organ on all modalities than low volume radiologists (i.e. large ellipses).

CONCLUSION

Radiologist categorization of indeterminate masses in the liver and kidney may be organ independent. High volume radiologists are less likely to categorize masses as indeterminate than low volume radiologists.

CLINICAL RELEVANCE/APPLICATION

The probability of categorizing indeterminate abdominal masses may be inherent to radiologists. Low volume radiologists may benefit from targeted education.

SSG06-05 Shedding Light on the Off-Hours Coverage Gap in Radiology: Improving Critical Results Reporting and Turnaround Times

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S104B

Participants

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PURPOSE

To demonstrate the magnitude of patient safety gains achieved through radiologist staffing changes at a academic medical center in terms of reporting turnaround times and reporting critical findings.

METHOD AND MATERIALS

A Kaizen event engendered a subspecialty team-based evening shift staffing plan. Inpatient reporting turnaround and critical results communication (CRC) times were evaluated before and after plan implementation. Pneumothorax on x-ray and intracranial hemorrhage (ICH) on CT in 2015 before implementation and in 2016 after implementation were identified using Primordial dashboard (Primordial, San Mateo, CA). CRC was extracted for each case. CRC and number of studies meeting the institutional CRC target goal of 60 minutes were compared before and after late-shift implementation for cases within the late-shift coverage using Mann-Whitney U test and chi-square test, respectively; as control the same parameters were also compared for cases outside the late-shift coverage timings. IBM[®] SPSS package (ver. 24) for used for statistical analysis.

RESULTS

No significant difference CRC for pneumothorax outside the late-shift (4-8 PM) ($p = 0.6$; before coverage: median: 143 mins, $n = 133$; after coverage: median: 123 mins, $n = 121$) was observed. There was a significant late-shift pneumothorax CRC reduction ($p = 0.02$; before coverage: median: 853 mins, $n = 31$; after coverage: median: 30 mins, $n = 25$) and a significant difference in the proportion of pneumothorax cases meeting the 60-minute target goal (52%) during the late-shift compared with 33% outside the late-shift ($p = 0.003$). For ICH, similar trends were observed with no significant difference in CRC for cases outside the late-shift ($p = 0.3$; before coverage: median: 81 mins, $n = 91$; after coverage: median: 182 mins, $n = 107$) and a significant difference in CRC for late-shift cases ($p < 0.001$; before coverage: median: 112 mins, $n = 66$; after coverage: median: 22 mins, $n = 93$). Similarly, there was a significant difference in the proportion of ICH cases meeting the 60-minute goal (57%) during late-shift coverage compared with 42% outside late-shift coverage ($p < 0.001$).

CONCLUSION

Matching staffing to inpatient imaging workflow patterns improves the management of critical findings and imaging findings in general with improved turnaround times.

CLINICAL RELEVANCE/APPLICATION

Inpatient delays present a major patient safety problem remediated through staffing improvements.

SSG06-06 Transition to 24/7/365 In-House Faculty Coverage: Improving Patient Quality and Safety While Maintaining the Integrity of Resident Education

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S104B

Participants

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PURPOSE

24/7/365 in-house faculty radiologist coverage is steadily becoming the new norm in academic departments. To address increased expectations of our emergency department, demands from surgical specialties and hospitalists, and our desire to provide accurate, final overnight reads, our academic department transitioned to such a call paradigm during 2016, abandoning the traditional independent house staff overnight call model. The desire to optimize radiology services, thereby improving quality and patient safety, was considered in concert with maintaining high-quality, rigorous resident training. In order to prioritize resident training while modifying our system of overnight call coverage, we gathered opinions and perceptions from resident trainees prior to the call transition and then again six months following the implementation of the new call model.

RESULTS

Twenty-seven of 32 (84%) residents responded to the initial survey gathering opinions and perceptions regarding resident education in advance of the call change. A majority of respondents (85%) predicted that the number of cases primarily interpreted by residents would decrease as a result of the presence of in-house faculty. Additionally, half of the resident trainees believed the development of autonomous resident decision making would be delayed as a result of in-house call supervision. In terms of one-on-one teaching at the workstation, 62% of residents felt that there would likely be more time for teaching with overnight faculty working in the reading room. New requirements for expedited turnaround times for initial or "wet" reads were viewed as likely favorable for patient care by 46% of those surveyed. Finally, 42% of the residents felt that non-subspecialty overnight reads were somewhat bad for patient care, while 50% viewed the practice as "neutral". Six months after the initiation of new call system, the resident trainees were invited to participate in a follow-up survey. Twenty-seven of 32 (84%) residents participated. Well over half (67%) of the trainees felt that the presence of in-house faculty did not change the number of cases primarily and independently interpreted. Similarly, 63% of respondents felt that the new system of call coverage did not affect the development of autonomous decision making or problem solving. In addition, 48% of residents experienced increased teaching and learning opportunities at the workstation. It was the opinion of 60% of residents that patient care had improved as a result of faster report turnaround time and overall increased resident supervision. Lastly, 52% of the residents would prefer to have subspecialty faculty render the final reads on exams.

CONCLUSION

As 24/7/365 in-house faculty coverage becomes the norm in academic radiology departments, being cognizant of factors contributing to successful resident training is essential. As our department prepared to initiate a new call model with around the clock in-house faculty, we gathered data regarding resident attitudes and predictions concerning education, patient care and report quality. Six months following the start of the new call protocol, we resurveyed our trainees to assess their subjective initial experience. Overall, the new call paradigm has been favorably received with the majority of residents feeling that there is no delay in the development of autonomous decision making and problem solving skills. Additionally, nearly half felt that there was more time at the workstation for one-on-one teaching compared with the previous system of overnight call. Residents also have favorable opinions regarding effects on patient care quality as a result of the presence of in-house overnight faculty, although were somewhat divided on having non-subspecialty radiologists issue final reads.

METHODS

Our thirty-two Diagnostic Radiology residents were invited by email to respond to an anonymous online survey in advance of changes to traditional independent house staff overnight call being replaced by 24/7/365 in-house faculty call coverage. The initial survey consisted of eleven single answer questions regarding opinions on the preferred work location of overnight in-house staff, as well as questions related to the anticipated effects of the new in-house faculty overnight coverage on resident call case volume, development of resident autonomous decision making, opportunities for teaching at the workstation, in addition to perceived effects on patient care and safety related to accelerated report turnaround time and final reads authored by non-subspecialists. Six months following the implementation of the new call system, a follow-up resident survey consisting of eight questions gathering subjective opinions regarding the effects of the new call system on call case volumes, perceived development of autonomous decision making, opportunities for teaching at the workstation and the perceived effects on patient care and report quality was sent by email invitation.

PDF UPLOAD

https://abstract.rsna.org/uploads/2017/17001362/17001362_c7eu.pdf

SSG06-07 Radiology Report Recommendations: An Actionable Value-Add?

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S104B

Participants

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PURPOSE

To investigate whether recommendations given in radiology reports contain specific, actionable information for the ordering physician.

METHOD AND MATERIALS

In this IRB approved, HIPAA compliant study, we performed a search of our PACS database for abdominal CT reports containing report recommendations from 1/8/15-11/7/15. Recommendations were categorized into: immediate further imaging work-up, follow-up imaging in 1-24 month, referral to subspecialist, correlation with laboratory testing, clinical correlation, correlation with prior outside imaging, follow-up only if clinically indicated. If further imaging evaluation was recommended, the modality and time interval for follow-up were noted.

RESULTS

11,520 CT examinations of the abdomen and pelvis were performed during the study period. 1,129 (9.8%) examinations contained a report recommendation. Percentage of report recommendations by staff member varied from 5.4-16.1%. The following action items were recommended: immediate further imaging evaluation of a suspected diagnosis n=466(41.3%), follow-up imaging at time intervals of 1-24 month n=261(23.1%), referral to subspecialist n=128(11.3%), repeat imaging due to technical issues n=6(0.5%). Additional recommendations (n=88,7.8%) included: correlation with laboratory testing (n=25), clinical correlation (n=28), correlation with prior outside imaging (n=35). 52 (4.6%) reports recommended imaging follow-up only if clinically indicated. A choice of imaging modality was given in 71 (6.3%) and of time interval in 72 recommendations (6.3%), time interval for follow-up was not specified in 48 recommendations (4.3%).

CONCLUSION

9.8% of abdominal CT reports contain a report recommendation. 72.1% of recommendations provide the ordering physician with specific actionable information. Attention to specifying follow-up recommendations in regards to imaging modality, follow-up interval and clinical scenario could improve 27.9% of reports.

CLINICAL RELEVANCE/APPLICATION

27.9% of report recommendations do not include all necessary information needed to be actionable for the ordering physician.

SSG06-08 Patient Satisfaction and Imaging Volume in Outpatient MRI

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S104B

Participants

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PURPOSE

Patient satisfaction is often regarded as a quality endpoint, but information acquired from satisfaction surveys may also provide insight into patients' preferences, especially when relative excess in imaging capacity allows patients greater flexibility in choosing where they undergo imaging. In this study, we test the hypothesis that the distribution of patient visits among MRI sites is influenced by factors affecting patient satisfaction.

METHOD AND MATERIALS

Outpatient MRI visits at a 10-site university-affiliated hospital system were analyzed during a 1-year period in which system-wide MRI volume gradually declined (April 2015 through March 2016). The study encompassed 42,236 MRI examinations total. Sites were classified as having "decreasing", "stable", or "increasing" volume trend using an average quarterly volume change threshold of 5%. Based on 1314 completed Press Ganey outpatient services surveys of MRI visits during the study period, net changes in each site's

satisfaction scores from the baseline fiscal quarter (Q4 FY15) were calculated. Effects of volume trend and fiscal quarter on satisfaction score changes were evaluated by two-way ANOVA.

RESULTS

Volume trend was stable at 6 of the 10 sites, increased at 1 site (by 18% per quarter), and decreased at 3 sites (by 10-24% per quarter). In the latter 3 quarters, average net change in satisfaction scores (from baseline [Q4 FY15]) at sites with decreasing volume were consistently negative and lower than at sites with stable or increasing volume. ANOVA shows statistically significant main effects of volume trend on net score changes for multiple subsections of the satisfaction survey: Overall Assessment ($p < 0.03$), Facility Section ($p < 0.006$), Personal Issues ($p < 0.002$), Registration Section ($p < 0.0001$), and Test or Treatment ($p < 0.03$).

CONCLUSION

Patient satisfaction and patient volume at MRI imaging sites are interrelated, and patient experiences or perceptions of quality of care may influence decisions regarding what imaging sites are preferentially utilized.

CLINICAL RELEVANCE/APPLICATION

Patient satisfaction with imaging experiences may have operational importance beyond being a quality metric due to its potential impact on imaging volume.

SSG06-09 Reading Room Huddles: An Initial Experience

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S104B

Participants

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Nadja Kadom, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

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PURPOSE

In our pediatric neuroradiology section it has become difficult to remind everyone of our performance goals on a daily basis, especially given presence of rotating trainees. Here, we report our initial experience of using a reading room huddle to communicate our daily section goals.

METHOD AND MATERIALS

A huddle form was created listing our Time Goals (attending arrival by 8:30 am, signing overnight studies by 11 am, hand-off with neuroradiologist on call at 4:50 pm, concluding service at 5 pm); Resource Availability (faculty, fellow and resident leave throughout the day, coverage for fetal MRIs); and Operational Functionality (determine who can protocol CT and MRI studies, check sedated studies, consult with clinicians (Figure 1). A survey was sent to assess the impact of the huddle, its strengths, and areas for improvement.

RESULTS

The huddle was performed on 23 weekdays since March 8, 2017. The huddle survey was sent to 11 participants and 9 responses were received. Positive impact on Time Goals was: 78% for attending arrival by 8:30 am, 89% for signing overnight studies by 11 am, 89% for hand-off at 4:50 pm, and 79% for concluding service at 5 pm. Positive impact on Resource Availability was: 78% for faculty, fellow and resident leave throughout the day, and 67% for coverage for fetal MRIs. Positive impact on Operational Functionality was: 56% for determine who can protocol CT and MRI studies, check sedated studies, and consult with clinicians. The strengths were "quick, organized, facilitates communications". Improvements were "daily review of the CT and MRI schedule".

CONCLUSION

We are successfully using reading room huddles to communicate our time goals, assure attending and trainee availability, and identify any education needs of trainees. The feedback shows a favorable rating of the reading room huddles, although hard data to check its impact on the performance goals remains to be collected and analyzed. After the initial success, our huddle form is now being adopted at additional reading sites within the adult neuroradiology section.

CLINICAL RELEVANCE/APPLICATION

Reading room huddles are a useful communication tool that can be used to assure that performance metrics, including those related to direct patient care, are effectively communicated on a daily basis.

SSG07

Informatics (Structured Reporting and Workflow)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: N230B

IN

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

Participants

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Pamela T. Johnson, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

Sub-Events

SSG07-01 Patient-Centered Radiology Reporting: Utilizing Online Crowdsourcing to Assess the Effectiveness of a Web-Based Interactive Radiology Report

Tuesday, Nov. 28 10:30AM - 10:40AM Room: N230B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To evaluate the effectiveness of a patient-centered web-based interactive mammography report.

METHOD AND MATERIALS

A survey was distributed on Amazon Mechanical Turk, an online crowdsourcing platform. The study population included 193 female U.S. residents ages 18 or older, randomized to one of three simulated BI-RADS 0 mammography reports: (1) web-based interactive report, (2) standard radiology report, or (3) Mammography Quality Standards Act (MQSA)-modelled patient letter. Participants responded to questions pertaining to report comprehension, satisfaction with and perception of the interpreting radiologist, and experience with the presented report. Two-tailed, non-paired t-tests and chi-squared tests were used to evaluate differences in responses between groups.

RESULTS

Report comprehension was significantly higher for the interactive web-based report group compared to the standard report group (1.9 vs. 1.7, $p=0.033$). Satisfaction with the interpreting radiologist was also significantly higher for the web-based interactive report group compared to the standard report group (22.1 vs. 19.7 out of 25, $p<0.001$). Overall, the patient letter group performed better than the standard report on many of the assessed criteria, however there were no significant differences between the patient letter and web-based interactive report groups.

CONCLUSION

This study suggests that radiology reporting style influences the effectiveness of result communication. Our data suggest that a web-based interactive patient report may increase report viewing time, patient comprehension, and satisfaction with the interpreting radiologist compared to the standard radiology report. Future work is needed to determine if these findings are reproducible in actual patient care settings, and to determine how best to use web-based portals for optimal patient-centered radiology communication.

CLINICAL RELEVANCE/APPLICATION

As online patient portals become more prevalent, radiologists must implement novel and effective methods to optimize patient communication, such as our patient-centered interactive report.

SSG07-02 Comparison of TIRADS Scoring Systems Using Consensus Lexicon

Tuesday, Nov. 28 10:40AM - 10:50AM Room: N230B

Awards

Trainee Research Prize - Fellow

Participants

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PURPOSE

To compare the predictive performance of six previously reported ultrasound (US) based thyroid nodule malignancy scoring systems and identify visual features that are most discriminative.

METHOD AND MATERIALS

After IRB approval, we collected US images of 47 malignant and 46 benign biopsy-confirmed nodules from 93 patients. Using the standardized lexicon for Thyroid Imaging, Reporting and Data System (TIRADS) of the ACR, we identified 20 descriptors reflecting presence or absence of the following visual features: solid, predominantly solid, predominantly cystic, cystic or spongiform composition; hyperechoic, isoechoic, hypoechoic or very hypoechoic echogenicity; taller-than-wide shape; smooth, irregular, lobulated or ill-defined nodule margin, halo, extrathyroidal extension, punctate echogenic foci, macrocalcifications, peripheral calcifications and comet-tail artifacts. Blinded to the diagnosis, an expert radiologist reviewed the images and recorded the features. We then compared six TIRADS scoring systems as described in the works of Park et al., Kwak et al. in 2011, Kwak et al. in 2013, Zayadeen et al., Russ et al., and the ACR TIRADS of 2017.

RESULTS

Malignancy prediction performance of the TIRADS scoring systems in terms of AUC was 0.73 for Park et al., 0.72 for Kwak et al. 2011, 0.81 for Kwak et al. 2013, 0.77 for Zayadeen et al., 0.78 for Russ et al. and 0.73 for ACR TIRADS. Analysis of feature importance, measured as decrease in AUC in its absence, revealed that the most important features were punctate echogenic foci for Russ et al. (0.05), Zayadeen et al. (0.05) and Park et al. (0.08), very hypoechoic echogenicity for Kwak et al. 2013 (0.06) and Kwak et al. (0.03), and macrocalcifications for ACR TIRADS (0.01). Univariate analysis revealed punctate echogenic foci to be the most discriminative individual feature with AUC of 0.68.

CONCLUSION

The use of descriptors derived from the standardized ACR TIRADS lexicon helped implement six risk stratification systems based on different lexicons. The best performing system, Kwak et al. 2013 with AUC of 0.81, was the only system based on multi-center studies. Presence of echogenic foci and very hypoechoic echogenicity were found to be most important features.

CLINICAL RELEVANCE/APPLICATION

The use of standard descriptors of thyroid nodule appearance enables the use of malignancy scoring and stratification systems, which could ultimately help decrease unnecessary biopsies.

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SSG07-03 Ontology-Driven Data Mining: Estimating Conditional Probabilities from Unstructured Radiology Reports

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N230B

Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

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PURPOSE

Conditional probability values -- used in radiology decision support systems -- typically have been provided by experts or computed from discrete data. We sought to develop an automated, ontology-based approach to estimate conditional probabilities from a database of unstructured, narrative-text radiology reports.

METHOD AND MATERIALS

The Radiology Gamuts Ontology (RGO) expresses knowledge of 13,965 diseases and imaging findings, and the 1,682 hierarchical ('is-a') relationships and 55,569 causal relationships between those terms. Using RGO terms and their synonyms, an information-retrieval system performed named-entity recognition and negative-expression filtering to identify positive mentions of RGO entities in all radiology reports generated by a large academic and community health system in 2016. Conditional probabilities were computed based on co-occurrence of entities in the set of patients using expected likelihood estimation ($\lambda=0.5$). The feasibility of the approach was tested using two examples of differential diagnosis based on the ontology.

RESULTS

The database contained 942,979 reports on 638,152 distinct patients. Conditional probabilities were estimated for the causes of two index conditions: diffuse bowel wall thickening and splenomegaly. The entities with the greatest conditional probability given the presence of diffuse bowel wall thickening were cirrhosis and hypoproteinemia, with estimated conditional probabilities of 17.5% and 12.8%, respectively. The probability of diffuse bowel wall thickening given the presence of systemic lupus erythematosus (SLE) was estimated as 0.08%; none of the 634 patients with SLE had a report that mentioned diffuse bowel wall thickening. The two most likely causes of splenomegaly were cirrhosis and leukemia, with conditional probabilities of 36.0% and 5.8%, respectively. A

Bayesian-network model was constructed using the probability estimates.

CONCLUSION

Ontology-driven mining of unstructured radiology reports can compute conditional probabilities for use in decision support systems.

CLINICAL RELEVANCE/APPLICATION

Ontology-based knowledge can guide a case-retrieval system to search radiology reports for terms related to imaging findings and their related causes. The approach can extract quantitative information from conventional narrative ('free-text') radiology reports, which can be used to improve diagnostic decision making in radiology.

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SSG07-04 Recall of Unstructured Radiology Reports is Significantly Inferior to Recall of Structured Reports

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N230B

Participants

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PURPOSE

To measure recall of structured compared to unstructured radiology reports.

METHOD AND MATERIALS

Institutional review board approval was obtained. A structured radiology report is a uniform report template that uses headings and subheadings followed by standardized statements to create uniformity and improve communication with referring physicians. A structured radiology report differs from the "free text" radiology report, which lacks headings or a standardized format. Four hypothetical radiology reports, two structured and two unstructured, were devised based on a review of common cross-sectional imaging studies. The reports, each followed immediately by a multiple-choice questionnaire listing possible diagnoses from the report, were distributed to healthcare professionals using a web-based survey tool, respondents consented to the survey. The diagnoses included in the multiple choices were either present in the radiology reports or were dummy diagnoses. Based on the number of correct responses, correct critical findings and incorrect responses, rates per number of potential diagnoses were calculated for each individual and averaged. The paired sign test compared results between structured and unstructured reports.

RESULTS

148 healthcare professionals completed the survey. The mean percentage of incorrect diagnoses was 4.5% for structured reports compared to 16.7% for unstructured reports ($p < 0.001$). The average rate of critical diagnosis recall was 82.7% for structured reports and 65.1% for unstructured reports ($p < 0.001$). The average percentage of all diagnoses detected (respondent sensitivity to recall any of the report diagnoses) for structured compared to unstructured reports was 64.3% and 59.0%, respectively ($p = 0.007$).

CONCLUSION

Recall of unstructured radiology reports is significantly inferior to recall of structured reports immediately after reading the report. Structured reports more accurately convey the salient findings of a radiology study.

CLINICAL RELEVANCE/APPLICATION

Structured radiology reporting leads to fewer missed critical findings and better recall of critical findings. Structured radiology reporting is therefore likely to improve patient care through the more efficient transfer of information from the radiologist's report to the referring clinician.

SSG07-05 Flexible and Scalable Radiation Dose Monitoring and Reporting using RadLex Playbook

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N230B

Participants

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CONCLUSION

We demonstrated the ability and utility of the RadLex Playbook to unify diverse names across devices within an institution and to facilitate dose reporting in individual types of imaging procedures as well as groups of procedures. Our work and results should be

applicable to other institutions and types of procedures, and may streamline and improve dose reporting and monitoring.

Background

Monitoring and reporting radiation dose in imaging procedures is challenging due to variation in naming conventions. It is also difficult to create reports that aggregate several types of procedures relevant for dose reporting. Our goal was to adapt and apply the RadLex Playbook standardized nomenclature to unify disparate names of CT imaging procedures to enable dose reporting and summarization of dose data according to clinically relevant groups of procedures.

Evaluation

The RadLex Playbook provides a composable grammar for naming imaging procedures using RadLex atomic terms. We extended Playbook V2.3 to cover specific aspects of CT imaging that are needed for reporting dose information (e.g., pediatric vs. adult subject, age range, and field of view) at our institution. We created Playbook identifiers and corresponding sets of RadLex terms to describe CT imaging procedures at our institution (e.g., Pediatric head (32-cm) 6-15y) and mapped them to the various procedure names collected in our dose reporting system (DoseWatch, GE Medical Systems). We then wrote queries to generate dose reports for 20 different types of CT procedures as well as 7 types of high-level queries that aggregated several types of CT procedures (e.g., average dose for all perfusion head CT procedures).

Discussion

A major challenge for dose reporting is variations in naming procedures across institutions within a single hospital system, and even among imaging devices in a single hospital. By using Playbook and doing a one-time mapping to the disparate names used by the different devices, we could generate dose reports in a facile manner. Moreover, we could easily generate reports that aggregate many different types of imaging procedures, such as determining the average dose of all different kinds of perfusion head CT procedures.

Honored Educators

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SSG07-06 Multicenter Implementation of a Quality Project on MR Protocol and Workflow Optimizations Based On Clinical Indication: Preliminary Results from a Prospective Study

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N230B

Participants

Christopher M. Ahlers, MD, Mainz, Germany (*Presenter*) Nothing to Disclose
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Federica Zanca, PhD, Digem, Belgium (*Abstract Co-Author*) Employee, General Electric Company

PURPOSE

In clinical routine, MRI protocols are not often harmonized across scanners with consequent large variation in exam duration and inefficient machine utilization. The aim of this study was to harmonize and optimize MRI protocols thanks to data analytics.

METHOD AND MATERIALS

Data from a multicenter setting comprising 4 hospitals and 5 MR scanners (four 1.5 T, one 3T, GE Healthcare) were collected through a software. A core-team was set-up (one radiologist and one referring technologist, MR application specialist). A comprehensive four-steps strategy was implemented: 1) MPPS and DICOM headers data collections on a central server; 2) data analyses through an ETL (Extract Transform Load, Talend) module and a business-intelligence software (Centricity Insights, GE Healthcare); 3) protocol and workflow optimization; 4) assessment modification on practices. In the data analyses phase, focus was set on 3 scanners (two 1.5T and one 3T) and 3 protocols per scanner (knee, shoulder, cervical spine CS, lumbar spine LS depending on the scanner). In the optimization phase, tweak of scan time, matrix size, number of excitation, acceleration factor and field of view were implemented to harmonize the total sequence duration if possible. Image quality was also assessed.

RESULTS

About 3300 exams were collected. We identified strong variations in scan duration between scanners for the 4 most practiced procedures (Knee, Shoulder, LS, CS). As an example, for shoulder we identified a variation of 4 min between 2 systems (from 12 min to 16 min). In that case, sequence Cor PD FS FSE showed a difference of 1:12min (3:02min vs 4:14min) which was reduced to 4 seconds between machines (3:02min vs 3:06min) by harmonizing acceleration factors and matrix size. Generalizing this approach to all sequences of shoulder protocol allowed to reduce the exam duration by 13%. Generalizing to most performed procedure and optimizing the scheduling allowed an increase of 20 exams/week (14% of total activity). Preliminary results on image quality confirmed diagnostic level.

CONCLUSION

By implementing automatic collection of operational and clinical data in MR we could standardize and harmonize protocols to guarantee uniform diagnostic image quality while increasing productivity and patient satisfaction.

CLINICAL RELEVANCE/APPLICATION

Harmonizing and optimizing MR protocols as well as scheduling implies quality in healthcare and increased productivity.

SSG07-07 Light-Messenger: A Web-Based, Gamification Enhanced Notification System to Replace Intra-

Department Phone Calls with Light Signals in a CT and MRI Protocolling Workflow

Tuesday, Nov. 28 11:30AM - 11:40AM Room: N230B

Participants

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PURPOSE

To reduce frequent intra-departmental phone calls in a digital protocolling workflow during radiology scheduling. Scheduling CT/MRI technologist frequently call each subspecialty section (40-60 calls/day) as a reminder to protocol urgent or non-urgent requests in order to complete scheduling of in- and outpatients.

METHOD AND MATERIALS

A web-based platform was conceived to substitute phone calls with a light signal in each reading room through a "sender" web page offering 3 buttons for each subspecialty to broadcast "please protocol" with different color-coded priorities: low (green) = non-urgent protocol; medium (orange): protocol in the next 15 minutes; high (red) = protocol immediately. A java-based server application (Java EE) addresses microcontrollers (Arduino YUN) in each reading room which control LED strips. The radiologists confirm on a "receiver" website that they a) perceived the signal and b) will protocol. A gamification system with high score ranking was implemented adding achievements such as "first confirmation of the day", "fastest confirmation time", "most confirmations a day" et cetera. Prior and post introduction of the "light messenger" an online survey was conducted to assess satisfaction with the protocolling process and identify reasons for discontent. Furthermore, RIS timestamps from order entry and protocolling performed events were gathered to analyze the duration of the protocolling process.

RESULTS

Since the introduction in 8/2016 duration from order entry to protocolling was reduced by 28% for the median (36 to 26 min.); 31% for the upper (171 to 118 min.) and 11% for the lower quartile (9 to 8 min.). Satisfaction with the scheduling process increased for all teams especially the CT team. In the survey "frequent queries necessary" was listed 42% less as a primary reason for discontent, "frequent phone calls" 27% less and the "protocolling duration" 38% less. On average 40 phone calls/day were replaced with non-disruptive light signals.

CONCLUSION

A formerly disruptive workflow was transformed into a less disruptive process with increased satisfaction across teams, more time for core activities and shortening of scheduling duration.

CLINICAL RELEVANCE/APPLICATION

More time for core activities and less disruption ultimately translates into better patient care by faster scheduling and more time to focus on image acquisition and reading.

SSG07-08 Toward Interoperability of Image Annotations: Automated Conversion of Image Annotations in PACS to the Annotation and Image Markup Format

Tuesday, Nov. 28 11:40AM - 11:50AM Room: N230B

Participants

Nathaniel Swinburne, MD, New York, NY (*Presenter*) Nothing to Disclose
Hakan Bulu, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose
Sara Lewis, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
David S. Mendelson, MD, Larchmont, NY (*Abstract Co-Author*) Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Medical Systems Corporation Advisory Board, Bayer AG
Daniel L. Rubin, MD, MS, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

As quantitative imaging becomes more prevalent in radiology, interoperability of image annotations gains increasing importance. Our work provides a mechanism to expose this data and enable easy exchange and incorporation with other structured and quantitative data in the patient's longitudinal medical record. This first step along with the harmonization of AIM with DICOM-SR could ultimately improve patient care in multiple use cases including treatment response evaluation.

Background

Sharing radiologic image annotations among multiple institutions is important in many clinical scenarios such as tracking cancer

lesions; however, interoperability is thwarted because different vendors' PACS store image annotations in non-standardized, proprietary formats. Interoperability of image annotations is also crucial for data sharing efforts such as the RSNA Image Share initiative. Our goal was to develop software to automate conversion of image annotations in a commercial PACS to the Annotation and Image Markup (AIM) standardized format.

Evaluation

Utilizing the Pixelmed library of DICOM tools and AIM application programming interface (API), we created a software module in Java to parse the DICOM presentation state (DPS) objects (which contain the image annotations) for an imaging study exported from a commercial PACS (GE Centricity v3.x). Our software identifies line annotations encoded within the DPS objects and exports the annotations in the AIM format. To validate the interoperability of our approach, we used our software to import annotations from Centricity PACS into ePAD (<http://epad.stanford.edu>), a freely available AIM-compliant workstation, and the line annotations were correctly displayed as overlays on the appropriate DICOM images.

Discussion

Our work demonstrates that proprietary format DICOM image annotation data can be automatically converted to a standardized format such as AIM, enabling interoperability and use by vendor-neutral applications. This effort could be extended for use with other vendors' PACS.

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SSG07-09 Readability of Radiology Reports

Tuesday, Nov. 28 11:50AM - 12:00PM Room: N230B

Awards

Student Travel Stipend Award

Participants

Teresa Martin-Carreras, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Charles E. Kahn JR, MD, MS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

Radiology reports often contain complex sentences, polysyllabic terms, and concepts that may be unfamiliar to those outside of radiology. As increasing numbers of patients read radiology reports, the reports' high reading levels may present challenges to their understanding. The average U.S. adult reads at an 8th grade reading level, and fewer than 4% of all radiology reports in our sample were readable at or below this level. While the target audience of radiology reports has traditionally been the referring provider, the ready access to online medical records requires that radiologists consider the impact of their reports on the patient, and emphasizes the need for the expansion of lay-language resources which may facilitate patient understanding of their radiology reports.

Background

Although originally written primarily for referring healthcare providers, radiology reports are increasingly read by patients as health systems institute electronic health portals for patients to access their medical records. This report sought to assess the readability of radiology reports.

Evaluation

Radiology reports from January 1, 2017 to February 3, 2017 from a large health system were randomly sampled and reviewed retrospectively. The number of words and sentences in each report was computed. Three readability indices were measured: Flesch-Kincaid Grade Level (FKGL), Gunning Fog index (GFOG), and Simple Measure of Gobbledygook (SMOG). A "reading grade level" was computed as the mean of the three indices for each report. Mean and standard deviation (SD) were computed for the reports' sentence count, word count, and readability indices. Pairwise correlation between readability indices was measured. This HIPAA-compliant study was approved by the organization's Institutional Review Board; informed consent was waived.

Discussion

Of the 108,228 reports sampled, 2,947 duplicate reports were excluded. The 105,281 included reports contained a mean (\pm SD) of 17.8 ± 13.1 sentences and 205 ± 161 words. The mean reading grade level was 12.9 ± 2.4 . There were 4,094 reports (3.9%) at reading grade level ≤ 8 , of which 650 reports (0.6%) were at reading grade level ≤ 6 .

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SSG08

Molecular Imaging (Oncology)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S504CD

BQ MI NM OI

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
Gabriel C. Fine, MD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

SSG08-01 Detection of Metabolic Subgroups in DEN-Induced HCC Using Hyperpolarized 13-C-Pyruvate-MRSI

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S504CD

Awards

Student Travel Stipend Award

Participants

Georgios Kaissis, MD, PhD, Munchen, Germany (*Presenter*) Nothing to Disclose
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Geoffrey Topping, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Hepatocellular carcinoma (HCC) is characterized by genetic, structural and metabolic heterogeneity. Since tumor metabolism is a possible target for oncological pharmacotherapy, non-invasive methods for subgroup detection and stratification are needed. Notably, differentiation of highly glycolytic tumors from those with lower glycolytic capacity is a promising target for stratification and therapy. The aim of this study is to evaluate magnetic resonance spectroscopic imaging (MRSI) using hyperpolarized 13-C-Pyruvate as an imaging modality for non-invasive detection of metabolic tumor heterogeneity in diethyl nitrosamine (DEN)-induced HCC in rats.

METHOD AND MATERIALS

A total of 21 tumor bearing and 5 control animals were imaged using free-induction-decay chemical-shift imaging (FID-CSI). Signal intensity ratios between Lactate and Alanine (Lac/Ala-Ratios) were calculated based on label exchange between hyperpolarized metabolites. Tumors were removed and subjected to histopathology and immunostaining. In addition, rtPCR of tumor extracts was performed and LDH and GPT activities measured in tumor extracts using liquid NMR spectroscopy.

RESULTS

Lac/Ala-Ratio was significantly higher in HCC precursor lesions and in HCC than in normal liver ($p=0.0007$). LDH/GPT ratios in tumor extracts correlated positively with Lac/Ala-Ratios ($R^2=0.357$). rtPCR of tumor extracts yielded increasing expression levels of glycolytic enzymes and increasing expression of EpCAM with increasing Lac/Ala ratios.

CONCLUSION

MRSI with hyperpolarized metabolites can reliably differentiate between normal liver and HCC and is able to discern highly glycolytic tumors, offering a non-invasive approach for tumor stratification and a potential readout for non-invasive monitoring of antiglycolytic pharmacotherapy in HCC.

CLINICAL RELEVANCE/APPLICATION

This preclinical study demonstrates the usage of hyperpolarized MRSI for metabolic tumor subgroup detection in HCC. This method can aid future translational and personalized medicine approaches in pre-therapy risk stratification by allowing non-invasive and radiation-free characterization of tumor biology.

SSG08-02 Comparison of 68Ga-PSMA PET/CT with Multiparametric MRI for Staging High Risk Prostate Cancer

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S504CD

Participants

Chandan J. Das, MD, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose

Madhavi Tripathi, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Shruti Tulsyan, MBBS, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Amlesh Seth, MBBS, MCHIR, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To compare Ga-68 PSMA PET/CT with MPMRI for the staging of high risk prostate cancer.

METHOD AND MATERIALS

This was a prospective study in which 36 patients with high-risk prostate cancer with a serum PSA ≥ 20 and/or Gleason's Score ≥ 8 . Each patient then underwent both Ga-68 PSMA PET/CT and MPMRI including DWIBS within an interval of one week. For comparison, the prostate gland was divided into twelve segments, the segment with the highest SUVmax and lowest ADC value was localized as the probable primary site. If this segment corresponded on PET/CT and MRI it was taken as concordance and if abnormal tracer accumulation was seen to extend into either seminal vesicle it was taken as involvement on PET. Lymph node and skeletal involvement was evaluated on a per patient basis and regional basis. Each patient was staged using TNM classification on both modalities and compared.

RESULTS

Median age of 36 patients included was 65 years and median PSA was 94.3 ng/ml. Concordance for localization of primary on Ga-68 PSMA PET/CT & MRI was seen in 19/36 36 patients (52.7 %). PET was incorrect for seminal vesicle involvement in 8 patients. Capsular involvement could not be commented upon on PET. T staging on Ga-68 PSMA and MRI was similar in 21/36 patients (58.3 %) and differed in 15/36 patients (41.7 %). Ga-68 PSMA PET/CT detected higher number of patients with regional (44) lymph nodes in comparison to MRI (25). Concordance for regional lymph node staging was seen in 25 patients (69.4 %) and for non-regional lymph node staging in 26 patients (72.2 %). In one patient PET/CT reported skeletal metastases which was not seen on MRI. Ga-68 PSMA PET/CT detected distant metastases involving lung (2 patients) and liver (1 patient) not seen on MRI. In comparison to MRI. Ga-68 PSMA PET/CT changed M stage from M0 to M1a in one patient, from M0 to M1b in 1 patient and from M1b to M1c in 3 patients.

CONCLUSION

In comparison to MRI Ga-68 PSMA PET/CT was able to detect more lymph node (both regional and non-regional) involvement as well as metastases. It was also useful for localization of primary cancer. However concordance for primary localization by Ga-68 PSMA PET/CT was limited and so was the depiction of capsular invasion and seminal vesicle involvement.

CLINICAL RELEVANCE/APPLICATION

Ga-68 PSMA PET/CT is useful for lymph node and metastases staging in high-risk prostate cancers and presently its utility for staging of disease in the prostate is limited.

SSG08-03 HER2-Positive Tumor Accumulation of Conventional Heterogenous versus Novel Site-Specific Ga-67 Radiolabeled Anti-HER2 Antibody

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S504CD

Participants

Yumiko Kono, MD, Hirakata, Japan (*Presenter*) Nothing to Disclose
Keita Utsunomiya, MD, PhD, Moriguchi, Japan (*Abstract Co-Author*) Nothing to Disclose
Yuta Ohira, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Hirokazu Satoh, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoki Kan, Hirakata, Japan (*Abstract Co-Author*) Nothing to Disclose
Yohei Matsumoto, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose
Yasuhiro Ueno, Moriguchi, Japan (*Abstract Co-Author*) Nothing to Disclose
Kaoru Maruyama, Hirakata, Japan (*Abstract Co-Author*) Nothing to Disclose
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Noboru Tanigawa, MD, Hirakata, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare the accumulation of Ga-67 labeled anti-HER2 antibodies with novel homogeneous site-specific conjugation versus conventional chemical, heterogeneous site, conjugation in HER2-positive tumors.

METHOD AND MATERIALS

First, anti-HER2 antibody was chemically conjugated with deferoxamine. The resulting chemical conjugate was radiolabeled with Ga-67 (Chem-Ab). Second, site-specific anti-HER2 antibody conjugation was performed with 67-Ga radiolabeled transglutaminase (SSC-Ab). In vitro, binding activity of HER2 to both antibodies, Chem-Ab and SSC-Ab, was evaluated using ELISA with fluorescent antigen labeling. In vivo, a xenograft mouse model consisting of subcutaneously transplanted CHO cells with HER2 overexpression was established. We divided the subjects into the Chem-Ab group (n=7) and the SSC-Ab group (n=7). Planar images were acquired over three days, for both groups, after antibody injection and the tumor / whole body count ratios (T/WB ratio) was measured. On the fourth day, pharmacokinetic analysis was used to compare the Chem-Ab group to the SSC-Ab group, in both whole organs and tumor, for Ga-67 accumulation of.

RESULTS

SSC-Ab was found to have a higher binding capacity than Chem-Ab. The T/WB ratio increased in both groups. On the third day, the SSC-Ab group had a significantly higher T/WB ratio than the Chem-Ab group (p=0.03). In the SSC-Ab group, the antibody

accumulation was significantly higher than the Chem-Ab group in not only the tumors (20.37, 15.08 %ID/g, $p=0.016$), but also in the liver and spleen.

CONCLUSION

The site-specific conjugation method enhanced the accumulation of the anti-HER2 antibody labeled with Ga-67 in tumors and also in the liver and spleen as well.

CLINICAL RELEVANCE/APPLICATION

Novel homogeneous site-specific antibody conjugation with Ga67 may offer improved efficacy in solid tumour radioimmunotherapy over conventional heterogeneous conjugation.

SSG08-04 Improved Oncological 18F-FDG PET Imaging Using Concurrent Octreotide Acetate Administration to Suppress Brown Fat and Cardiac Uptake

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S504CD

Awards

Student Travel Stipend Award

Participants

Pedram Heidari, MD, Boston, MA (*Presenter*) Nothing to Disclose

Peiman Habibollahi, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Umar Mahmood, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Co-Founder, CytoSite Biopharma; Stockholder, CytoSite Biopharma; Consultant, CytoSite Biopharma

PURPOSE

This study evaluates the effect of octreotide acetate (OCT) in improving the FDG biodistribution for oncological imaging, with assessment of the likely mechanism of action.

METHOD AND MATERIALS

To demonstrate a somatostatin receptor (SSTR)-independent effect, AR42J (high), HT-29 (low) and A549 (negligible SSTR) cell lines were incubated with FDG and OCT at 10^{-11} to 10^{-6} M concentration and were counted for tracer retention. Temporal serum insulin (INS) level was measured using ELISA in mice that received an IP dose of vehicle or OCT (0.6-5 mg/kg). HT-29 bearing mice were fasted for 4h and treated with an IP injection of saline (control), OCT (5mg/kg), or OCT+INS (Novolin 5 IU/kg) 20 minutes before FDG injection and were subsequently imaged using PET or sacrificed to measure FDG organ biodistribution. Cytosolic and plasma membrane (PM) Glut-4 expression were measured using Western blot of tumor, muscle, brown fat and heart in all groups.

RESULTS

There was no significant difference in FDG uptake of HT-29, A549 or AR42J cells treated with different doses of OCT. There was a significant dose-dependent reduction in the serum INS in mice treated with OCT which peaked at 15-30 minutes. A significant reduction in SUVmean of cardiac muscle and brown fat was seen in OCT compared to control group, while the tumor uptake was similar between 2 groups. The OCT+INS group had intense uptake in cardiac muscle and brown fat and reduced uptake in the tumor. FDG uptake in the biodistribution studies paralleled those of PET. We note a decline in the Glut-4 PM fraction in heart and skeletal muscle, brown fat, and tumor in the OCT group compared to control and OCT+INS groups. The cytosolic fraction of Glut-4 increased in the OCT group.

CONCLUSION

OCT can improve the FDG biodistribution for oncological imaging, resulting in minimal change in tumor uptake, and reduced brown fat and cardiac uptake. The mechanism likely involves reduction of serum INS and decrease of Glut-4 PM fraction. The tumor uptake is not affected as it is usually mediated via highly expressed Glut-1 and 3.

CLINICAL RELEVANCE/APPLICATION

Brown fat and cardiac uptake pose diagnostic challenges in oncological FDG PET imaging. Octreotide injection could offer an alternative to strict and cumbersome protocols for reduction of brown fat and cardiac uptake without a significant effect on tumor FDG uptake.

SSG08-05 Orthotopic Hepatic Cancers: Optical Imaging-Monitored Intratumoral Radiofrequency Hyperthermia-Enhanced Direct Oncolytic Virotherapy

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S504CD

Participants

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PURPOSE

To investigate the feasibility of using molecular imaging-guided intratumoral radiofrequency hyperthermia (RFH) to enhance the direct oncolytic virotherapy of orthotopic hepatocellular carcinoma (HCC) in rats.

METHOD AND MATERIALS

This study included in-vitro confirmation experiments using luciferase-labeled rat hepatic cancer cells (McA-RH 7777) and in-vivo validation experiments on orthotopic hepatic cancers in nude rats. Both cells and hepatic cancers in four groups (n=6/group) were treated by: (i) combination therapy with intratumoral oncolytic virotherapy (T-VEC) plus RFH at 42 ° for 30 minutes; (ii) T-VEC alone; (iii) RFH alone; (iv) phosphate buffered saline (PBS). For in-vitro confirmation, confocal microscopy and bioluminescence optical imaging of cells in agarose were used to evaluate the cell viabilities and apoptosis. For in-vivo validation, T-VEC were directly infused into the margins of hepatic cancers through the injection needles of a multipolar RF probe, followed by RF hyperthermia at 42 ° for 30 minutes. Optical imaging and ultrasound imaging were used to follow up bioluminescence signal and size changes of tumors over two weeks, which were correlated with subsequent histology analysis.

RESULTS

Of in-vitro experiments, confocal microscopy showed the lowest number of viable cells, as well as a significant decrease of bioluminescence signal intensity of cells in combination therapy group, compared to the other three control groups ($P < .001$). Of in vivo experiments, optical imaging demonstrated significantly decreased bioluminescence signal intensity in combination therapy group, compared with the other three treatment groups ($P < .05$). Ultrasound images showed the smallest tumor volumes of the combination therapy group, in comparison to the other three treatment groups ($P < .05$). Imaging findings were well correlated with the increased apoptosis in the combination therapy group, compared to other three control groups (Figure).

CONCLUSION

We have validated the feasibility of using intratumoral RFH to enhance oncolytic virotherapy of HCC, which is effectively monitored by optical imaging and ultrasound imaging techniques. This new concept may open new avenues for eradicating the residual tumor at the margins of RF ablated HCCs.

CLINICAL RELEVANCE/APPLICATION

This study may open new avenues for eradicating the residual tumor at the margins of RF ablated HCCs.

SSG08-06 NaLuF4 for Spectral CT in the Diagnosis of Osteosarcoma

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S504CD

Participants

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PURPOSE

To investigate the potential of spectral computed tomography (CT), used in combination with a Lutecium-based upconversion nanoparticles (UCNPs), for characterization of osteosarcoma and bone.

METHOD AND MATERIALS

Spectral CT which can enrich conventional CT images with the capability to image and quantify certain elements based on their distinctive K-edge energies was chosen as a powerful tool. Lutecium-based upconversion nanoparticle (UCNPs) had higher spectral CT performance compared with clinically used iohexol. Spectral CT performance was investigated by testing gradient concentration of these contrast agents (CAs) in vitro. Balb/c nude mice were used as model for imaging osteosarcoma in vivo. Cellular uptake of Lutecium-based UCNPs was further evaluated by using confocal microscopy. Toxicity tests were also carried out including cellular toxicity tests, blood routine examinations, hepatorenal function, body weight and some other indexes.

RESULTS

Spectral CT enabled differentiation of Lutecium-based UCNPs, iohexol and bone. Different materials were presented as colorized voxels against the normal grayscale X-ray background, distinguishing the high attenuation of calcium from the osteosarcoma tumor tissues that contained the Lutecium-based CAs. The results of in vivo and in vitro experiments demonstrated that Lutecium-based CAs had higher spectral CT performance and could still be obviously observed at higher KeV (120-140 KeV) images while the signals of iohexol and bone were relatively weak. The toxicity was proven to be low which made it potential for clinical application in the future.

CONCLUSION

Spectral CT imaging, combined with Lutecium-based CAs, provided a promising opportunity for effectively distinguishing bone and osteosarcoma in vivo.

CLINICAL RELEVANCE/APPLICATION

Achieving high-resolution imaging of osteosarcoma and in vivo differentiate it from the bone for accurate tumor diagnosis and therapy.

SSG08-07 Dedicated Breast PET (dbPET) for Quantifies Response to Neoadjuvant Therapy in Breast Cancer: The Irruption of a Great Ally

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S504CD

Participants

Michel Herranz, Santiago de Compostela, Spain (*Presenter*) Nothing to Disclose
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PURPOSE

Continued progress in the control of breast cancer will require sustained and increased efforts to provide high-quality screening, diagnosis, and treatment. Recently, the MAMmography with Molecular Imaging (MAMMI) dedicated breast PET (dbPET) has emerged as an additional imaging tool for breast cancer diagnosis, clarification of complex lesions and therapy follow-up. This study is aimed to determine whether correlations exist between physiological images with 18FDG of pre, post-2-cycles and post Neoadjuvant Chemotherapy, with a predictive value of response.

METHOD AND MATERIALS

Two hundred (200) patients, and three scan points: pre, after 2 cycle and post (pre-surgery) Neoadjuvant Chemotherapy were included in this study. A prone position high-resolution dedicated breast PET (MAMMI-dbPET) was performed 60 min after administration of 120-140 MBq of 18F-FDG. Maximum standardized uptake value (SUVmax) quantification, volume characterization, positioning in all three space-axes, distances to reference points (proximal breast limit, nipple areola complex) were registered.

RESULTS

When treatment was successful, a significant difference was found between pre and post neoadjuvant chemotherapy status and the SUVmax ($p < 0.001$) of breast tumors. Pre Neoadjuvant (mean SUVmax, 13.1) demonstrated a significantly higher SUVmax than did post 2 cycles tumors (median SUV, 5.5) ($p = 0.019$). No statistical significant difference was found for SUVmax of post-2 cycles vs. post lesions with a mean SUVmax of 5.5 and 3.9 ($p = 0.35$) respectively. A statistically significant difference was found for volume measurement of pre vs. post-2 cycles vs post Neoadjuvant therapy lesions. A clear qualitative difference by three different observers has been reported among dbPET and MRI volume characterization.

CONCLUSION

dbPET MAMMI has proven to be an excellent tool for quantification, 3D spatial localization and monitoring of neoadjuvant therapy. Our data suggest that SUVmax measurements of 18FDG-dedicated breast PET can provide valuable information about therapy efficiency. Such an association might be of relevant importance to treatment continuity or adjustment.

CLINICAL RELEVANCE/APPLICATION

The use of a physiological technique such as dbPET, will allow us to be more precise and in an earlier way in the follow-up of the treatment.

SSG08-08 Enhancing Tumor MRI with a CA IX-Targeted Dendritic Contrast Agent

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S504CD

Participants

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Hongjie Hu, MD, Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Youqing Shen, Hangzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

A novel dendritic contrast agent (DCA) based on an internal functional dendrimer with CA IX-targeted groups (sulfonamide) on surface was prepared to enhance MRI of tumor.

METHOD AND MATERIALS

(1) 4T1 cells (3×10^5 per well) were cultured in 6-well plate under 5% CO₂, 1% O₂ and 94% N₂ for 48h. Then RhB labeled G3(DTPA-Gd)-SA (CA IX-targeted DCA) and G3(DTPA-Gd)-Cys (Control) was added at 6h. The cells were then collected and measured by flow cytometry (FCM). (2) 4T1 cells was planted in the mammary fat pad of Balb/c mice 6-weeks 5×10^5 each). After 7 days, two kinds of DCA were injected intravenously and T1-weighted imaging was measured pre-injection and 5 min, 30 min, 60 min, 120 min, 240 min post-injection.

RESULTS

The R1s of G3(DTPA-Gd)-SA and G3(DTPA)-Cys were both slightly over 10 mM⁻¹s⁻¹. It was reported that the CA IX level of 4T1 cell line was induced to higher expression after cultured under hypoxia condition. The results of FCM indicated that the G3(DTPA-Gd)-SA-RhB had significantly higher uptake in hypoxic cells than G3(DTPA-Gd)-Cys-RhB, which provided a brief proof of the capability of sulfonamide based DCA binding to hypoxic 4T1 cell. Moreover, in the in vivo MRI experiment, the signal intensity in the tumor sites for the two groups was similar in the first 2h. However, after 4h post-injection, the tumor area of G3(DTPA-Gd)-SA was still obviously enhanced while that with G3(DTPA-Gd)-Cys already faded.

CONCLUSION

The CA IX-targeted DCA had high cellular uptake in hypoxic cells, and it could enhanced the MRI of tumor. Along with its stable defined structure, CA IX-targeted DCA had great potential in early hypoxic tumor detection.

CLINICAL RELEVANCE/APPLICATION

Early hypoxic tumor detection is a great challenge in clinic. The work provided a hypoxic tumor targeting MRI contrast agent which could increase the accuracy of early hypoxic tumor. Thus, it had great potential for clinical translation.

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S504CD

Awards

Trainee Research Prize - Fellow

Participants

Benjamin Larimer, PhD, Charlestown, MA (*Presenter*) Nothing to Disclose
Eric Wehrenberg-Klee, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Although cancer immunotherapy has delivered stunning responses, these occur in only a small fraction of patients. A predictive biomarker of early response could identify patients for whom therapy is ineffective, allowing alternative treatment based on individualized biological feedback. Granzyme B is released by immune cells during the cellular immune response, and represents one of the dominant mechanisms by which T cells mediate cancer cell death.

METHOD AND MATERIALS

Two mouse tumor models (CT26 and MC38) were used for both biomarker analysis and murine imaging. Mice were treated with either anti-PD-1 mono agent or in combination with anti-CTLA-4, and PET images were acquired prior to growth divergence between treated responders and non-responders. Immunofluorescent and immunohistochemical microscopy was used to quantify total granzyme B in melanomas from 9 patients treated with mono-agent PD-1 therapy.

RESULTS

A novel Granzyme B PET imaging agent was designed and shown to accumulate at significantly higher levels in combination treated and PD-1 treated mice than in vehicle-only mice. Furthermore, imaging of treated mice distinguished two groups with either high or low granzyme B PET tumor uptake. Although on the day of imaging both groups had equivalent tumor volumes, those mice with high PET uptake subsequently regressed, whereas the low PET uptake group uniformly progressed. A retrospective analysis of human melanoma samples revealed similar results, with significantly higher levels of granzyme B found in treated responding patients as early as 15 days post therapy initiation.

CONCLUSION

Two murine models of cancer immunotherapy demonstrate that granzyme B PET imaging is able to distinguish treated responders from non-responders, prior to growth divergence. Additionally, human samples analyzed by our peptide revealed significant differences in accumulation as early as 15 days post-therapy initiation. These results indicate granzyme B imaging is a highly accurate, predictive PET biomarker for immunotherapy response.

CLINICAL RELEVANCE/APPLICATION

A biomarker of early response to cancer immunotherapy is needed. Granzyme B PET imaging represents a novel and accurate approach to quantifying immune response with significant clinical potential.

SSG09

Science Session with Keynote: Musculoskeletal (Machine Learning)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E450B

CT MK MR IN

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

Participants

Martin Torriani, MD, Boston, MA (*Moderator*) Nothing to Disclose
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Moderator*) Nothing to Disclose

Sub-Events

SSG09-01 Musculoskeletal Keynote Speaker: Machine Learning Basics: A Radiologist's Perspective

Tuesday, Nov. 28 10:30AM - 10:50AM Room: E450B

Participants

Martin Torriani, MD, Boston, MA (*Presenter*) Nothing to Disclose

SSG09-03 Accelerated Knee MRI with Machine Learning Based Reconstruction Compared to Standard Knee MRI Protocol: Analysis of Protocol Interchangeability and Image Quality

Tuesday, Nov. 28 10:50AM - 11:00AM Room: E450B

Participants

Elisabeth R. Garwood, MD, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

Assess protocol interchangeability and image quality of an accelerated knee MRI reconstructed with a machine learning based algorithm compared to standard MRI.

METHOD AND MATERIALS

A neural network trained to differentiate between acceleration related aliasing artifacts and true image content was developed, according to methods previously described. 25 patients referred for diagnostic knee MRI underwent examination at 3T with five 2D FSE sequences using both standard reconstruction (parallel imaging acceleration factor 2, acquisition time 12:57 minutes) and an accelerated knee protocol that utilized machine learning based reconstruction (acceleration factor 3, 9:10 minutes). Images were interpreted retrospectively by two MSK radiologists, blinded to acquisition and reconstruction parameters, for meniscus, ligament, bone marrow, and chondral pathology. Concordance of standard MRI interpretation was compared to concordance between machine-learning and standard MRI interpretation. Image quality was assessed using a 4-point ordinal scale.

RESULTS

Agreement between readers was similar when using the standard protocol compared to using different protocols (86%-98% for all structures). Different readers had a higher impact on concordance than different protocols, with higher inter-protocol concordance (same reader, different protocols; 93%-99.5%) than intra-protocol concordance (different readers, same protocol; 86%-98%). Interchangeability analysis demonstrated that switching from the standard protocol to machine learning would introduce less than 5% discordance (upper limit of a 95% confidence interval) for all structures. Overall image quality degradation ($p < 0.001$) was observed with the machine learning based reconstruction.

CONCLUSION

Accelerated knee MRI utilizing a machine-learning-based reconstruction algorithm was interchangeable with standard knee MRI in terms of diagnostic concordance. However, reduced subjective image quality was observed. Future directions include modification of the loss function that is used during the neural network training procedure and alternative network architectures to improve image quality.

CLINICAL RELEVANCE/APPLICATION

Machine learning based MRI reconstruction promises novel possibilities for scan acceleration. Our initial experience applying this technique to knee MRI demonstrates protocol interchangeability but reduced subjective image quality.

SSG09-04 Automatic Vertebrae Localization and Identification in Spine CT Using Decision Forests

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E450B

Participants

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PURPOSE

In clinical diagnosis and appropriate surgical planning in the spine, the fast recognition and characterization of vertebral bodies is a crucial step. Usually for radiologists it is a time consuming task that hinders the workflow, because they have to label them manually. For this reason, the main purpose of our work was to locate and identify vertebral bodies automatically in body CT scans by applying an Artificial Intelligence (AI) technique.

METHOD AND MATERIALS

A dataset of 200 CT scans with arbitrary field of view were collected. Due to the goal of the study, a wide range of pathological conditions was needed in order to enrich the algorithm. For the automatic localization and identification of vertebral bodies we used Decision Forests, an AI technique based on supervised learning. This means that we need both input and output data to train the forest. An in-house software application was used for labelling the scans by selecting the centroids of each vertebral body included. From the 200 scans 150 were used for training and 50 for test. From each training scan we randomly selected 50,000 voxels. Around each voxel a 3D cuboid was processed, where 126 intensity-based features were extracted as input data. The corresponding output data is the distance from the selected voxels to each vertebra. To test, 100,000 voxels were randomly selected from a previously unseen CT and features were extracted. Using our trained forest, we obtained the predicted distance from each voxel selected to each vertebra. Finally, using this information we could predict their position.

RESULTS

The algorithm was tested against 50 new cases obtaining a satisfactory vertebrae classification with no human interaction. A mean performance of 95% for correct localization was achieved. The mean error distance between the real position of vertebrae and the tested one was of 10.5 mm on the thoracic region and of 15.4 mm on the lumbar one.

CONCLUSION

Automatic localization and identification of vertebral bodies can be addressed with excellent results by AI methods to improve diagnosis workflow and characterize bone structure. These methods can be used to address current barriers such as the automatic localization and segmentation of anatomical structures.

CLINICAL RELEVANCE/APPLICATION

Automatic localization and identification of vertebral bodies can help radiologists to perform diagnosis and bone characterization in a shorter period of time.

SSG09-05 Semantic Labeling of Musculoskeletal Radiographs Using Deep Learning

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E450B

Awards

Student Travel Stipend Award

Participants

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Imon Banerjee, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Deep convolutional neural networks (CNNs) are rapidly advancing techniques in computer vision that allow rapid, unsupervised feature learning and have potential clinical advantages including speed and consistency. Our goal is to develop and validate a deep CNN system to automatically learn and recognize common musculoskeletal radiographs.

METHOD AND MATERIALS

793 radiographs of major appendicular joints were exported and anonymized from PACS. Images were annotated with 13 class labels: AP and lateral views of the ankle, elbow, foot, hand, and knee, AP views of the pelvis, and AP and axillary views of the shoulder. To create a normalized dataset for training, we implemented an image preprocessing step that adjusts window/level settings based on image bit depth and sharpens the image by enhancing low contrast local image regions. We adapted a transfer learning approach and fine-tuned the weights of ImageNet's pre-trained AlexNet CNN to recognize 13 classes by continuing the backpropagation. For training and validation, we used a hold-out approach (793 training images, 154 validation images). The deep CNN was trained using Matconvnet on a 2.3GHz Intel Core i7 with 8GB of RAM and an NVIDIA GeForce GT 650M 285. Training parameters: Momentum 0.9, Weight decay $3e-4$, Epoch size 50, and batch size 50. Performance accuracy was measured as percentage of correctly labeled class, and the top-5 error rate was the fraction for which the correct label was not among the five labels.

RESULTS

The deep CNN performed with an accuracy of 97.4% on the test dataset. The top-5 error rate was 0%.

CONCLUSION

We have implemented a deep CNN that automatically classifies radiographs of major joints using DICOM images from PACS. Future work could be extended to identify all radiographic images and views.

CLINICAL RELEVANCE/APPLICATION

Deep learning can enhance PACS through automated labeling of radiographs and identification of relevant comparisons, improving hanging protocols and radiologist workflow.

SSG09-06 Prediction of Osteoporotic Vertebral Fractures from Calcaneal Images using Deep Learning

Tuesday, Nov. 28 11:20AM - 11:30AM Room: E450B

Participants

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PURPOSE

The purpose of this work is to evaluate a classifier that predicts bone fragility as assessed by prevalent vertebral fractures shown on vertebral fracture assessment (VFA). The classifier uses the trabecular texture extracted from digital radiographic calcaneal images with a deep convolutional neural network (CNN). The performance of CNN-extracted features is compared to bone mineral density (BMD).

METHOD AND MATERIALS

The clinical dataset consists of digital radiographic images of the calcaneus obtained using a peripheral instantaneous X-ray Imager (PIXI) from 900 patients who had undergone vertebral fracture assessment and BMD measurements. For each calcaneal image, a region of interest (ROI) is manually identified and input to a CNN for trabecular texture extraction. Two classifiers based on different CNNs are evaluated: a CNN that has been pre-trained and a CNN that has been pre-trained then fine-tuned. Fine-tuning leverages data augmentation with images that have been generated using a CNN-based texture synthesis method. For both classifiers, the extracted features from CNN are input to a two-class support vector machine (SVM). Five-fold cross validation is used to assess the performance in predicting vertebral fracture, with area under the receiver operating characteristic curve (AUC) as the performance metric.

RESULTS

The SVM based on features extracted with a pre-trained-only CNN achieved AUC of 0.61 (95% CI: 0.57 - 0.63), which is similar to the one based on BMD (0.62, 95% CI: 0.52 - 0.73). The classifier using features extracted with a fine-tuned CNN is still being developed, but it is expected to perform significantly better than the features extracted with a pre-trained-only CNN as well as the BMD.

CONCLUSION

The comparable performance of the features extracted with a pre-trained CNN shows strong promise for using CNN-extracted trabecular texture to evaluate bone fragility in osteoporotic patients. Given the performance using the pre-trained CNN, significant improvement is expected for a fine-tuned CNN.

CLINICAL RELEVANCE/APPLICATION

Predicting the risk of fracture in osteoporotic patients is a challenging problem, which is clearly demonstrated by the relatively low AUC for classifier based on BMD, despite it being the current clinically-accepted method. Using CNN-extracted features to characterize bone quality and structure show great potential to enhance the current clinical standard.

SSG09-07 Detection and Measurement of Prevertebral Stripe in Cervical Lateral View Using Deep Learning

Tuesday, Nov. 28 11:30AM - 11:40AM Room: E450B

Participants

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Jin-Suck Suh, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To show the feasibility of the deep-learning based convolutional neural networks (CNNs) measurement of prevertebral soft tissue thickness (PSTT) as a radiographic marker of cervical spine injury and to correlate CNNs measurements with radiologist's measurements.

METHOD AND MATERIALS

Following institutional review board approval, 200 cervical lateral radiographs were included for training dataset. The prevertebral lines and anterior vertebral lines were annotated by one musculoskeletal radiologist. Two separate pipelines were configured and

trained for extraction and measurement of PSTT at the levels of C2 and C6, using the U-net based CNNs. Consecutive 134 patients who were undertaken cervical lateral radiographs in emergency department were included for test dataset. In the test dataset, the PSTT were measured by the U-net based CNNs model trained from the 200 training dataset. The PSTT were also measured by a musculoskeletal radiologist as reference values. For statistical analyses, Pearson's correlation test and intraclass correlation (ICC) were conducted to correlate the measure values between the CNNs-based measurement and radiologist's measurement. Diagnostic performances of the CNNs-based measurement were evaluated.

RESULTS

U-net based CNNs successfully extract the PSTT (n=130/134, 97%). In the total 130 radiographs, the CNNs-based measurements showed a good correlation at the C2 ($r=0.88$, $p<0.05$ and $ICC=0.94$) and C6 ($r=0.48$, $p<0.05$ and $ICC=0.62$). There were false positives on CNNs measurement (positive on CNNs measurement and negative on radiologist's measurement) in eight radiographs. The detection sensitivity, specificity, and accuracy were 100%, 93.6%, and 96.8%.

CONCLUSION

The CNNs measurements can be clinically utilized in measurement of PSTT by training a deep learning-based pipeline for depicting the PSTT.

CLINICAL RELEVANCE/APPLICATION

The CNNs measurements can be a complementary tool providing timely accurate labels that only require rapid confirmation for busy physician or radiologist.

SSG09-08 Performance of Deep Convolutional Neural Network Based Classifiers in Automated Evaluation of Anterior Shoulder Dislocation and Occult Radial Head Fracture

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E450B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Anterior shoulder dislocation and occult radial head fracture are two common findings on Emergency Department (ED) radiography. Our purpose was to develop convolutional neural network (CNN) based classifiers for these diagnoses and characterize their performance.

METHOD AND MATERIALS

102 de-identified internal rotation radiographs of the shoulder were obtained (51 with anterior dislocation, 51 normal). Similarly, 97 de-identified lateral radiographs of the elbow were obtained, 47 of which showed anterior joint effusions in the presence of trauma; remaining 50 were normal. Diagnoses were verified by a board-certified radiologist. These data sets were augmented 12x via multiple rotations as well as contrast equalization and non-rigid deformation. Images were used to train classifiers using both AlexNet and GoogLeNet CNN architectures using the Caffe framework. 20% of the augmented data sets were used in validation. Separate test data sets consisting of 60 shoulder and 60 elbow radiographs (each 50% pathology, 50% normal) were used to assess performance. Receiver operating characteristic (ROC) curves were generated and area under the curve (AUC), sensitivity, and specificity were computed. Differences in AUCs were obtained with a statistical significance threshold of 0.05.

RESULTS

Shoulder dislocation classifier ROC curve demonstrated an AUC of 0.997 with a p-value of $3.7e-11$, sensitivity of 96.7%, and specificity of 100%. The elbow classifier AUC was 0.50 with a sensitivity of 23.3% and a specificity of 83.3%.

CONCLUSION

Our shoulder dislocation classifier shows near-perfect accuracy and may be particularly useful to the growing number of non-radiologists that interpret radiographs in the emergency setting; such a classifier may also be useful in identifying shoulder dislocation as an incidental finding on other imaging (e.g. chest radiographs). In contrast, detection of elbow effusions is a task that demands higher visual discrimination and as such likely requires additional preprocessing and a greater number of training cases than present in our current study. Comparison of the results of our shoulder and elbow classifiers is illustrative of the strengths and weaknesses of currently available CNN architectures and training methods.

CLINICAL RELEVANCE/APPLICATION

Deep convolutional neural networks can detect anterior shoulder dislocation with near-perfect accuracy and can thus aid in expeditious diagnosis in an emergency setting.

SSG09-09 Deep Learning For Detection of Full Thickness Anterior Cruciate Ligament Tear

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E450B

Participants

Peter Chang, MD, Bronx, NY (*Presenter*) Nothing to Disclose

Tony T. Wong, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the feasibility of an automated deep learning artificial intelligence algorithm to detect full thickness anterior cruciate ligament (ACL) tears.

METHOD AND MATERIALS

One hundred (N = 100) patients between 18 and 40 years old with a full thickness ACL tear were identified in a retrospective review of knee MRIs obtained between September 2013 and March 2016. A second control group of one hundred (N = 100) normal patients was identified with no ACL pathology. All two hundred ACL diagnoses were confirmed through visual inspection by a board-certified subspecialist musculoskeletal radiologist (MJR). For each exam with an ACL tear, coronal proton density (PD) non-fat suppressed sequences were manually annotated to delineate: (1) a bounding-box around the cruciate ligaments; (2) slices containing an ACL tear. Based on this, a two-step convolutional neural network (CNN) was trained to: (1) identify the ACL; (2) assign a binary classification to each patient depending on the presence or absence of an ACL tear (Figure 1). The CNN is based on a generative-adversarial network for semi-supervised learning utilizing feature-matching. Both 2D and 3D CNNs were evaluated.

RESULTS

The two hundred MR volumes yielded a total of 3184 coronal PD slices, 480 slices of which contained an ACL tear. Of the two tested architectures, the 3D CNN model performed better, classifying 89.5% of patients correctly based on a five-fold validation. The 2D CNN model classified 78% of patients correctly (417/480 slices). Both CNN models were trained for 500 epochs with a batch size of 32. The final trained 3D CNN can generate predictions for all 200 patients in 287 seconds (1.4 seconds per patient).

CONCLUSION

A deep learning CNN model can evaluate for the presence of a full thickness ACL tear with reasonable accuracy. A 3D model outperforms a 2D model, suggesting that detection of an ACL tear may be limited when using a single coronal MR slice and benefits from the context of adjacent slices. Further work will focus on evaluating deep learning models for assessing and quantifying lower grade ACL and other ligamentous injuries.

CLINICAL RELEVANCE/APPLICATION

Anterior cruciate ligament tears are commonly encountered injuries in sports medicine with significant morbidity. This is the first time a deep machine learning algorithm has been used to evaluate ACL injuries.

SSG10

Nuclear Medicine (Gastrointestinal, Lymphoma and Melanoma Imaging)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S505AB

CT **GI** **NM**

AMA PRA Category 1 Credits TM: 1.50
ARRT Category A+ Credit: 1.00

Participants

Frederik L. Giesel, MD, MBA, Heidelberg, Germany (*Moderator*) Patent application for F18-PSMA-1007
Farrokh Dehdashti, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

SSG10-01 Initial Experience with a New PET/CT System Using SiPM Detectors

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S505AB

Participants

Sonya Y. Park, MD, Stanford, CA (*Presenter*) Nothing to Disclose
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Andrei Iagaru, MD, Stanford, CA (*Abstract Co-Author*) Research Grant, General Electric Company

PURPOSE

We installed the first worldwide of a new digital PET/CT system that brings together silicon photomultiplier (SiPM) technology with time-of-flight (TOF) and block sequential regularized expectation maximization (BSREM, Q.Clear®). We report our initial clinical experience using the Discovery Meaningful Insights (DMI) scanner and evaluate the image quality in comparison to standard PET/CT scanners with and without TOF capability.

METHOD AND MATERIALS

Seventy-three patients were scanned first on the standard of care PET/CT followed immediately by a scan on the new digital PET/CT system using the same scan time per field of view. Images from the digital PET/CT were reconstructed using a conventional (non-TOF) algorithm, TOF alone and TOF in combination with Q.Clear®. Images from the standard of care PET/CT were reconstructed using clinical standard of care settings. Three blinded readers randomly reviewed four datasets per patient for image quality using a 5-point Likert scale: standard, DMI non-TOF, DMI TOF and DMI TOF+Q.Clear. Standardized uptake value (SUV) measurements for the single most avid lesion on each dataset were also recorded.

RESULTS

In this side-by-side comparison, datasets from the DMI showed higher image quality ($P < 0.001$) and SUV measurements compared with the standard of care systems. Scores were further improved when TOF and Q.Clear® algorithms were added for image reconstruction. Of clinical interest, nine patients demonstrated lesions that could only be visualized on images from the DMI. Noticeably less respiratory artifacts at the diaphragm were also reported in the TOF-reconstructed images.

CONCLUSION

The new digital PET/CT system outperforms the standard of care scanners in terms of image quality, with further benefits added by the use of TOF and Q.Clear® reconstruction algorithms. This may be most beneficial in detecting small lesions and may result in more accurate disease staging.

CLINICAL RELEVANCE/APPLICATION

The new digital PET/CT system with SiPM technology and updated reconstruction algorithms provides better image quality and resolution, and is recommended for evaluation of all patients.

SSG10-02 Diagnostic Performance Of 68Ga-DOTATATE PET/CT in Evaluation of Neuroendocrine Malignancies: What Parameters Are Useful?

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S505AB

Participants

Farshad Moradi, MD, San Diego, CA (*Presenter*) Nothing to Disclose
Andrei Iagaru, MD, Stanford, CA (*Abstract Co-Author*) Research Grant, General Electric Company

PURPOSE

We had previously shown that normal biodistribution of 68Ga-DOTATATE and uptake in neuroendocrine tumors are both variable

We had previously shown that normal biodistribution of 68Ga-DOTATATE and uptake in neuroendocrine tumors are both variable among patients. The aim of this study is to systematically investigate the diagnostic performance of SUVmax and tumor-to-tissue uptake ratios (SUVr) for discrimination of benign versus malignant lesions.

METHOD AND MATERIALS

68Ga-DOTATE PET/CT was performed in 104 patients with clinically suspected or confirmed neuroendocrine malignancies. Benignity/malignancy of lesions with focal uptake were determined by histopathology or clinical follow up. Receiver operating characteristic (ROC) curves were constructed for SUVmax and uptake ratios normalized to physiologic activity in different tissues. Areas under the ROC curves (AUC) were calculated and compared for various parameters.

RESULTS

A total of 127 benign and 497 malignant lesions with focal uptake were identified. SUVmax yielded an area under ROC curve of 0.94 (corresponding to sensitivity and specificity of 88% at a cutoff of 6.4 g/mL). Sixty percent of malignant lesions (and none of the benign ones) had intense uptake (SUVmax>15). Diagnostic performance was lower when these lesions were excluded (sensitivity and specificity of 80% at a cutoff of 5 g/mL). Similar diagnostic performance was obtained using tumor-to-liver (AUC=0.95, $p>0.05$) or tumor-to-adrenal uptake ratio (AUC=0.95, $p>0.05$). Diagnostic performance decreased when activity was normalized to blood pool (AUC=0.93, $p<0.02$). Normalizing to pancreas, renal parenchyma, or splenic uptake yielded areas under the ROC curve that were not significantly superior to tumor-to-blood pool uptake ratio.

CONCLUSION

Intense uptake on 68Ga-DOTATATE PET/CT is highly specific for neuroendocrine malignancies. SUVmax and tumor-to-liver uptake ratio yield comparable diagnostic performance that is superior to tumor-to-blood pool uptake ratio for determining malignancy.

CLINICAL RELEVANCE/APPLICATION

Liver uptake can be used for normalization of lesion activity in 68Ga-DOTATATE PET/CT.

SSG10-03 Integrated Time-Of-Flight FDG PET/MRI-MRCP for Evaluation of Distant Metastases in Patients with Pancreatic Cancer and Elevated CA 19-9: A Feasibility Study

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S505AB

Awards

Student Travel Stipend Award

Participants

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Mark Truty, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the feasibility and diagnostic performance of integrated FDG PET/MRI-MRCP for distant metastases in patients with pancreatic cancer and elevated CA 19-9.

METHOD AND MATERIALS

46 pancreatic cancer patients underwent FDG PET/MR on a 3.0 T time-of-flight PET/MRI (SIGNATM, GE Healthcare) (04/2016-11/2016). Of these, 23 patients (65.2% females; mean age: 62.9-years, range 46-79) had elevated CA 19-9 (>55 U/mL) and constituted study cohort. Imaging protocol consisted of multi-bed position whole body survey (2-3 minutes/bed) with an additional 15-minute single bed position respiratory-compensated focused abdominal PET. MR component included respiratory-navigated T2W, DWI, IDEAL-IQ, MRCP and breath-hold post-contrast dynamic sequences (average protocol duration ~ 60-minutes). PET/MR findings were compared with that of CT performed within 3-weeks of PET/MR. Final diagnosis was established using a composite pathologic and clinico-radiological reference standard.

RESULTS

PET/MR was positive for metastatic disease in 7 (30.4%) patients. In 3 patients (13%), PET/MR detected all metastatic lesions (liver, adrenal and peritoneal) that were also detected on CT. In 2 patients (8.7%), PET/MR detected additional 7 hepatic metastases (size: 5-mm to 1.8-cm) that were occult on multiphase CT performed within one-week of PET/MR. In the first of these two patients, management changed from planned neo-adjuvant therapy to that of palliative chemotherapy while in the other patient it changed from planned observation to that of palliative chemotherapy. One patient (4.3%) had a biopsy-proven false-positive liver lesion on PET/MR.

CONCLUSION

Integrated FDG PET/MRI-MRCP is feasible for evaluation of distant metastases in patients with pancreatic cancer. In our preliminary cohort, PET/MR detected additional hepatic metastases that were occult on CT in patients with pancreatic cancer and elevated CA 19-9.

CLINICAL RELEVANCE/APPLICATION

Integrated FDG PET/MRI-MRCP combining whole body and liver-specific imaging is feasible in clinical practice. When compared with CT, this hybrid modality has the potential to detect occult metastases that change clinical management in patients with pancreatic cancer.

SSG10-04 A Pilot Study of Patterns of Response to Immune Checkpoint Inhibitor Therapy in Patients with Hodgkin Lymphoma Treated with PD1i

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S505AB

Awards

Trainee Research Prize - Fellow

Participants

Laurent Dercle, MD, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

In patients with Hodgkin Lymphoma [HL], the response evaluation criteria were designed for the assessment of chemotherapy and targeted molecular agents. Anti-Programmed Death 1 antibodies [PD1i] are immune-checkpoint inhibitors which improve patients outcome but lead to new immune pattern of response. We investigated the accuracy of 3-month-FDG-PET/CT for response classification and the frequency of new patterns of response in HL patients treated with PD1i.

METHOD AND MATERIALS

The FDG-PETs and CTs data of all consecutive r/rHL patients treated by PD1i (Pembrolizumab or Nivolumab), from 2013-2015 were retrospectively reviewed according to Cheson 2014 criteria and LYRIC 2016 revised criteria. Patients achieving an objective response at any time of treatment were classified as immune-responding, otherwise they were classified as immune-refractory. The variation in imaging features on FDG-PET and contrast-enhanced CT-scans were measured every three months.

RESULTS

Sixteen patients were included, median age was 39 (19-69) years, and the median of previous lines of therapy was 6 (3-13). With a mean follow-up of 22.6 months and an estimated overall survival of 34.7 months, two deaths occurred, both of progressive disease. All the nine out of sixteen (56%) immune-responding patients achieved an objective response at 3-month that translated into a significant decreased tumor metabolism (Δ SUVmean), decreased metabolic tumor volume (Δ MTV), and increased healthy splenic metabolism (Δ SUVmax). The respective AUC [95CI] of these 3-month-FDG-PET biomarkers was 0.89 [.72-1.0] ($p=0.01$), 0.98 [.90-1.0] ($p=0.005$) and 0.85 [.63-1.0] ($p=0.04$) for response classification. Five out of 16 patients (31%) displayed new imaging patterns related to PD1i; we observed two transient progressions consistent with indeterminate response according to the LYRIC 2016 criteria (IR2b at 14-month and one IR3 at 18-month), and three patients with new lesions related to immune-related adverse events.

CONCLUSION

FDG-PET/CTs detect immune-responding HL patients at 3 months. New imaging immune-patterns were encountered in 31% of patients, encouraging a close cooperation with clinicians.

CLINICAL RELEVANCE/APPLICATION

In Hodgkin Lymphoma, 3-month-FDG-PET/CT is accurate for classification of response to PD1i immune-checkpoint inhibitors although new immune patterns of response are observed in 31% of patients.

SSG10-05 Whole-Body MRI Including Diffusion-Weighted Imaging for Pretherapeutic Assessment and Staging of Low Grade Lymphoma: Results of a Prospective Study in 30 Patients

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S505AB

Participants

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PURPOSE

To determine the clinical utility of whole-body MRI (WB-MRI) in the pretherapeutic imaging and staging of low grade lymphoma with low FDG avidity.

METHOD AND MATERIALS

This prospective study included 30 treatment-naïve patients with low grade lymphoma (14 follicular, 14 extranodal marginal zone B-cell lymphoma of the mucosa-associated lymphoid tissue (MALT), 1 small lymphocytic lymphoma and 1 nodal marginal zone lymphoma), who underwent WB-MRI (DWI and T2-weighted STIR) and FDG-PET/CT. WB-MRI and FDG-PET/CT were independently evaluated by each two blinded observers. Region-based sensitivity and the staging, relative to the reference standard, given by

each technique were compared in Group A (whole-body regions) and Group B (whole-body regions excluding bone marrow). Difference in staging were resolved using biopsy, and clinical and CT follow-ups as standard of reference.

RESULTS

WB-MRI and FDG-PET/CT had region-based sensitivities of 87.4 - 88.9% and 82.3 - 84.4% in Group A, and 93.4 - 95.1% and 89.3 - 91.8% in Group B, respectively. WB-MRI and FDG-PET/CT agreed with the reference standard in 73.3% (k, 0.64) and 66.7% - 70% (k, 0.56-0.60) in Group A, and 100% (k, 0.96) and 96.7-100 % (k,0.96), respectively. The kappa values for interobserver agreement on WB-MRI and FDG-PET/CT were 0.985 and 0.867 in Group A, and 0.984 and 0.863 in Group B, respectively.

CONCLUSION

In patients with low grade lymphoma with a low FDG avidity, WB-MRI and FDG-PET/CT have similar performance with regard to pretherapeutic regional assessment and staging. However, both of WB-MRI and FDG-PET/CT seems to be limited in terms of bone marrow evaluation.

CLINICAL RELEVANCE/APPLICATION

Whole-body MRI is a feasible alternative to FDG-PET/CT for staging of less FDG-avid low grade lymphoma.

SSG10-06 Prediction of Treatment Response and Recurrence after Chemotherapy with Texture Analysis or Volumetric Parameters on FDG PET in Patients with Follicular Lymphoma

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S505AB

Participants

Mitsuaki Tatsumi, MD, PhD, Suita, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate if texture features(TFs) or volumetric parameters(VPs) on FDG PET were useful in predicting treatment response and recurrence after chemotherapy(Cx) in patients with follicular lymphoma(FL).

METHOD AND MATERIALS

45 FL patients having pre- and postCx FDG PET/CT exams were included in this study. They had at least one lesion with metabolic tumor volume(MTV, SUV threshold 2.5) >5 ml in preCx PET exams for accurate analysis. PreCx PET images were analyzed retrospectively. TFs were obtained from a 3D ROI covering the hottest lesion in each preCx exam. TFs evaluated in this study included homogeneity, entropy, and dissimilarity as local heterogeneity parameters, and short- and long-run emphasis, low- and high gray-level zone emphasis, intensity variability, size-zone variability, and zone percentage as regional heterogeneity parameters. MTV and total lesion glycolysis(TLG) were calculated as VPs for the hottest as well as whole-body lesions in addition to SUVmax. Values of these parameters were compared each other and were evaluated as to prediction of Cx response, i.e. complete response(CR) or not(non-CR), which was determined with Lugano classification using postCx PET results. They were also evaluated as to recurrence within 2 years.

RESULTS

23 and 22 pts showed CR and non-CR, respectively, after Cx. All TFs correlated with VPs or SUVmax, except for homogeneity or low gray-level zone emphasis(LGZE) v.s. SUVmax. The values of LGZE in CR pts were significantly higher than those in non-CR pts($p<0.05$). No difference was observed in other TFs, VPs, or SUVmax between CR and non-CR pts. ROC analysis revealed LGZE the best parameter to predict CR after Cx(AUC:0.72, sen.64%, spe.70%, acc.67%). Lugano classification scores exhibited a weak correlation with long-run emphasis($\rho:0.3$) or zone percentage($\rho:-0.3$)($p<0.05$, Spearman). 25 of 45FL pts showed recurrence within 2 years. None of TFs, VPs, and SUVmax allowed prediction of the recurrence.

CONCLUSION

This study demonstrated that texture analysis on preCx FDG PET was useful and better than VPs and SUVmax in predicting treatment response. However, none of preCx PET parameters allowed prediction of recurrence in this FL pts population.

CLINICAL RELEVANCE/APPLICATION

Texture analysis on FDG PET before treatment was demonstrated to be useful and better than volumetric parameters and SUVmax in predicting treatment response of chemotherapy in follicular lymphoma patients.

SSG10-07 Comparison of Quantitative Parameters and Deauville 5 Point Score from 18F-FDG PET/CT Scans in Patients with Follicular Lymphoma

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S505AB

Participants

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PURPOSE

To compare the quantitative PET parameters and Deauville 5 point score of interim and end-of-therapy FDG PET/CT studies in patients with follicular lymphoma.

METHOD AND MATERIALS

18Fluoro-deoxy-glucose positron emission tomography/computed tomography (FDG PET/CT) images of 38 consecutive patients with newly diagnosed follicular lymphoma between 2013 to 2015 at a single institution were retrospectively reviewed. 8 patients did not have sufficient follow-up information. 3 patients could not be evaluated because the PET images from outside sites were corrupted. Deauville 5 point score (D5PS), maximum standardized uptake value (SUVmax), peak standard uptake value corrected for lean body mass (SULpeak), and tumor to liver ratio (T/L ratio) were assigned to the interim and end-of-therapy PET/CT studies of 27 patients. Patient with D5PS of 1, 2, and 3 were considered as responders, and those with D5PS of 4 and 5 were considered as 'nonresponders'. We compared changes in quantitative PET parameters with the D5PS assessments.

RESULTS

Of 27 patients (age mean 48.9 yrs, range 29-71 yrs; 15 male and 12 female), 14 received R-CVP and 13 received R-CHOP as first line therapy. The clinical stages were stage I, n=1; stage II, n=1; stage III, n=10; and stage IV, n=15. According to interim PET, 17 patients were responders and 10 were nonresponders. At end-of-therapy, 23 patients were responders, and 4 were nonresponders. The absolute and percent decrease in the PET parameters between responders and nonresponders were as in table 1. There were 10 nonresponders on interim PET, and 6 patients achieved response at end-of-therapy (5 patients on R-CVP and 1 received R-CHOP), while 4 patients were nonresponders at end-of-therapy as well (all 4 on R-CHOP). There was no particular PET parameter threshold that could predict the end-of-therapy response.

CONCLUSION

For patients with follicular lymphoma, quantitative assessment in PET/CT was not be of value in differentiating interim responders and nonresponders and did not show significant association with D5PS.

CLINICAL RELEVANCE/APPLICATION

Quantitative assessment in FDG PET/CT was not be of value in differentiating interim responders and nonresponders in patients with follicular lymphoma.

SSG10-08 Time Course of FDG-PET/CT Findings in Extranodal Mucosa-Associated Lymphoid Tissue Lymphoma in the Thyroid Treated By Radiotherapy

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S505AB

Participants

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PURPOSE

Radiotherapy (RT) is an useful treatment for malignant lymphoma with localized disease. Aim of study was to evaluate time course of FDG-PET/CT findings in patients with extranodal mucosa-associated lymphoid tissue (MALT) lymphoma in the thyroid who underwent RT.

METHOD AND MATERIALS

34 patients (M/F 7/27, age 45-77yrs.) with primary MALT lymphoma of the thyroid were included. None of the patients were associated with diabetes. Either or both of TgAb and TPOAb were positive in all. Clinical stage was IE in 24, and was IIE in 10. The dose of RT was 40Gy/20f (30Gy for the whole neck with additional 10Gy to the thyroid gland). Follow up period ranged 16-80 mos. FDG-PET/CT was performed 5 times; before RT (PET/CTpre), 3-5mos. after RT (PET/CT1, n=34), 15-20mos. after RT (PET/CT2, n=32), 32-48mos. after RT (PET/CT3, n=25), and 58-73 mos. after RT (PE/CT4, n=18). Both visual interpretation and semi-quantitative analysis with SUVmax were performed by 2 independent nuclear medicine physicians. Negative FDG uptake, which was considered as a sign for absence of viable tumor, was defined as thyroidal FDG uptake less intensive than that of the mediastinum or SUVmax of less than 3.5. Therapeutic outcome was confirmed by biopsy in 17 pts. and by clinical examination and imaging modalities in the remaining 17.

RESULTS

On PET/CTpre images, positive FDG uptake in the thyroid was positive in all patients with nodular appearance in 14 (41%) and diffuse appearance in 20 (59%). After RT, CR was achieved in 32 out of 34 pts (94%). Among the patients with CR, negative FDG uptake on PET1, 2, 3, and 4 was seen in 6/32 (19%), 11/32 (36%), 15/25 (60%), and 9/18 (50%), respectively by visual interpretation. Likewise, negative FDG uptake on PET 1,2, and 3 was achieved in 4/32 (32%), 8/32 (25%), 11/25 (44%), and 9/18 (50%), respectively by semi-quantitative analysis. 9 out of 18 pts. (50%) showed persistent thyroidal FDG uptake even on PET/CT4 by visual and semi-quantitative evaluation. Appearance of FDG uptake was diffuse in all.

CONCLUSION

RT was a valuable treatment against thyroid MALT lymphoma with I stage I or II disease. However, 50% of the patients with CR showed positive FDG uptake persisting for more than 4 yrs. after RT. Post-therapeutic FDG-PET/CT findings must be interpreted with caution in thyroid MALT lymphoma treated by RT.

CLINICAL RELEVANCE/APPLICATION

FDG-PET/CT has a limited value in response assessment of RT for thyroid MALT lymphoma .

SSG10-09 Correlation of 18F-FDG Uptake in Lymphoid Organs Early After PD1-Therapy Initiation to Therapy Response and Baseline Biomarkers in Melanoma: Preliminary Results of an Ongoing Study

Participants

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PURPOSE

Aim of our study was to evaluate if relative changes of 18F-FDG uptake in the liver, the spleen and the bone marrow 2 weeks after PD1-therapy initiation compared to the baseline scan correlate to baseline biomarkers and to therapy outcome after three months.

METHOD AND MATERIALS

We performed a subgroup analysis of 10 patients (4 f; 64±11 y) with metastasized melanoma treated with anti-PD1-antibodies out of a prospectively conducted ongoing study. All patients were examined in a whole-body 18F-FDG-PET/MRI before the therapy start (t0), two weeks (t1) and three months after the treatment initiation (t2). If not metastatically involved in any of the timepoints, the 18F-FDG-uptake in the liver, the spleen and the bone marrow were acquired. Therapy response was assessed with PET response criteria in solid tumors (PERCIST) at t2. The relative eosinophil count (REC), relative lymphocyte count (RLV) and the neutrophile-lymphocyte-ratio (NLR) were assessed during the week before therapy initiation.

RESULTS

At t2, progressive metabolic disease (PMD) was seen in six patients, stable metabolic disease (SMD) was seen in two patients and three patients showed complete metabolic response (CMR). Therapy responders (CMR and SMD at t2) showed a significant summed relative increase of 18F-FDG-uptake in the investigated organs of +28% ($p<0.003$) while non-responders (PMD) showed no significant change ($p=0.65$). The relative change of 18F-FDG-uptake at t1 of the liver showed the best correlation to REC ($R=0.78$), RLC ($R=0.50$) and NLR ($R=-0.44$).

CONCLUSION

Our preliminary results let assume that an increased uptake of 18F-FDG-PET in the liver, the spleen and the bone marrow two weeks after therapy initiation might indicate a therapy response in patients treated with anti-PD1-antibodies. This has to be proven in a larger patient cohort.

CLINICAL RELEVANCE/APPLICATION

Increased 18F-FDG uptake in lymphoid organs early after therapy initiation might help to identify responders to anti-PD1-therapy.

SSG11

Neuroradiology (Molecular Neuroimaging: From Diffusion to Beyond)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: N229

CT MR NR

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

Participants

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Edward P. Quigley, MD, salt lake city, UT (*Moderator*) Nothing to Disclose

Sub-Events

SSG11-01 MR-NODDI Evaluating Amyotrophic Lateral Sclerosis: A Tract Based Spatial Statistics Analysis

Tuesday, Nov. 28 10:30AM - 10:40AM Room: N229

Participants

Rifeng Jiang, Fuzhou, China (*Presenter*) Nothing to Disclose
Qing Duan, MD, Fuzhou, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Amyotrophic lateral sclerosis (ALS) is an incredibly lethal disease and resistant to therapy. Symptoms of ALS can be similar to those of a wide variety of other, more treatable diseases or disorders. The aim of this study is to use neurite orientation dispersion and density imaging (NODDI), a novel tool, to quantify changes of white matter (WM) skeleton in patients with ALS compared to healthy controls.

METHOD AND MATERIALS

Two shells of diffusion-weighted magnetic resonance images (shell 1: $b=1000\text{s/mm}^2$, $\text{direction}=25$; shell 2: $b=2500\text{s/mm}^2$, $\text{direction}=25$) were acquired from 12 patients with ALS and 12 age- and sex-matched healthy controls. FMRIB's Linear Image Registration Tool was used to register all diffusion-weighted volumes to their corresponding $b = 0\text{ s/mm}^2$ volume, and to correct for motion and eddy currents. The Brain Extraction Tool was used to remove non-brain tissue, FSL's DTIFIT was used to calculate FA, and NODDI toolbox was used to calculate the intra-neurite volume fraction (Ficvf) and orientation dispersion index (ODI). FSL's Tract-Based Spatial Statistics (TBSS) tool was used to align individual FA maps to FSL's standard adult FA template. Following registration, the FA maps of all subjects were thinned to create white matter skeletons. Then, Ficvf and ODI maps were created and registered using the TBSS registrations of FA to the adult FA template, and the skeleton mask was applied to the registered images. The white matter skeletons differences in FA, Ficvf and ODI were compared between ALS patients and healthy controls.

RESULTS

In the TBSS analysis, significant FA reductions were demonstrated within the (pre)frontal WM, partial parietal WM, corpus callosum and partial corticospinal tract (with TFCE-correction). Similarly, significant Ficvf reductions were found within almost all the WM skeleton (with TFCE-correction), which was more extensive than that of FA. In contrast, ODI showed no significant changes in all the WM skeleton.

CONCLUSION

NODDI is a more potential tool to demonstrating the neurite density reductions for ALS patients. Significant Ficvf reductions can be observed within almost all the WM skeleton, which indicates the reductions of the neurite density in the corresponding WM. Ficvf found more extensive changes than FA, indicating Ficvf is a more sensitive parameter.

CLINICAL RELEVANCE/APPLICATION

NODDI will help lead to earlier diagnosis and treatment for ALS.

SSG11-02 Histogram Analysis of Diffusion Kurtosis Imaging of Nasopharyngeal Carcinoma: Correlation between Quantitative Parameters and Clinical Stage

Tuesday, Nov. 28 10:40AM - 10:50AM Room: N229

Participants

Xiaoquan Xu, Nanjing, China (*Presenter*) Nothing to Disclose

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PURPOSE

To evaluate the correlation between histogram parameters derived from diffusion-kurtosis (DK) imaging and the clinical stage of nasopharyngeal carcinoma (NPC).

METHOD AND MATERIALS

DK imaging data of forty-seven consecutive NPC patients were retrospectively analyzed. Apparent diffusion for Gaussian distribution (Dapp) and apparent kurtosis coefficient (Kapp) were generated using diffusion-kurtosis model. Histogram parameters, including mean, median, 10th, 90th percentiles, skewness and kurtosis of Dapp and Kapp were calculated. Patients were divided into low and high T, N and clinical stage based on American Joint Committee on Cancer (AJCC) staging system. Differences of histogram parameters between low and high T, N and AJCC stages were compared using t test. Multiple receiver operating characteristic (ROC) curves were used to determine and compare the value of significant parameters in predicting high T, N and AJCC stage, respectively.

RESULTS

High T-stage (T3/4) NPC showed significantly higher Kapp-mean ($P=0.018$), Kapp-median ($P=0.029$) and Kapp-90th ($P=0.003$) than low T-stage (T1/2) NPC. High N-stage NPC (N2/3) showed significantly lower Dapp-mean ($P=0.002$), Dapp-median ($P=0.002$) and Dapp-10th ($P<0.001$) than low N-stage NPC (N0/1). High AJCC-stage NPC (III/IV) showed significantly lower Dapp-10th ($P=0.038$) than low AJCC-stage NPC (I/II). ROC analyses indicated that Kapp-90th was optimal for predicting high T-stage (AUC, 0.759; sensitivity, 0.842; specificity, 0.607), while Dapp-10th was best for predicting high N- and AJCC-stage (N-stage, AUC, 0.841; sensitivity, 0.875; specificity, 0.807; AJCC-stage, AUC, 0.671; sensitivity, 0.800; specificity, 0.588).

CONCLUSION

DK imaging-derived parameters correlated well with clinical stage of NPC, therefore could serve as an adjunctive imaging technique for evaluating NPC.

CLINICAL RELEVANCE/APPLICATION

DK imaging-derived histogram parameters were useful for characterizing NPC, and correlated well with the clinical stage of the NPC patients. Dapp-10th was optimal for predicting the high N- and AJCC-stage, while Kapp-90th was most powerful for predicting the high T-stage. Our results suggested that DK imaging-derived parameters could be a potential imaging marker for pretreatment staging, and DK imaging could be a useful adjunctive imaging technique for evaluating NPC before treatment.

SSG11-03 Cerebral Sodium (23Na) Magnetic Resonance Imaging in Patients with Migraine vs Healthy Controls

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N229

Participants

Melissa Ong, MD, Mannheim, Germany (*Presenter*) Nothing to Disclose
Alexander Schmidt, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Justus Benrath, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Simon Konstantin, PhD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Lothar R. Schad, PhD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG
Stefan Haneder, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Evaluation of ^{23}Na concentrations in patients with clinically manifest migraine vs. healthy controls.

METHOD AND MATERIALS

In this prospective, IRB-approved study we recruited 12 patients (all female; mean age 34 ± 11 years) who have been clinically evaluated for migraine and who have filled out a questionnaire regarding onset of disease, length, intensity (scale 1-10) and frequency of attacks and accompanying aura, as well as 12 healthy controls (all female; mean age 34 ± 11 years). Both groups underwent a cerebral ^{23}Na -magnetic resonance imaging examination at 3.0T (TimTrio, Siemens Healthcare Sector). For each scan a non-contrast enhanced T1w MP-RAGE sequence for anatomical referencing and a 3D-density-adapted, radial gradient echo (GRE-) sequence for ^{23}Na -imaging were acquired using a double-tuned ($^1\text{H}/^{23}\text{Na}$), dedicated head-coil. ^{23}Na -sequences were reconstructed according to the MP-RAGE, allowing direct cross-referencing of regions-of-interest (ROI). Circular ROIs were placed in predetermined anatomic regions: anterior and posterior cerebrospinal fluid (CSF), grey and white matter (GM/WM), brain stem and cerebellum. External ^{23}Na reference phantoms were used to calculate the ^{23}Na tissue concentrations. ^{23}Na concentrations of migraine patients and healthy controls were compared and statistically analyzed by Wilcoxon rank sum test.

RESULTS

Overall ^{23}Na concentrations (in millimoles per liter) in the anterior CSF region of patients with manifest migraine were significantly higher with 79 ± 7 vs. 69 ± 4 in healthy controls ($p=0.0001$) (see figure 1). Similar findings were found for the posterior CSF region with ^{23}Na concentrations of 85 ± 6 in migraine patients vs. 63 ± 8 in healthy controls ($p=0.0013$). No statistical difference was found for ^{23}Na concentrations in the grey and white matter, brain stem and cerebellum.

CONCLUSION

Cerebral ^{23}Na concentrations in CSF of migraine patients are significantly higher than in healthy controls.

CLINICAL RELEVANCE/APPLICATION

Cerebral ^{23}Na MRI may be a potential imaging tool for the diagnosis of migraine.

SSG11-04 Leakage Correction improves Prognosis Prediction of Dynamic Susceptibility Contrast Perfusion MRI in Primary Central Nervous System Lymphoma

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N229

Awards

Student Travel Stipend Award

Participants

Yeon Soo Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of this study is to evaluate whether CBV measurement with leakage correction from dynamic susceptibility contrast perfusion weighted image(DSC-PWI) can be useful for the prognosis prediction of primary CNS lymphoma(PCNSL).

METHOD AND MATERIALS

Among 130 patients with PCNSL from January 2007 to April 2016, 46 patients were classified by radiation therapy(RT) stratification:non-RT(n=16);RT group(n=30). Patients of both groups were reclassified into progression free survival(PFS) based subgroups by their PFS period:3 years criteria for RT group;1 year criteria for non-RT group. With a dedicated imaging processing program(NordicICE), the normalized cerebral blood volume(nCBV) map with or without leakage correction and leakage map were obtained. Those perfusion maps were co-registered with contrast enhanced T1 weighted image(CET1WI) and fluid attenuated inversion recovery(FLAIR). The total volume of interest(VOI) was drawn on co-registered images corresponding with enhancing lesion on CET1WI or hyperintensity lesion on FLAIR. Histogram analysis was used to calculate the corresponding parameters of the total VOIs. Student's t-test and Mann-Whitney test were used to evaluate significant difference of aforementioned imaging parameters between both groups. The PFS associated with nCBV was analyzed by Kaplan-Meier survival analysis.

RESULTS

The 75th percentile nCBV with leakage correction corresponding on CET1WI(T1nCBVL75%) had significant difference between the short(<3-year) and long(\geq 3-year) PFS subgroups of RT group(23.3%[7/30]vs76.7%[23/30], $P<.05$) and between the short(<1-year) and long(\geq 1-year) PFS subgroups of non-RT group(43.7%[7/16] s56.3%[9/16], $P<.05$). Patients of RT group with high T1nCBVL75%(> 5.3377) had shorter PFS than the others with low T1nCBVL75%(<= 5.3377)($P<.05$). However, patients of non-RT group with high T1nCBVL75%(> 4.2243) had longer PFS than the others with low T1nCBVL75%(<= 4.2243)($P<.05$).

CONCLUSION

Based on RT stratification, CBV with leakage correction has potential as a noninvasive biomarker for prognosis prediction of PCNSL to identify high risk patients and has different relationship with PFS based on the presence of combined RT. The high value of CBV with leakage correction correlates with shorter PFS in RT group and with longer PFS in non-RT group.

CLINICAL RELEVANCE/APPLICATION

Pretreated CBV value with leakage correction from DSC-PWI would be helpful to plan for therapeutic strategy in patients with PCNSL.

SSG11-05 Characterization of Parotid Tumors with Arterial Spin Labeling Perfusion-Weighted MR Imaging

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N229

Participants

Ahmed Abdel Razek, MD, Mansoura, Egypt (*Presenter*) Nothing to Disclose
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PURPOSE

To characterize parotid tumors with arterial spin labeling perfusion-weighted MR imaging

METHOD AND MATERIALS

This study was conducted upon 44 consecutive patients (27M, 21 F aged 15-75 ys: mean 45ys) with parotid tumors that underwent arterial spin labeling perfusion-weighted MR imaging at 1.5 Tesla scanner (Ingenia Philips Nederland). Multi-phases arterial spin labeling with FEEPI sequence was applied. The applied scanning parameters: TR = 2500 ms, TE = 20 ms, flip angle = 35 degrees, slice thickness = 6 mm, interslice gap = 1 mm, NEX = 1, FOV = 25 cm X 20 cm, SENSE factor = 2.5 and scanning time = 4 minutes. There was reconstruction of 1200 source images. The tumor blood flow (TBF) of parotid tumors were calculated and correlated with histopathological findings.

RESULTS

The TBF of malignant parotid tumors (37.9 ± 6.19 mL/100 g/min) was significantly different ($P = 0.001$) from that of benign parotid tumors (14.1 ± 3.12 mL/100 g/min). The threshold values of TBF used in differentiating malignant from benign parotid tumors was 25.5 mL/100 g/min with area under the curve (AUC) of 0.90. The TBF of malignant parotid tumors was significantly different from that of Warthin's tumors ($P = 0.001$). The cutoff TBF used to differentiate malignancy from Warthin's tumors was 18.7 mL/100 g/min with AUC of 0.88. There was a significant difference in TBF between pleomorphic adenomas and Warthin's tumors ($P = 0.041$). The threshold values of TBF used in differentiating pleomorphic adenomas from Warthin's tumors was 15.2 mL/100 g/min with AUC

of 0.88.

CONCLUSION

Arterial spin labeling perfusion-weighted MR imaging is non-invasive promising method that are used for differentiation of malignant from benign parotid tumors and for characterization of some benign parotid tumors.

CLINICAL RELEVANCE/APPLICATION

Arterial spin labeling perfusion-weighted MR imaging can be added to routine MR imaging for better characterization of parotid tumors

SSG11-06 Spectral Dual Energy CT Texture Analysis of Head and Neck Squamous Cell Carcinoma Tumor for Prediction of Cervical Nodal Metastasis

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N229

Participants

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PURPOSE

To evaluate a novel prediction model using dual energy CT (DECT) multi-energy texture feature analysis of head and neck squamous cell carcinoma (HNSCC) tumors to (1) predict the presence of associated cervical lymphadenopathy and (2) compare the accuracy of multi-energy versus single energy (65 keV) texture evaluation for endpoint prediction.

METHOD AND MATERIALS

87 patients with HNSCC having undergone a DECT scan of the neck were included in this study (64 untreated, 23 recurrent tumors). Texture analysis was performed using a commercial software (TexRAD®) by manually delineating a region of interest around the largest diameter of the tumor. Analysis and texture feature extraction was then performed on virtual monochromatic images (VMIs) ranging from 40 to 140 keV in 5 keV increments or VMIs at 65 keV alone. Random forests (RF) models were constructed using various histogram-based texture features for outcome prediction with internal cross-validation in addition to use of separate randomly selected training (70%) and validation (30%) sets. Sensitivity (Sens), specificity (Spec), positive predictive value (PPV), and negative predictive value (NPV) were determined for predicting positive versus negative nodal status in the neck.

RESULTS

When the entire patient population was evaluated, multi-energy texture analysis could predict the nodal status with an estimated Sens, Spec, PPV, and NPV of 77%, 75%, 77%, and 75%, respectively. Texture evaluation of VMIs at 65 keV only had a lower accuracy, with an estimated Sens, Spec, PPV, and NPV of 69%, 50%, 60%, and 60%, respectively. When the subset of untreated cases was evaluated, Sens, Spec, PPV, and NPV was 100%, 56%, 71%, and 100% using multi-energy analysis.

CONCLUSION

Multi-energy DECT texture analysis of HNSCC tumor is superior to texture analysis of single energy image sets at 65 keV alone and can be used to predict the nodal status in the neck with relatively good accuracy, providing information not currently available by routine clinical evaluation of the primary tumor.

CLINICAL RELEVANCE/APPLICATION

DECT texture analysis of the HNSCC tumor incorporated into radiomic models has the potential to predict neck nodal status with sufficient accuracy to preclude elective neck dissection in some cases.

SSG11-07 Advancing Precision Imaging of the Orbits with Higher Definition Digital PET/CT

Tuesday, Nov. 28 11:30AM - 11:40AM Room: N229

Participants

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Jun Zhang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
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Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study is to assess the clinical potential of digital photon counting PET (dPET) detector technology to enable higher definition imaging of the orbit and its associated structures and compare its imaging characteristics to conventional photomultiplier tube-based detector PET (cPET).

METHOD AND MATERIALS

Twenty oncology patients with no known orbital malignant or metastatic involvement agreed to participate in an ongoing intra-individual comparison of FDG PET imaging using pre-commercial release dPET/CT (Vereos) and cPET/CT (Gemini TF 64) systems. Standard whole-body cPET was performed using a target dose of 481 MBq FDG and imaged at ~75 min p.i. and investigational dPET was performed either at ~55 min or ~95 min p.i. Conventional PET and dPET images were reconstructed using voxel volumes of 4

mm3 (standard definition). Digital PET images were also reconstructed with smaller voxel volumes of 2 mm3 (high definition) and 1 mm3 (ultra-high definition). Intra-individual comparison of cPET/CT and dPET/CT image characteristics as well as overall image quality was performed by a blinded reader panel.

RESULTS

All 20 cPET and 60 dPET data sets were evaluable. No FDG-avid pathologic orbital lesions were identified. There was improved image quality with higher definition dPET/CT. Ultra-high definition dPET/CT images were rated best and enabled better delineation of the orbital soft tissue structures. Quantification of physiologic FDG uptake in orbital structures using higher definition dPET demonstrated slightly increasing SUVmax values which likely relate to the reduction in partial volume.

CONCLUSION

There exists an unmet clinical need to improve visualization and characterization of orbital soft tissue structures on FDG PET. Even with whole-body acquisitions, higher definition dPET/CT enables better visualization and characterization of normal orbital structures when compared with standard definition cPET/CT.

CLINICAL RELEVANCE/APPLICATION

Higher definition digital PET improves image quality and better delineates orbital structures which may allow for better lesion detectability especially for small, metabolically active lesions.

SSG11-08 Relationship between MRI and Optical Coherence Tomography (OCT) Measurements in Patients with Optic Nerve Atrophy

Tuesday, Nov. 28 11:40AM - 11:50AM Room: N229

Participants

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Anh-Dao Cheng, BS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Nurhan Torun, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Alexander Brook, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Yu-Ming Chang, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Rafeeqe A. Bhadelia, MD, Chestnut Hill, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to: (1) Assess the relationship between MRI measurements of optic nerve (ON) area and OCT measurement of retinal nerve fiber layer (RNFL) thickness, and (2) Determine a threshold ON area which predicts clinical diagnosis of optic nerve atrophy.

METHOD AND MATERIALS

Twenty-six patients with suspected optic nerve atrophy (unilateral = 13; bilateral = 13) who also had both an orbital MRI and an OCT study were retrospectively evaluated. An additional thirty-five patients who had received prior MR imaging (without OCT measurements) as part of a seizure protocol, and who had no listed ocular diagnoses, were included as controls. Age data was included and controls were selected to have an age distribution similar to case subjects. Coronal inversion-recovery images of orbital MRI were used to determine ON area at mid orbital level. RNFL thickness was determined on a Heidelberg Engineering Spectralis SD-OCT machine. Each eye was treated as a separate data point. Correlation coefficients were used to evaluate relationships, Mann-Whitney test to compare measurements, and ROC to investigate predictive accuracy.

RESULTS

No significant relationship between ON area and age was detected. A significant relationship was found between MRI measurements of ON area and OCT measurements of RNFL thickness ($r=0.61$; $p < 0.001$). There was a significant difference in ON area between subjects with optic nerve atrophy ($3.5 \pm 1.9 \text{ mm}^2$; Mean \pm SD) and controls ($7.2 \pm 2.8 \text{ mm}^2$; $p < 0.001$). Selecting a threshold MRI-measured ON area of 4.4 mm^2 had a sensitivity of 0.89 and a specificity of 0.91. The area under the ROC curve was 0.94.

CONCLUSION

MRI measurements of ON area correlate significantly with RNFL thickness measured by OCT. Our data also suggest that MRI-measured ON area $< 4.4 \text{ mm}^2$ has high sensitivity and specificity for predicting the presence of optic nerve atrophy, making it a potential diagnostic tool for radiologists.

CLINICAL RELEVANCE/APPLICATION

MRI measurement of optic nerve area can be used to predict the presence of optic nerve atrophy, making it a potential diagnostic tool for radiologists.

SSG11-09 Predictive Values of ASQ Imaging in Predicting Hypothyroidism in Hashimoto's Thyroiditis

Tuesday, Nov. 28 11:50AM - 12:00PM Room: N229

Participants

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Ji-Hye Won, Bucheon, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Chul-Hee Kim, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Hye Jeong, MD, Bucheonsi, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

ASQ (acoustic structure quantification) can provide objective and quantitative analysis of thyroid echogenicity. Our aim is to

investigate the clinical significance of ASQ imaging parameters whether it can predict progression of hypothyroidism in Hashimoto's thyroiditis (HT).

METHOD AND MATERIALS

We prospectively enrolled 92 lobes in 50 patients with HT who underwent ASQ imaging with 3 year follow up. Initial and 3 year follow up ASQ parameters including AV mode, AV average, AV SD, AV ratio, blue mode, blue average, blue SD and clinical data including thyroid function test were collected. Clinical and ASQ parameters were analyzed as possible predictors of hypothyroidism.

RESULTS

Patients who developed hypothyroidism showed lower AV mode ($P=.003$), lower AV average ($P=.039$), lower blue average ($P=.02$) and lower blue SD ($P=.025$) than patients with no change or improved thyroid function. Lower AV blue mode value (OR 0.98, $P=.0019$) and larger changes in AV ratio (OR 1.06, $P=.0297$) were significantly associated with hypothyroidism in HT.

CONCLUSION

Patients who progressed to hypothyroidism showed lower ASQ values at initial presentation. Initial ASQ parameters might be useful in stratifying the risk of hypothyroidism progression in patients with HT.

CLINICAL RELEVANCE/APPLICATION

ASQ imaging may be helpful for identifying patients at high risk for progression of hypothyroidism in HT.

SSG12

Neuroradiology (Slow and Steady: Understanding Movement Disorders)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: N227B

NR

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

FDA

Discussions may include off-label uses.

Participants

Rihan Khan, MD, Tucson, AZ (*Moderator*) Nothing to Disclose
David R. De Lone, MD, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSG12-01 Clinical Indication and Impact on Management of DaTscan (Ioflupane I-123) SPECT/CT in Patients with Suspected Parkinsonian Disease

Tuesday, Nov. 28 10:30AM - 10:40AM Room: N227B

Awards

Student Travel Stipend Award

Participants

Charles Marcus, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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Steven P. Rowe, MD, PhD, Parkville, MD (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

An accurate diagnosis is of importance for a timely and appropriate therapeutic management of patients with clinically uncertain parkinsonian syndromes (CUPS). We aim to evaluate the clinical impact of DaTscan (I-123 Ioflupane) on diagnosis and therapeutic management.

METHOD AND MATERIALS

This is a retrospective study including patients seen at a Movement Disorder Center between January 2005 and January 2015. The main inclusion criteria was a pre-test clinical diagnosis of CUPS. All studies were performed after injection of 3-5mCi I123-Ioflupane followed by SPECT imaging of the head 3-4 hours after injection using a gamma camera equipped with low energy high resolution collimators. Patients demographic data, medications at the time of the study, relevant laboratory tests, diagnosis before and after the test and change in management after the study were reviewed.

RESULTS

203 (85 male, 118 female; median age 64 years) patients diagnosed with CUPS were included in the study. In 152 patients, a diagnosis prior to and after the scan was available. In 180 patients, medication history during the time of the study was available. At baseline, the most common diagnosis was Parkinson's disease (77/152; 50.7%), followed by essential tremor (37/152; 24.3%) and parkinsonism (26/152; 17.1%). In majority of the patients (163/180; 90.6%), medications that affect radiotracer binding were withdrawn per protocol prior to the study. In 10.4% patients, in whom the medications were not withdrawn, the radiotracer binding pattern was qualitatively reviewed. The DaTscan led to a change in diagnosis in 79/152 (51.9%) patients. In 68/139 (48.9%) patients, there was certain impact in therapeutic management. The most frequent change in clinical management was initiation of a new medication not planned at baseline. DaTscan was safe and well tolerated with no reported adverse events.

CONCLUSION

I-123 Ioflupane SPECT of the brain performed for evaluation of patients with suspected parkinsonian syndromes lead to change in diagnosis in 51.9% patients and change in management in 48.9% patients and appears to be a powerful tool in supporting movement disorder specialists in clinical decision making.

CLINICAL RELEVANCE/APPLICATION

DaTscan is a powerful tool in the current clinical diagnosis and management of patients with suspected parkinsonian disease

SSG12-02 Deep Cerebral Venous Oxygenation Content in Patients with Parkinson's Disease Using Quantitative Susceptibility Mapping

Tuesday, Nov. 28 10:40AM - 10:50AM Room: N227B

Participants

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Junyi Dong, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Xiaoxin Li, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Shesnia Salim Padikkalakandy Cheriya, MD, MBBS, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the deep brain venous blood oxygen content changes in patients with Parkinson's disease using Quantitative Susceptibility Mapping (QSM), and to explore the ability of QSM in reflecting the clinical condition.

METHOD AND MATERIALS

This prospective study approved by the hospital ethics committee. Twenty PD patients enrolled in the study. All the clinical-proved patients fulfilled the UK Parkinson's disease Brain Bank Criteria for the diagnosis of idiopathic PD underwent conventional MRI and QSM scan. All the patients' clinical conditions quantified according to the Montreal Cognitive Assessment (MoCA) and Hoehn-Yahr grading scale. The score was 14-30 and 1-3. Twenty age and gender matched healthy controls underwent conventional MRI and QSM scan and the clinical data were collected. The blood oxygen content of deep brain vein were estimated by the susceptibility value, different susceptibility value of blood vessels and surrounding tissues were processed with SPIN software, recording as $\Delta(S)$. The blood vessels consist of bilateral Basal Vein (BV), Superficial Middle Cerebral Veins (SMCV), Internal Cerebral Vein (ICV), and Superior Thalamostriate Vein (STV). The difference of $\Delta(S)$ of each vein between PD group and healthy control group compared using independent sample t-test. The correlation between $\Delta(S)$ and clinical condition (MoCA and Hoehn-Yahr scales) tested using Spearmans correlation.

RESULTS

1. The different susceptibility value $\Delta(S)$ of BV, SMCV, ICV, and STV were higher in PD patients than the controls ($t=2.165, 2.300, 2.105, P<0.05$). 2. The $\Delta(S)$ of BV and STV had significant positive correlation with MoCA scores ($r=0.625, 0.632, P<0.01$).

CONCLUSION

The state of hypoxia of the brain parenchyma appears in PD patients. The extent of hypoxia can reflect the disability of the patients.

CLINICAL RELEVANCE/APPLICATION

Quantitative Susceptibility Mapping (QSM) can reflect the venous blood oxygen content changes via susceptibility change of different tissues.

SSG12-03 Imaging Findings on MR Guided Focused Ultrasound Thalamotomy for Tremor

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N227B

Participants

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PURPOSE

Thalamotomy of the ventral intermediate nucleus (VIM) is effective in alleviating medication resistant tremor in patients with essential tremor (ET) and Parkinson's disease (PD). MRI guided focused ultrasound (MRgFUS) is an innovative technology that enables noninvasive thalamotomy via thermal ablation. In this presentation we show the imaging finding post MRgFUS, in a cohort of 32 patients.

METHOD AND MATERIALS

Patients with severe medication resistant tremor underwent unilateral VIM thalamotomy using MRgFUS. MRI studies were obtained at the day of treatment, 1 day post treatment, 1 week, 2-3 months and at 1 year post treatment. MRI studies included high resolution T2 images in addition to routine contrast enhanced study. Images were retrospectively analyzed for lesion size and imaging characterization. Patients were also evaluated for tremor alleviation and quality of life.

RESULTS

MRgFUS resulted in close to a spherical lesion in the planned target with a diameter of 4-9 mm (average, 6.8 ± 1.5 mm), surrounded by mild edema at 1 post procedural day with increased edema one week after the procedure. The edema lasted for 5-8 weeks following the procedure. On DWI the lesion had diffusion restriction immediately post treatment, which lasted up to 2 months. The central aspect of the lesion had low SWI signal that started at 1day post treatment. Peripheral enhancement appeared usually at 2 months post treatment. At 3 months the lesion decreased in size and the edema resolved, and at 1 year follow-up the lesion was sometimes difficult to depict, with no correlation of the residual lesion size or imaging characteristics to the sustained tremor relief.

CONCLUSION

MRgFUS resulted in a lesion at the planned target. The lesion undergoes expected imaging changes with initial increase in edema and later resolution. So far there are no imaging characteristics that depict response to treatment.

CLINICAL RELEVANCE/APPLICATION

On MRI there are expected imaging changes following MRgFUS.

SSG12-04 Inhibitory Motor Dysfunction in Parkinson's disease Subtypes

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N227B

Participants

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PURPOSE

Parkinson's disease (PD) is divided into postural instability gait difficulty (PIGD) and tremor-dominant (TD) subtypes. Increasing evidence has suggested that the GABAergic neurotransmitter system is involved in the pathogenesis of PD; however, to-date, MRS of GABA in both subtypes has not been performed. Thus, the aim of this study was to evaluate the differences of GABA levels between PD motor subtypes using MEGA-PRESS.

METHOD AND MATERIALS

PD patients were classified into PI GD (n = 13) and TD groups (n = 9); sixteen age- and gender- matched healthy controls were recruited. All subjects were right-handed and underwent MRS scan including MEGA-PRESS. GABA+ levels and Creatine (Cr) levels were quantified in the left basal ganglia (BG). Differences in GABA+ levels among three groups were analyzed using analysis of covariance. The relationship between GABA levels and unified Parkinson's disease rating scale (UPDRS) was also analyzed.

RESULTS

GABA+ levels were significantly lower in left BG regions of PD patients compared with healthy controls ($p < 0.001$). In PD patients, the GABA concentration was lower in the TD group than PI GD group ($p = 0.025$). Cr levels in PI GD and TD were lower than controls ($p = 0.006$; $p = 0.001$). A significant negative correlation was found in PI GD between GABA levels and UPDRS ($r = -0.586$, $p = 0.035$), while no correlation was found in TD.

CONCLUSION

Low BG GABA levels in PD patients, and differences between PI GD/TD patients, suggest that GABAergic dysfunction may play an important role in the pathogenesis of Parkinson's disease.

CLINICAL RELEVANCE/APPLICATION

Low BG GABA+ levels in PD patients, and differences between PI GD/TD patients, suggest that GABAergic dysfunction may play an important role in the pathogenesis of Parkinson's disease.

SSG12-05 Surface-Based Morphometry and Tractography in Patients with Parkinson's disease and Freezing of Gait

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N227B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Freezing of Gait (FOG) is a disabling gait disturbance, consisting in a transient inability to initiate or maintain stepping, often experienced by patients with Parkinson's Disease (PD). Although recent Magnetic Resonance Imaging (MRI) studies underlined the involvement of certain brain areas in FOG patients, there is still lack of agreement between authors. Our purpose was to study structural Gray Matter (GM) and White Matter (WM) changes in PD patients with FOG.

METHOD AND MATERIALS

We studied 21 PD patients with FOG, 16 PD patients without FOG (nFOG) and 19 healthy subjects (HS). Patients were evaluated with clinical scales assessing for motor and cognitive functions. Participants underwent a standardized 3T MRI protocol (Siemens, Verio). For gray matter evaluation, Cortical volume (CV), Cortical thickness (CTh), and Surface Area (SA) were obtained by an automated surface-based analysis of T1-3D images using FreeSurfer pipeline. For white matter evaluation, DTI images were analyzed using Tracts Constrained by Underlying Anatomy (TRACULA) in FreeSurfer.

RESULTS

No differences in demographic and clinical characteristics were found between FOG and noFOG patient groups. FOG patients exhibited a significant reductions in CTH in the mesial surface of both the hemispheres (superior frontal gyrus, paracentral lobule, posterior cingulate areas, precuneus, pericalcarine cortex) and in the right dorsolateral prefrontal cortex, compared to HS. FOG patients showed smaller SA in the right supramarginal and superior parietal areas than nFOG. WM changes were observed in FOG patients in the temporal bundle of the superior longitudinal fasciculus, uncinate fasciculus and cingulum cingulate gyrus (mostly in the right hemisphere) and in the frontal radiation of the corpus callosum. DTI abnormalities in most of these white matter bundles significantly correlated with cognitive scores.

CONCLUSION

FOG may result from disruption of integration processes rather than from damage of a single area. GM changes in mesial frontal-parieto-occipital cortex are associated to WM changes of long-range associative fibers that allow both inter- and intra-hemispheric integration.

CLINICAL RELEVANCE/APPLICATION

Deterioration of multiple brain structures involved in high-level gait control, and loss of integration between motor, cognitive and limbic information may constitute the anatomical substrate of freezing of gait in Parkinson's disease.

SSG12-06 Longitudinal Diffusion Tensor Imaging as a Predictor of Motor Impairment Worsening in Early Stage Parkinson's Disease

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N227B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To verify whether white matter microstructural changes are predictors of declining motor impairment in Parkinson's disease (PD).

METHOD AND MATERIALS

A total of 123 patients with early PD were enrolled along with 49 controls. Participants underwent clinical, motor (Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III) and 3T MRI DTI investigations at baseline and 18 month evaluation. Baseline and longitudinal fractional anisotropy (FA) and mean diffusivity (MD) changes were analysed voxelwise using Tract Based Spatial Statistics in generalised linear models. Imaging parameters were analysed using Tract Based Spatial Statistics. The relationships between fractional anisotropy (FA) and mean diffusivity (MD) with motor function were investigated using multiple linear regression. All analyses were controlled for age, sex, disease duration, levodopa dose and visit intervals.

RESULTS

At baseline, patients with PD had significantly higher widespread MD than controls. At follow-up, both groups showed a further significant FA decrease and MD increase. Baseline MD was a significant predictor of worsening of motor impairment in PD (B (95%CI) 61.07 (15.75; 106.40), p 0.009), whereas FA was not a significant predictor (B (95%CI) -76.55 (-158.42; 5.32), p 0.067).

CONCLUSION

MD represents an important correlate and predictor of motor impairment in PD: DTI is potentially a useful tool in stratification of patients into clinical trials and to monitor the impact of treatment on motor function.

CLINICAL RELEVANCE/APPLICATION

This prospective longitudinal large cohort, demonstrated that mean diffusivity is a predictor of future worsening of motor function in early Parkinson's disease. Diffusion tensor imaging is potentially a useful tool in stratification of patients into clinical trials to monitor the impact of treatment on motor function.

SSG12-07 Assessment of Patients Who Presented with Parkinsonism: Nigrosome-1 Susceptibility Map-weighted Imaging versus 18F-FP-CIT PET

Tuesday, Nov. 28 11:30AM - 11:40AM Room: N227B

Participants

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PURPOSE

Normal presynaptic dopaminergic function is one of the diagnostic exclusion criteria for idiopathic Parkinson's disease (IPD). Nigrosome-1 imaging can reflect the status of substantia nigra pars compacta (SNpc). As susceptibility map-weighted imaging (SMWI) has a higher contrast-to-noise ratio than conventional susceptibility-weighted imaging, it can be hypothesized that nigrosome-1 SMWI may show comparable diagnostic performance with 18F-FP-CIT PET (CIT PET). We sought to compare nigrosome-1 SMWI with CIT PET for assessing patients who presented with parkinsonism.

METHOD AND MATERIALS

We prospectively obtained both SMWI and CIT PET in 206 patients who presented with parkinsonism and in 16 healthy subjects. All participants underwent oblique axial 0.5×0.5×1.0-mm³ 6-echo gradient-recalled echo covering the SNpc at 3T. The reconstructed quantitative susceptibility mapping was used to generate SMWI. Each side of nigrosome-1 was retrospectively assessed by 2 independent reviewers. Discrepancy was resolved by consensus. Each side of the basal ganglia on CIT PET was assessed by a nuclear medicine specialist, which served as a reference standard. Participants with abnormality in either side of the basal ganglia on CIT PET or the nigrosome-1 on SMWI were considered having disease.

RESULTS

Patients were diagnosed as IPD (n = 98), drug-induced parkinsonism (n = 65), MSA-C (n = 10), MSA-P (n = 7), essential tremor (n = 7), PSP (n = 3), and others (n = 13) based on both clinical and imaging findings. Interrater agreement for SMWI was excellent ($k = 0.973$). As for 444 basal ganglia interpretations on CIT PET, SMWI showed 11 false-positive (FP) and 11 false-negative (FN) interpretations (sensitivity [SE], specificity [SP], positive-predictive value [PPV], and negative-predictive value [NPV] were 94.9%, 95.2%, 94.9%, and 95.2%), showing no significant difference ($P = 1.0$, McNemar test). As for 222 participants, SMWI demonstrated 7 FP interpretations without FN readings (SE, SP, PPV, and NPV were 100%, 93.7%, 94.1%, and 100%) ($P = 0.016$, McNemar test).

CONCLUSION

Presynaptic dopaminergic function on 18F-FP-CIT PET can be comparably assessed on SMWI in patients who presented with parkinsonism.

CLINICAL RELEVANCE/APPLICATION

Compared to CIT PET, SMWI has similar diagnostic performance without FN readings, and can serve as a screening imaging tool for patients who need further evaluation by dopamine transporter imaging.

SSG12-08 Clinical Application of Quantifying Changes in Nigrosomes in the Diagnosis of Early-Stage Parkinson's Disease

Tuesday, Nov. 28 11:40AM - 11:50AM Room: N227B

Participants

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PURPOSE

For diagnosing Parkinson's disease (PD), decreased dopaminergic neuron in the nigrosomes which are primary subregions of the substantia nigra pars compacta (SNpc), and increased iron deposition in the nigrosome 1 which is the largest nigrosome subgroup and located in the dorsolateral SNpc have been assessed. Our aim was to assess the utility of quantifying these neurodegenerative changes in the SNpc in the diagnosis of early-stage PD.

METHOD AND MATERIALS

Eighteen patients (PD group) with early PD stages (Hoehn and Yahr scale: 1-2) and 18 age-matched healthy controls (HC group) underwent quantitative susceptibility mapping (QSM), neuromelanin imaging and three-dimensional (3D) T1W imaging on a 3T magnetic resonance imager. Both QSM and neuromelanin values of the SNpc were calculated using a region of interest (ROI) based automated segmentation system with the voxel-based morphometric technique. Two respective ROIs encompassing the whole and dorsolateral SNpc were created (Figure). Signal to noise ratio (SNR) of the SNpc in the neuromelanin images was calculated on the basis of mean value of the automatically segmented background region. In both ROIs, the significance of intergroup differences in each median QSM value and neuromelanin area of higher SNR than that of the background region were tested using Mann-Whitney's U test. Logit (p) was used to estimate the probability of PD in relation to the QSM value and the neuromelanin area, and the diagnostic performances of each value of the ROIs and logit (p) were assessed using Receiver operating characteristic (ROC) analysis.

RESULTS

In both ROIs, QSM value was significantly higher, and neuromelanin area was significantly less, in PD group than in HC group ($P < 0.05$). The respective areas under the ROC curve for QSM value/neuromelanin area were 0.70/0.81 for the whole SNpc ROI and 0.73/0.78 for the dorsolateral SNpc ROI, and that for logit (p) in relation to QSM value of the dorsolateral SNpc ROI and neuromelanin area of the whole SNpc ROI was 0.86.

CONCLUSION

Comprehensive MRI assessment for the abnormality involving the nigrosomes can yield a high diagnostic accuracy for early PD.

CLINICAL RELEVANCE/APPLICATION

Quantifying the dopaminergic neurodegenerative changes with iron deposition, featuring spatial difference of nigral changes in the SNpc, can provide a high diagnostic accuracy for early PD.

SSG12-09 Response to Deep Brain Stimulation is Associated with Increased Resting State Connectivity in the Associative Basal Ganglia Circuit

Tuesday, Nov. 28 11:50AM - 12:00PM Room: N227B

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Deep brain stimulation (DBS) of the subthalamic nucleus (STN) or globus pallidus pars interna (GPI) is indicated in patients with refractory Parkinson's disease (PD) with significant motor fluctuations. While clinical characteristics facilitate patient selection, no objective tool to predict response to DBS exists. We examined resting state functional magnetic resonance imaging (rsfMRI) to determine the feasibility of this modality to serve as such a predictive tool.

METHOD AND MATERIALS

Eight patients (3 female) with advanced PD underwent a preoperative MRI under anesthesia in preparation for DBS surgery. Motor scores (UPDRS-III) were collected before and after DBS (mean follow-up of 5.9 months). Scans were performed in a 3T Achieva Philips MR scanner, including rsfMRI (TR=2000ms, TE=25ms, FOV=68×68mm, flip angle=90°, spatial resolution=1.87×1.87×3.5mm, matrix size=128×128). Images were preprocessed to correct for spatial and temporal artifacts. Regions of interest (ROIs) were defined using the Harvard-Oxford atlas and the ATAG-MNI04 basal ganglia atlas. Functional connectivity (FC) was calculated using the MatLab-based CONN toolbox via two-tailed bivariate correlations. Significant FC differences between patients who had improved UPDRS-III scores following DBS versus those who had worse UPDRS-III scores following DBS were evaluated with both a ROI-to-voxel and ROI-to-ROI analysis (FDR-corrected $p < 0.05$).

RESULTS

Patients were 66.5 ± 8.9 years old with disease duration of 7.3 ± 1.8 years. Preoperative UPDRS-III was 29.3 ± 10.6 and postoperative UPDRS-III was 21.9 ± 9.0 . Patients who responded more favorably to DBS had increased resting state connectivity within the basal ganglia (STN, pallidum, thalamus, striatum) and increased connectivity between the striatum and the frontal operculum ($p = 0.001$).

CONCLUSION

Three major basal ganglia networks consisting of motor, associative, and limbic circuits have been described. While much focus has been on motor circuits in PD, our findings suggest that the associative circuit may play a role in DBS response and show promise in the ability for rsfMRI to provide better pre-surgical consultation to patients regarding prognosis from DBS.

CLINICAL RELEVANCE/APPLICATION

Together, these results show promise in the ability for rsfMRI to provide better pre-surgical consultation and guidance to patients regarding prognosis from DBS.

SSG13

Physics (CAD and Machine Learning)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S404AB

BQ CT IN PH

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

Participants

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Sub-Events

SSG13-01 Observer Performance Study for Bladder Cancer Treatment Response Assessment in CT Urography With and Without Computerized Decision Support

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S404AB

Participants

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PURPOSE

To evaluate whether a computerized decision support system for bladder cancer treatment response assessment (CDSS-T) can assist radiologists in identifying patients who have complete response after neoadjuvant chemotherapy.

METHOD AND MATERIALS

With IRB approval, pre- and post-chemotherapy CTU scans of 123 patients were collected retrospectively, resulting in 158 pre- and post-treatment lesion pairs. The pathological cancer stage after treatment, as determined by cystectomy, was collected as the reference standard of whether a patient fully responded to treatment. Twenty-five percent of the lesion pairs (40/158) had T0 cancer stage after chemotherapy, which corresponds to a complete response. We have developed a CDSS-T system that uses a combination of DL-CNN and radiomics features to distinguish between cases that have fully responded to treatment and those that have not. Two abdominal radiologists and 4 residents trained in abdominal radiology estimated the likelihood of stage T0 disease after treatment by viewing each pre-post-treatment CTU pair displayed side by side on a specialized graphic user interface designed for CDSS-T. The observer provided an estimate without CDSS-T first and then might revise the estimate, if preferred, after the CDSS-T score was displayed. The cases were randomized differently for each observer. The observers' estimates with and without CDSS-T were analyzed with multi-reader, multi-case (MRMC) receiver operating characteristic (ROC) methodology. The area under the curve (AUC) and the statistical significance of the difference were calculated.

RESULTS

The AUC for prediction of T0 disease after treatment was 0.80±0.04 for the CDSS-T alone. Each observer's performance increased with the aid of CDSS-T. The average AUC for the observers were 0.75 (range: 0.70-0.79) without CDSS-T, and increased to 0.78 (range: 0.73-0.81) with CDSS-T. The differences in the average AUC values between without CDSS-T and with CDSS-T were statistically significant ($p < 0.01$).

CONCLUSION

Our study demonstrated that our CDSS-T system for bladder cancer treatment response assessment in CTU can improve radiologists' performance in identifying patients who fully responds to treatment.

CLINICAL RELEVANCE/APPLICATION

CDSS-T has the potential to improve radiologists' accuracy in bladder cancer treatment response assessment, which is vital for identifying non-responders and allowing them to seek alternative therapy.

SSG13-02 DeepBreath: Automated Lung Nodule Detection and Segmentation with Convolutional Neural Networks

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S404AB

Participants

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PURPOSE

To automatically detect and segment lung nodules in Computed Tomography (CT) scans for computer-aided detection of lung cancer

METHOD AND MATERIALS

Following the LUNG Nodule Analysis (LUNA) 2016 challenge, our dataset contains 888 CT scans from Lung Image Database Consortium (LIDC) with slice thickness $\leq 3\text{mm}$. There are 1,186 nodules in which the median diameter is 6.43mm (min=3.25mm, max=32.27mm). We designate 80% of the scans as training set, 10% as validation set and 10% as test set. We report all metrics on the test set. Our approach consists of the following three stages: First, we use a 2D U-Net-based segmentation proposal network to suggest initial nodule candidates for each scan. We apply higher weight to the loss in the center of the nodules with gradual drop-off towards the edges to encourage the network to learn the nodule center and boundary. Next, we use a 2.5D ResNet-based classifier to reduce the number of false positives (FP). We extract 9 views (6 diagonal and 3 orthogonal) for each candidate and oversample positive nodules to account for label imbalance. Finally, we segment positive nodules with a 3D U-Net based network to obtain fine-grained nodule masks. The network is trained on 3D patches centered on the nodule with ground truth masks based on agreement of three of the four LIDC annotators. We evaluated our method using nodule recall at 2 FP per scan and nodule recall from the proposal network. For nodule segmentation, we report the dice coefficient between ground truth and prediction segmentation.

RESULTS

In the first stage, the proposal network has a recall of 92.04% with an average of 969.34 FP/scan. By ensembling two proposal networks, we achieve a recall of 95.57% with 1161.24 FP/scan. After the classifier stage, the number of FP has been reduced by 500x to 2 FP/scan while maintaining a high recall of 85.86%, 95% CI [75.01% and 92.67%]. For nodule segmentation, the mean volumetric dice coefficient is 0.76 ± 0.14 .

CONCLUSION

Our automated nodule detection method yields a high nodule recall rate while maintaining a low false positive rate. Furthermore, our nodule segmentation method provides accurate and detailed nodule segmentation in 3D to assist clinical management and follow-up.

CLINICAL RELEVANCE/APPLICATION

A reliable lung CAdE system may become essential for detection of lung lesions for early diagnosis of cancer. It may improve radiologist accuracy and efficiency as a second reader.

SSG13-03 Direct Coronary Artery Calcium Scoring in Low-Dose Chest CT Using Deep Learning Analysis

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S404AB

Participants

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PURPOSE

Coronary artery calcium (CAC) score determined in screening with low-dose chest CT is a strong and independent predictor of cardiovascular events (CVE). However, manual CAC scoring in these images is cumbersome. Existing automatic methods detect CAC lesions and thereafter quantify them. However, precise localization of lesions may not be needed to facilitate identification of subjects at risk of CVE. Hence, we have developed a deep learning system for fully automatic, real-time and direct calcium scoring circumventing the need for intermediate detection of CAC lesions.

METHOD AND MATERIALS

The study included a set of 1,546 baseline CT scans from the National Lung Screening Trial. Three experts defined the reference standard by manually identifying CAC lesions that were subsequently quantified using the Agatston score. The designed convolutional neural network analyzed axial slices and predicted the corresponding Agatston score. Per-subject Agatston scores

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

SSG13-04 Investigating the Depth of Convolutional Neural Networks (CNNs) in Computer-aided Detection and Classification of Focal Lesions: Lung Nodules in Thoracic CT and Colorectal Polyps in CT Colonography

Participants

For information about this presentation, contact:

PURPOSE

METHOD AND MATERIALS

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

SSG13-05 Two Deep-Learning Models for Lung Nodule Detection and Classification in CT: Convolutional Neural Network (CNN) vs Neural Network Convolution (NNC)

Participants

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Subject level mean sensitivity values ranged between 40% to 80% for LungRAD4, 27% to 55% for LungRAD3, 22% to 50% for

LungRAD2, and 10% to 53% for LungRAD1. Sensitivity was stable at all dose levels in LungRAD3 and LungRAD4 categories (even down to 10% of screening dose), with a medium kernel and either 1mm or 0.6 mm slice thickness. Mean false-positive was between 2-9 per patient with most conditions yielding < 4.

CONCLUSION

CAD detection sensitivity was reasonably robust to dose, slice thickness and kernel, though the sharper kernel yielded the most variable performance. False positives were also surprisingly stable except at very high noise (low dose, thin slice, sharp kernel) conditions.

CLINICAL RELEVANCE/APPLICATION

CAD detection of lung nodules in low dose Lung Cancer Screening CT exams may provide assistance to radiologists; the performance may be robust across acquisition and reconstruction conditions.

SSG13-07 Multi-Task Transfer Learning Deep Convolutional Neural Network for Improved Computer-aided Diagnosis of Masses in Mammography

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S404AB

Participants

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PURPOSE

A multi-task transfer learning (MTTL) deep convolutional neural network (DCNN) was formulated to translate the 'knowledge' learned from non-medical images to medical imaging 'interpretation' tasks through supervised training and to simultaneously increase the generalization capabilities of DCNNs by learning auxiliary tasks. We compared the MTTL approach to traditional transfer learning method for classification of malignant and benign masses in mammography.

METHOD AND MATERIALS

From the University of South Florida (USF) digitized screen-film mammogram (SFM) database and with IRB approval from the University of Michigan (UM), heterogeneous mammography data sets of SFMs and digital mammograms (DMs) with a total of 2,282 mammograms containing 2,461 lesions were collected. With data augmentation, 19,688 regions-of-interests containing biopsy-proven masses were obtained. Through inductive transfer learning, the objective predictive model from IMAGENET DCNN trained on 1.2 million non-medical images was induced into the target task of classifying masses. In the multi-task learning, the transfer network learned three target tasks (SFM-UM, SFM-USF, DM-UM). In contrast, the single-task learning was trained with a SFM-UM data set alone. Using the training set, a 4-fold case-based cross-validation was performed to select the best training strategy in terms of the depth of convolutional layers that should be frozen during transfer learning. Each experiment was repeated for 10 stochastic initializations to evaluate the robustness of the trained DCNN. An independent test set containing 909 lesions sequestered from SFM-UM was used to assess the difference in performance between the DCNNs trained with single- and multi-task transfer learning by ROC analysis.

RESULTS

Transfer learning by freezing the first convolution layer alone provided the best training. The independent test *AUC* for single- and multi-task transfer learning reached 0.79 ± 0.02 and 0.82 ± 0.02 , respectively. The *AUC* difference between the two methods was statistically significant (p -value=0.007).

CONCLUSION

When using transfer learning for DCNNs, multi-task supervised learning achieved better generalization to unknown cases than single-task learning.

CLINICAL RELEVANCE/APPLICATION

The MTTL DCNN framework for classification of masses in mammography has the potential to be extended to digital breast tomosynthesis while utilizing auxiliary tasks from large SFM and DM data sets.

SSG13-08 Deep Learning Analysis for Automatic Calcium Scoring in Routine Chest CT

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S404AB

Participants

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PURPOSE

Coronary artery calcium (CAC) is a robust predictor of cardiovascular events (CVE) in asymptomatic individuals. Several guidelines

recommend reporting of CAC scores in ungated chest CT exams. In addition, chest CT can be used to quantify thoracic aorta calcification (TAC) and cardiac valve calcification (CVC), which may further improve prediction of CVE. This study evaluates the performance of an automatic method for scoring of CAC, TAC and CVC on routine chest CT exams.

CONCLUSION

Fully automatic scoring of coronary, aortic and cardiac valve calcifications highly correlates with manual scoring, even in ungated routine chest CT.

CLINICAL RELEVANCE/APPLICATION

Automatic calcium scoring in routinely acquired ungated chest CT enables identification of subjects at elevated cardiovascular risk without additional reading time.

SSG13-09 Automated Contrast Timing Classification with Deep Convolutional Neural Networks

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S404AB

Participants

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PURPOSE

To investigate whether a machine learning technique known as deep learning, e.g., Deep Convolutional Neural Networks (CNNs), which selects image pixel data directly (rather than utilizing human-designed features) in the extraction of image descriptors, has potential to explore and discover latent imaging features that are difficult to categorize by the human visual system and thus be used in a development of novel imaging biomarkers. We aim to evaluate if machine learning can achieve a classification of the contrast enhancement timing without any human annotation.

METHOD AND MATERIALS

700 CTs acquired at the portal venous phase had their contrast timing determined by a consensus reading between experienced radiologists. Patients were divided between optimal-timing (n=443) vs non-optimal timing (early or late, n=257). These timing data were used as the reference standard for the automated timing classification system. The whole 3D voxel images (normalized to 512*512*150) were used directly as input to a deep learning method (CNNs) to maximally explore the potential imaging features. The proposed network consisted of 5 convolutional layers and LeakyReLU activations, followed by average pooling layers and three dense layers. The outputs were equivalent to the classes: optimal and non-optimal. To train and evaluate the CNN we used a dataset of 700 CTs, within which 600 (396:204) were used as training and validation. The remaining 100 (57:43) were not included in the training set and were thus totally blind to the computer when used for testing. Five-fold cross validation was used to assess performance.

RESULTS

The classification performances were 89.3% (SE:0.01) in the training set and 93.2% (SE:0.01) in the validation set, which demonstrated the potential of CNNs in automatically analyzing contrast enhancement timing classification in CT scans.

CONCLUSION

There is great potential for the application of deep learning methods as an aid to radiologists in the analysis of medical images. Larger datasets with a wider spectrum of timing will be needed to refine performance and the learned imaging features needed to be examined.

CLINICAL RELEVANCE/APPLICATION

An immediate, unbiased appraisal of contrast timing can reduce medical error because certain pathologies are invisible outside of the appropriate contrast phase.

SSG14

Science Session with Keynote: Physics (Breast Tomosynthesis, Breast CT)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S405AB

BR CT PH

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

FDA Discussions may include off-label uses.

Participants

Stephen J. Glick, PhD, Silver Spring, MD (*Moderator*) Nothing to Disclose
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Sub-Events

SSG14-01 Physics Keynote Speaker: X-Ray Imaging of the Breast in 3D

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S405AB

Participants

Srinivasan Vedantham, PhD, Tucson, AZ (*Presenter*) Research collaboration, Konig Corporation

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ABSTRACT

X-ray Imaging of the breast in 3D Prospective clinical trials, retrospective multi-reader studies and observational studies from clinical practices have shown the benefits of digital breast tomosynthesis (DBT), a limited-angle tomographic technique, in breast cancer screening. These include reduced callback rates, particularly reduction in false-positive callbacks, and increased cancer detection rates, particularly for invasive cancers. While DBT continues to be rapidly adopted in clinical practices, studies on further optimization and improvements to DBT continue. In this session, knowledge-gaps in terms of reducing breast compression, system-specific optimization of angular range and angular sampling, model-based iterative reconstruction techniques, methods to monitor system performance using phantoms, and developing a framework for conducting virtual clinical trials to evaluate the potential performance improvements are addressed. Dedicated breast CT is an emerging modality with tremendous potential to be the future of breast imaging addressing numerous clinical needs from screening to surgical planning and monitoring therapy response. It eliminates the need for multiple views with breast compression, as a single scan provides volumetric data with near isotropic spatial resolution that allows viewing the breast in any orientation. It is inherently quantitative and allows for risk estimation by quantifying fibroglandular tissue volume, discriminating malignant and benign lesions by analyzing the enhancement from administered contrast media and quantifying treatment response by monitoring temporal changes in tumor volume.

SSG14-02 Optimized Technique for Reducing Breast Compression in Digital Breast Tomosynthesis

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S405AB

Participants

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PURPOSE

Digital breast tomosynthesis (DBT) provides tissue separation superior to mammography, and thus may obviate the need for breast compression, used to reduce breast thickness and consequently improve image quality and reduce mean glandular dose (MGD). Previous attempts to reduce breast compression have either resulted in poorer image quality or increased MGD. We optimized and evaluated an imaging technique for DBT with minimal breast compression without compromising image quality or MGD.

METHOD AND MATERIALS

Imaging technique for a Siemens MAMMOMAT Inspiration DBT system using reduced breast compression (<4 daN) was optimized using a signal-difference-to-noise ratio (SDNR) model accounting for the increase in scattered radiation due to increased breast thickness. Optimal tube potential (kVp) was determined by limiting MGD increase to <10% without decreasing SDNR. The optimized technique was evaluated in an IRB-approved, HIPAA-compliant prospective clinical study, where 21 patients with abnormal mammograms underwent DBT scans using full compression (FC) and minimal compression (MC). Skin markers were affixed to either side of the breast for motion assessment. Two breast radiologists scored lesion conspicuity in the two sets of images using a five-

point scale (-2: full compression much better, to +2: minimal compression much better).

RESULTS

Increasing the tube potential by 2-3 kVp over the FC technique causes no significant change in MGD or image quality. Conspicuity of 26 masses and 6 microcalcification clusters in 21 patients were compared. MGD for FC and MC were not significantly different; patient motion was shown to be comparable. Mass conspicuity was equivalent for FC and MC (mean score = -0.15, bootstrapped 95% CI: -0.38, 0.08); microcalcification conspicuity for MC was noninferior to FC (mean score = -0.17, 95% CI: -0.5, 0). All patients reported MC to be more comfortable than FC.

CONCLUSION

By optimizing imaging technique, breast compression can be reduced to less than half in DBT without sacrificing image quality or increasing MGD. The resulting increase in patient comfort may improve compliance with recommended screening practices.

CLINICAL RELEVANCE/APPLICATION

Breast compression in DBT may be reduced to <4 daN without compromising image quality or dose by optimizing imaging technique, potentially improving patient compliance with screening protocols.

SSG14-03 Design and Application of a Phantom for Testing Tomosynthesis Systems with Particular Emphasis on Automatic Cloud-Based Monitoring

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S405AB

Participants

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PURPOSE

To investigate the possibility of using a newly developed Tomosynthesis Phantom specifically developed for remote monitoring of DBT sites

METHOD AND MATERIALS

A newly developed Tomosynthesis QA Phantom has been developed for testing DBT systems. The phantom is also designed to allow remote analysis via web or cloud. The phantom includes: phantom positioning and alignment (important for remote analysis); scan geometry (x and y); chest wall offset; scan slice width and SSP(z) slice geometry (slice width); scan slice incrementation (z); Z axis geometry bead; low contrast from low contrast spheres; Point Spread Function (PSF); Image uniformity and Contrast to Noise Ratio (CNR). This study shows the success of remotely monitoring this phantom via cloud based uploads of Dicom data to a central processing system.

RESULTS

Results are shown for monitoring each of the parameters as listed in Methods and Materials. Data is shown for all known commercial Tomosynthesis systems. System reproducibility and performance over time, and long term trend analysis are shown. The results show robust and reproducible results. Results are shown for monitoring each of the parameters as listed in Methods and Materials. Data is shown for all known commercial Tomosynthesis systems. System reproducibility and performance over time, and long term trend analysis are shown. The results show robust and reproducible results. The ability to measure phantom position and alignment including roll, yaw, and pitch are found to be important but easily handled by the current software. Data on SSP and in plane resolution (MTF) are found to vary greatly among systems, depending on the DBT design, but amenable to remote monitoring and performance tracking.

CONCLUSION

It is possible to design and utilize phantoms for remote monitoring and performance tracking of Tomosynthesis DBT systems. Slice widths (SSP), and in plane resolution PSF and corresponding MTF although vary greatly among systems depending on the DBT design, are amenable to remote monitoring.

CLINICAL RELEVANCE/APPLICATION

A DBT phantom that is robust in performance measurements, and amenable to remote monitoring, offers clinicians, physicists, and administrators a tool to track the performance of the system.

SSG14-04 Impact of Tomosynthesis Angular Range on Mass Conspicuity in Patients with Dense Breasts

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S405AB

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Recent studies have suggested that cancer detection rates for digital breast tomosynthesis (DBT) are poor for patients with heterogeneously to extremely dense breasts. These studies have been predominantly limited to narrow-angle DBT. Increasing angular range (AR) reduces breast structural noise and increases image contrast for masses, potentially improving mass detection in dense breasts. We investigate the effect of AR on mass detectability using a previously validated cascaded linear system model (CLSM) for DBT, and compare theoretical results with clinical findings in an IRB-approved pilot study.

METHOD AND MATERIALS

Mass conspicuity in DBT reconstructions was modeled as a function of AR using a normalized detectability index d' , incorporating breast structural noise and image contrast. Under IRB-guidance, DBT images for 6 patients with heterogeneously or extremely dense breasts were compared using both the Hologic Selenia Dimensions DBT system (AR = 15°) and the Siemens MAMMOMAT Inspiration DBT system (AR = 50°). Two breast radiologists were presented with both sets of images for each patient and compared lesion conspicuity on a five-point scale (-2: lesion much more conspicuous on narrow-angle DBT, to +2: lesion much more conspicuous on wide-angle DBT).

RESULTS

Mass detectability was predicted to increase with increasing AR due to reduced structural noise and increased contrast in the reconstructed image slices. Increasing AR from 15° to 50° was predicted to increase detectability of 2, 5 and 10 mm masses by 85.3%, 87.5% and 87.9%, respectively. Clinical findings corroborated simulation results, with mass conspicuity shown to be equivalent or superior for wider-angle DBT, with a mean score of 0.89 (95% CI: 0.44, 1.44). Importantly, masses found in areas with high masking risk (defined as high local density as characterized by the radiologist) were more conspicuous on wider-angle DBT.

CONCLUSION

Using a normalized detectability index d' , mass conspicuity was shown to increase with increasing AR. These results were corroborated by a pilot reader study, and motivate a larger clinical study comparing mass conspicuity for differing DBT acquisition geometries.

CLINICAL RELEVANCE/APPLICATION

Tomosynthesis with wider angular ranges may provide mass conspicuity superior to tomosynthesis with narrow-angular range for patients with heterogeneously to extremely dense breasts.

SSG14-05 Reduced Anatomical Noise in Digital Breast Tomosynthesis with Model Based Iterative Reconstruction

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S405AB

Participants

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PURPOSE

The anatomical background of the breast strongly influences mass detection performance in breast imaging. Anatomical noise has previously been quantified using a parameter, β , which is strongly correlated with mass detection. Reported values of β in clinical modalities are approximately 3.3 for mammography, 3.2 for digital breast tomosynthesis (DBT), and 2.0 for breast CT. The purpose of this work was to determine whether the anatomical clutter in DBT reconstructions can be reduced using MBIR.

METHOD AND MATERIALS

The anatomical noise power spectrum (NPS) was measured for 105 clinical DBT exams acquired using Hologic Selenia Dimensions systems. A power-law model ($NPS_a = af^{-\beta}$) fitting of the anatomical NPS was performed. The exponent, β , was used as a surrogate for the anatomical noise background and compared between the commercial reconstruction (FBP) and an in-house MBIR method. β was measured as a function of position within the breast (central 25 slices) and averaged for each breast. The mean measured β values were compared using a two-tailed t-test ($H_0: \beta_{Comm} = \beta_{MBIR}$) to determine if the difference was statistically significant. The reconstructed images were also assessed subjectively.

RESULTS

The measured β for the commercial reconstruction method was 3.27 ± 0.40 , consistent with previously published values. For the MBIR method, the measured β value was 2.30 ± 0.55 . The reduction in anatomical noise was significant using the MBIR method compared with the commercial method ($p < 0.001$). The variation in β at different slice locations was negligible in both reconstruction methods. The appearance of anatomical clutter was reduced substantially in reconstructed images as well.

CONCLUSION

MBIR significantly reduced the anatomical noise in DBT reconstructions as quantified using a power-law fitting of the anatomical NPS. The reduction of β from 3.3 to approximately 2.3 indicates that with MBIR the anatomical noise in DBT is more similar to breast CT than mammography.

CLINICAL RELEVANCE/APPLICATION

Reducing anatomical noise in DBT images with MBIR may improve mass detection for DBT images. This has the potential to improve the sensitivity of treatable cancers for breast screening

SSG14-06 Digital Breast Tomosynthesis as a Replacement of Full-Field Digital Mammography for the Detection of Breast Cancer: An Open-Source, In-Silico Clinical Trial

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S405AB

Participants

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PURPOSE

To determine the comparative performance of digital breast tomosynthesis (DBT) as a replacement to full-field digital mammography (FFDM) using entirely in silico open-source methods and to compare results to previously reported clinical trials. Secondary objectives include measurements of the differential performance in subpopulations and across lesion types.

METHOD AND MATERIALS

Analytic breast phantoms modeling anatomical structures were generated in large numbers corresponding to 4 size and apparent density combinations (from 3.5 to 6 cm compressed thickness and 4 BIRADS density categories) and were compressed using finite-element modeling prior to imaging. Lesions were inserted representing microcalcification clusters and spiculated masses. Phantoms were imaged using a detailed Monte Carlo simulation approach with the GPU-accelerated, freely available MC-GPU code with improved focal spot and tube motion models and thick-layer detector description including fluorescence, anti-scatter grid, and electronic noise. 50-micron voxelized models were simulated using a binary tree geometry and delta-scattering transport. The detection algorithm uses a location-known-exactly paradigm with a channelized Hotelling Observer and spatial frequency filtering for irregular morphology. A small set of readers were trained with distinct training sets of normals and cancers and tested on independent sets. Uncertainty was estimated using a fully-paired multiple-reader, multiple-case analysis. The study was sized to achieve uncertainties lower than those seen in human trials for the differential performance in terms of area-under-the-ROC curve (AUC).

RESULTS

The performance AUC for FFDM during the pre-pilot stage ranged between 0.87 and 0.96. Sizing of the pivotal trial indicates that 30 computational readers trained on subsets of 100 pairs of cancer and normal regions-of-interest achieve the target uncertainty of approximately 0.01.

CONCLUSION

The findings indicate that the performance seen in in silico trials for FFDM is comparable, under reasonable assumptions, to results obtained in trials using patients and clinicians.

CLINICAL RELEVANCE/APPLICATION

This report describes the first imaging clinical trial performed exclusively using open-source computational methods. Our findings stimulate discussion around increasing the use of computational modeling in the assessment of imaging systems for regulatory evaluation.

SSG14-07 Initial Experimental Results from the First X-Ray Dark Field Breast Tomosynthesis Prototype System

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S405AB

Awards

Student Travel Stipend Award

Participants

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PURPOSE

X-ray digital breast tomosynthesis imaging systems have been successfully introduced in current clinical practice. However, the image contrast is limited as it depends on a single contrast mechanism: x-ray absorption. In this work, the first prototype breast tomosynthesis imaging system with both absorption contrast and a new contrast mechanism: dark-field contrast, was constructed and initial experimental results to assess imaging performance are presented.

METHOD AND MATERIALS

The prototype dark field tomosynthesis imaging system was based on a full field digital mammography system (Senographe 2000D).

GE Healthcare) with a dual-track rotating anode (Rh/Mo) tube and a CsI-based flat panel detector with 100 μm pixel size. Three x-ray gratings were integrated into the mammography system. The dark field tomosynthesis image acquisition was performed using the Grossman geometry, in which the gantry (including both the x-ray tube and detector) rotate around a fixed image object over an arc of 28° (2° interval). The system was operated at 36 kVp/180 mAs with the Rh anode and Rh filter. From a single tomosynthesis acquisition, both dark field and conventional absorption contrast tomosynthesis images were reconstructed using the shift-and-add algorithm; the images have an in-plane pixel size of 70 μm and a slice thickness of 0.5 mm. Two test objects, an overlay of microcalcifications on top of microbubbles and a mouse lung specimen, were used to perform the initial evaluation of the prototype system.

RESULTS

In addition to the conventional absorption contrast tomosynthesis imaging, x-ray dark field tomosynthesis imaging provided complementary image information for detailed structures in the two specimens. The contrast-to-noise ratio of the low-attenuating microbubbles was boosted from 5.9 in absorption tomosynthesis images to 21.0 in dark field tomosynthesis images.

CONCLUSION

A clinically compatible x-ray dark field breast tomosynthesis prototype system was developed. Based on the promising initial results using both phantom and biological specimen studies, this system will be used to evaluate the potential clinical utility of x-ray dark field tomosynthesis imaging.

CLINICAL RELEVANCE/APPLICATION

This is the very first report of a prototype x-ray dark field tomosynthesis system that will enable future clinical evaluation of the x-ray dark field breast tomosynthesis imaging method.

SSG14-08 A Novel Automatic Segmentation Algorithm for Tissue Classification of Dedicated Breast CT Images

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S405AB

Participants

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PURPOSE

To develop and validate a fully automatic classification algorithm to identify voxels containing skin, adipose, fibroglandular and vasculature in dedicated breast CT (BCT) images.

METHOD AND MATERIALS

The developed algorithm involves the following steps: i) an intensity and region-based segmentation method for skin detection; ii) a combination of unsupervised neural networks and energy minimizing splines for fibroglandular tissue segmentation and iii) an unsupervised data mining approach to classify the remaining tissue into fat and vasculature. To evaluate the accuracy of the algorithm, one slice each from five different patient BCT images were manually segmented under the supervision of an experienced breast radiologist and considered the gold standard. To evaluate the robustness of the algorithm to image noise, Gaussian, Poisson and speckle noise were separately added to another five patient BCT slices. Finally, to evaluate the classification of the vasculature, three different pre- and post-contrast injection patient BCT images were classified and compared. Dice Similarity Coefficients (DSCs) were calculated for all comparisons.

RESULTS

The DSCs between the manually and automatically segmented slices were (mean \pm 1 std.dev): skin: 0.949 ± 0.005 ; fibroglandular: 0.955 ± 0.009 ; adipose: 0.986 ± 0.016 ; vasculature: 0.879 ± 0.052 . The DSCs between the original segmentation result and the ones corrupted by noise were 0.887 ± 0.07 for Gaussian, 0.920 ± 0.06 for speckle and 0.912 ± 0.03 for Poisson noise. Finally, the vasculature DSCs for the three patient cases between the pre- and post-contrast injection images were 0.974, 0.952 and 0.891.

CONCLUSION

The algorithm results in accurate and robust breast tissue classification with no prior training and with the ability to detect blood vessels even in non-enhanced images. Potential applications include breast density quantification and tissue pattern characterization, both biomarkers of cancer development. Further possibilities include automatic identification of breast skin thickening, related to cancer development, and development of patient image-based phantoms which could be used for breast imaging research.

CLINICAL RELEVANCE/APPLICATION

Classification of breast CT images can provide quantitative assessments of breast tissue composition, density and distribution, all biomarkers of breast cancer development.

SSG14-09 Patient-Based 4D Digital Phantom for Dynamic Contrast-Enhanced Breast CT Imaging

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S405AB

Participants

Marco Caballo, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose

Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Research agreement, Siemens AG; Research agreement, Seno Medical Instruments, Inc; Research agreement, Identification Solutions Inc; Research agreement, Micrima Limited; Scientific

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Ioannis Sechopoulos, PhD, Atlanta, GA (*Abstract Co-Author*) Research Grant, Siemens AG; Research Grant, Toshiba Medical Systems Corporation; Speakers Bureau, Siemens AG; Scientific Advisory Board, Fischer Medical

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PURPOSE

To develop a realistic patient-based 4D digital breast phantom including time-varying contrast enhancement for dedicated breast CT perfusion imaging.

METHOD AND MATERIALS

A phantom was created by first segmenting a breast CT scan from a healthy patient into skin, fibroglandular tissue, adipose tissue and vasculature using an automated classification algorithm developed in our laboratory. A tumor model (a sphere with a radius of 10 voxels, equivalent to 2.6 mm) was inserted within the segmented fibroglandular tissue. Average values for blood volume and wash-in and wash-out rates were defined for each tissue type and for the tumor based on results from contrast enhanced dynamic breast MRI. Given these parameters, the proposed algorithm automatically calculates input functions for each tissue type, including the tumor. Then, blood flow (BF) and mean transit time (MTT) are computed for each voxel, taking into account the Hounsfield unit values from the original patient image. Finally, time attenuation curves are calculated for each voxel by convolving the inputs with an exponential function that depends on the BF and MTT values associated with that voxel.

RESULTS

The first 4D voxel phantom constructed in the present study has dimensions of 1008x1008x198x560 (x, y, z, t) with a sampling time of 1 s. Results show the expected enhancement of tissues according to the given input parameters. Moreover, the tumor presents a higher and much faster enhancement compared to the other healthy tissues, as expected. Additional phantoms from other patient cases can be generated at will.

CONCLUSION

The proposed digital phantom can model the behaviour of contrast in the breast during 4D breast CT image acquisition, displaying the different enhancement dynamics that may be found in a patient breast. These phantoms will be used to optimize the development of dynamic contrast enhanced dedicated breast CT imaging to obtain the highest possible image quality with the minimum possible dose. Future work includes the evaluation of the enhancement of different tumor types, 4D breast CT simulations and estimation of radiation dose.

CLINICAL RELEVANCE/APPLICATION

The proposed phantom can be used for optimizing 4D breast CT imaging, which has the potential to aid in the staging and characterization of breast tumors and in the monitoring of treatment.

SSG15

Physics (CT: Image Quality)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S503AB

CT **PH**

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

FDA Discussions may include off-label uses.

Participants

James M. Kofler JR, PhD, Rochester, MN (*Moderator*) Nothing to Disclose
Dianna D. Cody, PhD, Houston, TX (*Moderator*) In-kind support, General Electric Company

Sub-Events

SSG15-01 Efficient and Quantitative CT Protocol Optimization using Channelized Hotelling Observer

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S503AB

Participants

Lifeng Yu, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
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Thomas J. Vrieze, RT, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To develop a framework and software tool for efficient optimization of CT protocols using a channelized Hotelling observer (CHO) and associated task-based image quality metrics.

METHOD AND MATERIALS

The lack of efficient tools for CT image quality assessment and protocol optimization has been one of the main reasons for a large variation of radiation dose among CT practices. In this work, we developed a quantitative framework for protocol optimization and a software tool to address this issue. A phantom containing 21 objects of various contrast levels and sizes was 3D-printed and inserted into anthropomorphic phantoms of 3 sizes to mimic different adult attenuation levels. The software tool consists of two major components: (1) automated CHO calculation and (2) protocol optimization. The first component performs automated CT image quality assessment after loading the phantom images, which includes calculation of contrast-dependent spatial resolution, 2D and 3D noise power spectrum, index of detectability (d'), and area under the ROC curve (AUC) for a low-contrast detection task. The AUC and d' were based on a previously validated CHO model, with Gabor channels optimized to improve the statistical performance. The second component of the software tool automates the process of protocol optimization by using a predefined target AUC value or an AUC value associated with a reference protocol. As an example, the tool was tested on a 128-slice scanner to determine the dose reduction potential of iterative reconstruction (IR) in a routine abdomen/pelvis protocol.

RESULTS

CHO can be efficiently calculated using the developed tools with the number of Gabor channels reduced to 12 and the required number of repeated scans reduced to 15-20 without sacrificing the CHO accuracy. In the example of protocol optimization for IR, when the predefined target AUC was 0.9, acceptable dose reduction was between 20% and 30%, depending on the phantom sizes.

CONCLUSION

The developed framework for protocol optimization and software tool allows for efficient and objective determination of task-based image quality, which can be used for quantitative protocol optimization in CT.

CLINICAL RELEVANCE/APPLICATION

CT protocols can be efficiently and objectively optimized using the proposed quantitative method based on model observers, which may lead to reduced dose variation across CT practice.

SSG15-02 Task-based Parameter Optimization for Low Signal Correction in Low-Dose CT

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S503AB

Participants

Daniel Gomez-Cardona, MSC, Madison, WI (*Presenter*) Nothing to Disclose
John W. Hayes, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Ran Zhang, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Low signal correction (LSC) techniques applied to raw projection data in CT are an effective means to reduce noise streaks and noise amplitude in CT, enabling high quality CT images at reduced dose levels. Current empirical parameter selection in LSC requires many trial-and-error experiments, and often leads to variable performance for different imaging tasks. The purpose of this work is to present a task-based parameter optimization framework for LSC methods in low dose CT.

METHOD AND MATERIALS

Since LSC methods reduce noise in the raw data locally, noise and spatial resolution may not be uniform across the field of view (FOV). In the proposed framework, noise and spatial resolution were measured through repeated scans at a given dose level and incorporated into a mathematical observer model to calculate detectability. The detectability index was then used as figure of merit to optimize parameter selection for a given LSC method. Detectability maps obtained for a given LSC parameter space were incorporated into the following parameter selection criteria: a) maximize detectability for a given imaging task and given spatial location, b) maximize global detectability across imaging tasks for a given location, c) maximize detectability for a given imaging task across spatial locations, or d) maximize global detectability across imaging tasks and across locations.

RESULTS

Noise and spatial resolution properties were found to vary considerably across the FOV. Once these metrics were incorporated into the detectability index, the imaging performance for a given operating point in the parameter space was found to have a strong dependence on spatial location and imaging task. The proposed parameter selection criteria addressed the selection of the optimal filter parameters for LSC.

CONCLUSION

A task-based detectability framework was developed to optimize the selection of parameters for LSC. This framework is generalizable to any LSC methods that can be parameterized.

CLINICAL RELEVANCE/APPLICATION

LSC methods play an essential role in low dose CT technologies. An imaging task-based parameter selection framework can provide a means to achieve radiation dose reduction while to maintain diagnostic performance in low dose CT exams.

SSG15-03 CT Number Bias in Low Dose MDCT with Model Based Iterative Reconstruction (MBIR)

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S503AB

Participants

Daniel Gomez-Cardona, MSC, Madison, WI (*Presenter*) Nothing to Disclose
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Ke Li, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company Research funded, Siemens AG

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PURPOSE

New technologies have been developed and deployed in the field to enable radiation dose reduction. Although clinical benefits seem to be apparent, the potential challenges associated with radiation dose reduction have not been fully investigated. In this work, systematic studies were performed to investigate the change of CT number bias from reference with the decrease of radiation exposure levels and to compare the potential difference between CT number bias in conventional FBP reconstruction and model based iterative reconstruction (MBIR).

METHOD AND MATERIALS

To extract CT number bias, multiple repeated scans were performed on a quality assurance phantom and a clinical MDCT system equipped with both FBP and MBIR reconstruction methods. The CT number of 7 inserts with different attenuation levels was measured from a combined set of 10 exposure levels and 3 tube potentials, with each parameter set repeated 50 times. These measurements were finally compared to a reference consisting of the average of an ensemble of 50 scans obtained at a reference dose level at each kV. CT number bias was defined as the difference between the ensemble average CT number measured at a given exposure level and the ensemble average CT number measured at a reference exposure level for a given kV.

RESULTS

There are three important findings from this work: (1) CT number bias increases with decreasing radiation dose levels for both FBP and MBIR; (2) For a given material insert, the CT number biases in FBP and MBIR are completely inverted, i.e., for FBP a positive bias was obtained as the exposure level decreased; in stark contrast, for MBIR the bias becomes negative at low exposure levels; (3) CT number bias was found to be proportional to its own CT number level for both FBP and MBIR.

CONCLUSION

CT number bias increases with radiation dose reduction in both FBP and MBIR and a peculiar CT number bias inversion with respect to FBP, was experimentally observed for MBIR as exposure level was reduced.

CLINICAL RELEVANCE/APPLICATION

The discovery of increased CT number bias in low dose CT sets a new lower bound for radiation dose reduction to maintain diagnostic accuracy in low dose CT clinical exams.

SSG15-04 CT Iterative Reconstruction Kernels: Noise Characteristics and Their Differences

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S503AB

Participants

Gary Ge, Lexington, KY (*Presenter*) Nothing to Disclose
Victor Weir, PHD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Jie Zhang, PhD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To better understand noise characterization of computed tomography (CT) images reconstructed with iterative reconstruction kernels and demonstrate their differences.

METHOD AND MATERIALS

Unsubtracted and subtracted noise power spectra (NPS) and modulation transfer function (MTF) were measured using CT images acquired from a routine water phantom on Siemens Definition Edge, Force, and GE Revolution, respectively. Series of cutting-edge iterative reconstructions in Sinogram Affirmed Iterative Reconstruction (SAFIRE I31f-I70f), Advanced Modeled Iterative Reconstruction (ADMIRE I31f-I70f, and Br20s-Br70s in dual-source), and Advanced Statistical Iterative Reconstruction-V (ASIR-V Bone, Lung, Detail, Standard) were evaluated and compared at different strength settings (1-5 for Siemens, 20-100 for GE).

RESULTS

Each NPS demonstrates the expected shape of traditional back-projection filters. The peak frequency gradually shifts to lower frequency with the increased strength, corresponding to stronger smoothing effect. Low-frequency structured noise is observed in unsubtracted NPS for all kernels and is successfully removed in subtracted NPS. With the increases in filter sharpness, the NPS shifts to higher frequencies, preserving higher-frequency noise. The series of I kernels in SAFIRE and ADMIRE demonstrate comparable NPS. However, the Br kernels in ADMIRE dual-source shows differences from I kernels. There are notable differences in the NPS between manufacturers. Comparing the NPS of ADMIRE and ASIR-V shows that the GE kernels generally exhibit a larger decrease in peak noise resolution due to increasing kernel strength and a generally wider NPS profile than comparable Siemens kernels. Over-enhancing is observed in all sharp kernels.

CONCLUSION

Analysis of NPS helps characterize image noise associated with various reconstruction kernels and identify their differences to help in their clinical application. A comparison between manufacturers potentially helps standardize protocols across different CT scanners.

CLINICAL RELEVANCE/APPLICATION

Understanding how reconstruction kernels affect noise pattern allows tailoring protocols to task-specific clinical applications.

SSG15-05 Contrast Dose Reduction in Coronary CT Angiography on 16cm Wide-Detector CT with Reduced Injection Time

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S503AB

Participants

Zhijun Hu SR, xi'an, China (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate the effect of contrast agent injection time on coronary artery image quality in coronary CT angiography (CCTA) with wide-detector CT.

METHOD AND MATERIALS

A total of 40 patients underwent CCTA on a 16cm wide-detector Revolution CT with 100kVp tube voltage and automatic tube current modulation for noise index of 21HU. The contrast agent iopamidol (370mg/ml) was used at a dose rate of 25mgI/kg/s. The patients were divided into two groups based on the injection time: Group A (n=20 with standard 12s injection time) and Group B (n=20,8s). The CT value and standard deviation in the lumen of the ascending aorta, right coronary artery, left anterior descending branch, proximal lumen of LCX and adjacent tissue were measured to calculate the contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) for arteries. Two imaging radiologists with cardiovascular diagnosis experience over 8 years assessed image quality independently for subjective score using a 5-point scoring system (5: best, 1: worst, >= 3: diagnosable). Measurements between the two groups were compared using T test or rank sum test.

RESULTS

There was no significant difference in age, heart rate and body mass index between the two groups ($P > 0.05$); The CT number, SNR, CNR, effective dose and subjective score of the two groups were statistically the same ($p > 0.05$). There was a significant difference in contrast dose between group A ($54.7 \pm 8.3 \text{ ml}$) and group B ($37.9 \pm 6.5 \text{ ml}$) ($P < 0.05$), a reduction of about 30%.

CONCLUSION

Reduction of contrast injection time from the conventional 12s to 8s in CCTA with 16cm wide-detector CT effectively reduces contrast dose by 30% while maintaining image quality.

CLINICAL RELEVANCE/APPLICATION

Faster scan time enables the shortening of contrast injection time to save contrast dose by 30% while maintaining image quality in CCTA with 16cm wide-detector.

SSG15-06 Framework for Objective Clinical Image Quality Assessment in Thorax CT: A 3D Model Observer in Combination with A 3D Printed Lung Phantom Containing Nodules

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S503AB

Participants

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PURPOSE

To apply a 3D model observer to analyze the detectability of lung nodules in a 3D printed lung phantom in CT images acquired at different dose levels.

METHOD AND MATERIALS

A model of the distribution of the lung vessels, based on published morphometry based human data, was generated using an in-house algorithm developed in MATLAB. The simulated lung vessels had diameters between 8.5 and 0.2mm. The model was printed in a ProJet HD 3000 3D printer using Visijet EX200 as material. A PMMA thorax shaped holder ($20 \times 30 \times 3 \text{ cm}^3$) was created to contain the lung insert. Twenty cork spheres (6mm diameter) were placed at different positions as nodules surrogates. The phantom was scanned with a thorax protocol (Toshiba Aquilion Genesis, 120kV, collimation= $0.5 \times 80 \text{ mm}$, pitch=0.637, RFOV=400mm, AIDR3D, FC18 kernel, 0.5mm slice thickness and interval, 250-30-5-3mAs)). Twenty acquisitions were performed for each dose level, 10 with lesions and 10 without. Volumes of interest ($16 \times 16 \times 8.5 \text{ mm}^3$), centered on the nodule locations, were selected. Volumes were also cropped in equivalent anatomical positions in the nodule-free images. For the highest dose, ROIs were taken on the bigger vessels and also in the central slice of the nodules to estimate their attenuation. A 3D channelized Hotelling model observer (CHO), with 20 Gabor channels was used to analyze the samples with and without lesions for each dose level. Half of the images were used for training and half for testing for each condition. Test-statistics were calculated over the distributions of the model observer outcomes and a detectability index was calculated for each dose level.

RESULTS

The phantom vessels had a mean pixel value of ($118 \pm 5 \text{ HU}$) and the nodules ($-815 \pm 20 \text{ HU}$). The detectability of the lesions increased with increasing mAs value, for the 3D model observer. The d' values, from highest to lowest dose level ($\text{CTDI}_{\text{vol}} = 10.9 - 2.6 - 0.4 - 0.2 \text{ mGy}$) were (13.8 ± 1.1 , 11.2 ± 0.8 , 8.3 ± 0.6 , 7.5 ± 0.5).

CONCLUSION

A 3D model observer was applied to analyze the detectability of nodules in CT images of a 3D printed lung phantom mimicking the human vessel distribution. The detectability of the lesions increased with dose. These results represent a step towards measurement of clinical image quality with 3D model observers in CT.

CLINICAL RELEVANCE/APPLICATION

A 3D model observer can be a useful tool towards measuring clinical image quality in CT, in particular, for lung nodule detection tasks in a 3D printed lung phantom.

SSG15-07 Noise Suppression Dependency on Patient Size and Lesion Size with Adaptive Statistical Iterative Reconstruction in Adult Abdomen CT

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S503AB

Participants

Yifang Zhou, PhD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Jessica L. Nute, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Christina M. Lee, BS, ARRT, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Alexander W. Scott II, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To demonstrate the noise suppression dependency on patient size, lesion size and dose with adaptive statistical iterative reconstruction (ASIR) in adult abdomen CT.

METHOD AND MATERIALS

Three adult abdomen phantoms simulating the small, medium and large patient were scanned using a GE VCT 64-slice scanner.

Different dose levels were applied (CTDI_vol 2 mGy to 40 mGy). The images were reconstructed with variable ASIR fractions (0 - 100%). The noise images were obtained using subtraction between eight nearest neighbor slices. They were partitioned into matrices of square elements scaled 1.8 mm - 10 mm to match the lesion sizes of interest, and the statistically defined minimum detectable contrast (MDC) were computed to represent the noise suppression. To describe the relative noise suppression over FBP images, the normalized MDC (N_MDC) was defined as the ratio of the MDC with ASIR to the MDC with FBP. N_MDC was obtained at each element size from different ASIR blending fractions at variable dose levels.

RESULTS

N_MDC was found to decrease linearly as the ASIR blending fraction increases. The slope of the N_MDC, however, depends on the lesion size, patient size and dose. The slope was fitted against the lesion size by a power law with more contrast enhancement at smaller lesion size ($R^2 > 0.935$ among all cases). The contrast enhancement or noise suppression was found to be more pronounced as the phantom size increases or as the dose decreases. The difference on noise suppression due to different doses was also observed smaller for the smaller lesion sizes.

CONCLUSION

The suppression using ASIR in adult abdomen CT not only depends on the ASIR blending fraction, but also depends on the lesion size, patient size and dose.

CLINICAL RELEVANCE/APPLICATION

Adult abdomen CT dose optimization

SSG15-08 Impact of Iterative Reconstructions on Image Quality in Clinical CT Images Demonstrated by a Novel Noise Power Spectrum Measurement Tool

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S503AB

Participants

Hugo Pasquier, MSc, Creteil, France (*Presenter*) Nothing to Disclose

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PURPOSE

To quantify noise texture and magnitude characteristics of clinical Computed Tomography (CT) images obtained with Iterative Reconstructions (IR) techniques.

METHOD AND MATERIALS

An algorithm was developed to extract noise texture and magnitude metrics from 10 chest and abdomen clinical CT-scans (Discovery CT750 HD; GE Healthcare, Wisconsin) performed for oncology follow-up by measuring a global Noise Power Spectrum (NPS). After subtraction of adjacent slices, a segmentation algorithm was applied to exclude remaining anatomical structures. Noise magnitude (i.e. area under the 1D-NPS curve) and peak frequency (f_{peak}) were measured, within all the available regions of interest that did not contain edge pixels, and compared for chest and abdomen on image subsets of all CT scans reconstructed using Filtered Back Projection (FBP), Adaptive Statistical Iterative Reconstruction 30 % (ASIR30), 50 % (ASIR50) and Model-Based Iterative Reconstruction (MBIR).

RESULTS

Compared to FBP, ASIR30 and ASIR50, MBIR reduced noise magnitude by 31 %, 17 % and 13 % in chest and by 47 %, 34 % and 29 % in abdomen respectively ($p < 0.01$ each). These noise magnitude reductions were also associated to changes in noise texture: for chest and abdomen, f_{peak} were significantly lower for MBIR (0.08 and 0.09 mm⁻¹ respectively), ASIR50 (0.13 and 0.14 mm⁻¹ respectively) and ASIR30 (0.16 and 0.18 mm⁻¹ respectively) compared to FBP (0.23 and 0.27 mm⁻¹ respectively; $p < 0.01$ each).

CONCLUSION

Assessing NPS of clinical CT examinations can demonstrate the reduction of noise magnitude and the changes of noise texture associated to IR. This method could be used to tailor CT protocols according to radiologists' preferences regarding noise texture and magnitude.

CLINICAL RELEVANCE/APPLICATION

The proposed technique enables automatic quality control monitoring of image noise characteristics in clinical practice.

SSG15-09 Objective Quantification of the Impact of Image Artifacts on Lesion Detectability Using a Channelized Hotelling Model Observer

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S503AB

Participants

Andrea Ferrero, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

Kenneth A. Fetterly, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Objective assessment of the impact of image artifacts on the diagnostic quality of a cone-beam CT (CBCT) images is difficult, as conventional image quality metrics are not adequate to assess the influence of non-uniform artifacts. In this work, we investigated the use of a channelized Hotelling observer (CHO) to quantify the impact of artifacts arising from both the test object and external sources on lesion detection in CBCT data.

METHOD AND MATERIALS

A custom phantom insert containing vessels of diameter 2, 4 and 8 mm was filled with diluted iodine contrast medium to produce different image contrast levels (range 0-300 HU) and placed inside an anthropomorphic thoracic phantom. Projection images were acquired at 1.5°/frame over a 200° range using a C-arm. Severe external image artifacts were introduced by placing two metal pins adjacent to the posterior surface of the phantom. Detectability index (d') of a CHO was estimated using 150 background only images and 150 images of the iodine vessels with and without external artifacts. Using a standard CHO implementation, the total contribution of the vessels and artifacts to d' was estimated. The contribution of the artifacts was determined by masking the image area of the iodine vessels prior to channelization. d' of the artifacts was then subtracted from the total d' s to estimate d' of the iodine vessels only.

RESULTS

Per expectation, the contribution to d' of artifacts originating from the iodine vessels was proportional to the HU contrast of the iodine vessels whereas that of the external artifacts was independent of iodine concentration. As the severity of the externally produced artifacts was variable across the 2D images, their estimated contribution to d' was also variable with location in the image. After correcting for external artifacts, d' of the iodine vessels with external artifacts present was 4-67% lower than that without external artifacts.

CONCLUSION

This work proposes masking of the test object to directly estimate CHO d' of CBCT image artifacts arising both from the test object and external sources. This method may be used to directly estimate the magnitude of image artifacts and to remove their influence on d' estimates.

CLINICAL RELEVANCE/APPLICATION

Artifacts present in CBCT images can confound CHO performance. A correction method is proposed to eliminate their effect and provide valuable information on their influence on lesion detection in CBCT.

SSG16

Science Session with Keynote: Radiation Oncology (Genitourinary)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S104A

GU RO OI

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

Participants

Martin Colman, MD, Houston, TX (*Moderator*) Nothing to Disclose
Abhishek A. Solanki, MD, Maywood, IL (*Moderator*) Consultant, Blue Earth Diagnostics Ltd; Advisory Board, Blue Earth Diagnostics Ltd

Sub-Events

SSG16-01 Radiation Oncology Keynote Speaker:

Tuesday, Nov. 28 10:30AM - 10:50AM Room: S104A

Participants

Abhishek A. Solanki, MD, Maywood, IL (*Presenter*) Consultant, Blue Earth Diagnostics Ltd; Advisory Board, Blue Earth Diagnostics Ltd

SSG16-03 Patients Treated with Volumetric Modulated Arc Therapy for Prostate Cancer Return to Baseline Urinary Function Following Treatment to 81 Gy

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S104A

Participants

Jamie A. Cesaretti, MD,MS, Jacksonville, FL (*Presenter*) Nothing to Disclose
Mitchell D. Terk, MD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of the abstract was to determine both the acute and long terms consequences of VMAT to 81Gy for prostate cancer in a cohort of 501 men treated between 8/2010 and 12/2015 using a validated measure of urinary function.

METHOD AND MATERIALS

Five hundred and one men were treated with VMAT to 81 Gy from 8/2010 to 12/2015 for low (27.5%), intermediate (47.7% and high risk (24.8%) prostate cancer. In addition to the use of VMAT, patients were treated using gold fiducial markers, a rectal stabilization device and MRI treatment planning. All men were given the International Prostate Symptom Score sheet prior to treatment, at one month following treatment and at one year. IPSS scores were prospectively collected and comparisons of means were made by T-test. The incidence of elevations in IPSS which have been previously described to be bothersome to men and require either medical or surgical intervention are also reported.

RESULTS

The baseline IPSS score prior to therapy was 9.57 for the entire cohort, at one month following completion of radiation the average score was 10.51 ($p=0.003$) and at one year 9.23 ($p=0.17$). 119/501 (23.8%) of patients began treatment with an IPSS score greater than or equal to 15 with an average score of 19.65. At one month following treatment the IPSS score was 15.34 ($p<0.01$) and at a year 13.9 ($p<0.01$). For patients with baseline IPSS less than 15, the average score prior to therapy was 6.49, and at one month and one year 9.01 and 7.66 respectively ($p<0.01$). For 171 (34.1%) patients who were initially asymptomatic, IPSS less than or equal to 5, the average IPSS prior to treatment was 2.81, and at one month and one year 7.08 and 6.29 ($p<0.01$). When evaluated individually, 111/501 (22.2%) patients experienced a rise in IPSS of at least 5, 46/501 (9.1%) of 10, 15/501 (3.0%) of 15 and 6/501 (1.2%) of 20 points. No patient required catheterization at any point or use of pads.

CONCLUSION

Patients who were highly symptomatic prior to VMAT therapy experienced improved urinary function prior to baseline measurements at one month following treatment and continued improvement on to one year of treatment. Very few patients experienced a clinically significant rise in IPSS of greater than 15 and 20 from their pretreatment baseline measurements. No patient experienced catheterization or incontinence.

CLINICAL RELEVANCE/APPLICATION

Prostate cancer treatment to very high doses is associated with minimal urinary toxicity.

SSG16-04 Differences in Prostate Gland Geometry and Dosimetry After Pre-operative and Intra-operative Ultrasound Planning in Patients Undergoing Prostate Seed Brachytherapy: Implications for Current Practice

Participants

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PURPOSE

Currently prostate brachytherapy (PB) plans are generated using either pre-operative (POP) (done 2-3 wks before PB) or intra-operative (OR) ultrasound volume studies. This report compared: A) Prostate geometry between POP and OR volume studies; B) Prostate I-125 seed distribution between POP and OR plans; C) Prostate dosimetry after OR planning and POP planning.

METHOD AND MATERIALS

The POP and OR ultrasound volume studies and PB plans of 30 patients were analyzed and compared. PB dose was 144Gy with I-125 seeds. Different prostate gland volumes (cc) receiving a %dose (V100% and V150%) and dose to % prostate volumes (D90%) were estimated and compared using Wilcoxon rank sum test.

RESULTS

A) Mean prostate volume (cc) after POP vs. OR scans respectively and P values (P) was: prostate base 23.4 ± 3.2 vs. 22.8 ± 3.0 (P 0.35); prostate mid gland 24.0 ± 3.6 vs. 22.6 ± 2.8 (P 0.003); prostate apex 11.4 ± 3.1 vs. 10.3 ± 2.5 (P 0.07). B) Median difference in number of I-125 seeds between POP and OR plans were: Base 2.0 ± 4 (P 0.03); Mid gland 2.0 ± 9.6 (P 0.4); Apex 2.0 ± 6.4 (P 0.02). Median number of seeds added or removed for the 2 plans were: +4 and -2 for Base; +4 and -3.5 for Mid gland and +7.5 and -6.5 for Apex. These changes in number of seeds in the apex and base indicates significant difference in prostate geometry between these scans. C) Mean prostate PTV (cc) (V100% dose) between OR vs. POP plans was: Base 22.0 ± 4 vs. 21.7 ± 2.9 (P 0.004); Mid gland 23 ± 4.3 vs. 22.7 ± 3.2 (P 0.03) and Apex 10.8 ± 3.3 vs. 10.2 ± 3.3 (P 0.03). Mean prostate PTV (cc) (V150% dose) between OR vs. POP plans was: Base 10.8 ± 4.0 vs. 10.4 ± 2.6 (P 0.049); Mid gland 12.2 ± 4.2 vs. 12.0 ± 2.6 (P 0.3) and Apex 4.9 ± 1.9 vs. 4.3 ± 1.8 (P 0.02). Dose to 90% prostate PTV (D90) for OR vs. POP plans was $119 \pm 16\%$ vs. $113 \pm 20\%$ (P 0.04).

CONCLUSION

There were significant differences in prostate geometry and dosimetry between OR and POP scans. Differences in patient positioning (hip flexion) and use of general anesthesia for OR plans were responsible for these observations. The use of POP scans for PB may result in higher relapse rates due to underdosage of at-risk regions in the prostate. Intra-operative ultrasound volume study-based PB treatment planning provides superior prostate dosimetry compared to preoperative planning.

CLINICAL RELEVANCE/APPLICATION

Intra-operative volume study-based PB planning delivers a higher target dose to the prostate gland compared to pre-operative planning.

SSG16-05 Multiparametric MRI for Renal Cell Carcinoma: Assessment of Tumor Response after Stereotactic Ablative Body Radiotherapy

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S104A

Participants

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PURPOSE

Response assessment of renal cell carcinoma (RCC) after stereotactic ablative body radiotherapy (SABR) using size criteria from CT is challenging, as changes may evolve over months and even years post-therapy. The purpose of this study was to analyze early diffusion and perfusion changes in RCC tumors shown by multiparametric MRI after SABR, and to assess whether any changes are associated with overall treatment response.

METHOD AND MATERIALS

Twelve patients in a prospective Phase Ib clinical trial were analyzed, where patients with RCC tumour size <5cm diameter received a single fraction of 26 Gy and larger lesions received three fractions of 14 Gy. Multiparametric MRI including diffusion weighted (DWI) and dynamic contrast-enhanced (DCE) imaging was acquired at baseline and approximately three weeks and three months after SABR. Apparent diffusion coefficient (ADC) maps were computed from DWI data, heuristic parametric and pharmacokinetic maps using the extended Tofts model were fitted to the DCE data. Tumour volumes were contoured and statistics including histogram metrics extracted. Changes in DWI and DCE MRI characteristics were correlated with change in tumour volume shown by late follow-up CT (average 28 months after baseline CT, range 17-40 months) and with the Response Evaluation Criteria in Solid Tumors (RECIST) criteria.

RESULTS

The ADC mean, median and kurtosis measures increased in most patients at the third MRI scan indicating increased diffusion after

SABR, however there was no clear correlation with the change in tumour volume. DCE analysis showed strong correlations between the change in enhancement curve type and the change in tumor volume. Pharmacokinetic maps showed a positive correlation between tumour volume change and the difference in Ktrans, and a negative correlation with the change in Ve, at the third MRI scan.

CONCLUSION

Voxel-based analysis of tumors using DCE MRI shows promise for early prediction of overall tumour response, and may provide a useful biomarker for guiding patient management which is more reliable than RECIST criteria. DWI analysis did not provide a strong early indicator of treatment response.

CLINICAL RELEVANCE/APPLICATION

DCE MRI after SABR treatment for RCC may provide novel early response biomarkers which are more reliable than conventional CT based geometric RECIST response criteria.

SSG16-06 High Quality Volumetric CT Reduces PTV Margin for Radiotherapy of Prostate Cancer

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S104A

Participants

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ABSTRACT

Purpose/Objective(s): To determine whether superior soft tissue contrast provided by high-dose-high-quality volumetric CT (HDVCT) scans can reduce inter-observer variability in prostate gland segmentation which may result in the reduction of PTV margin. **Materials/Methods:** Ten prostate patients receiving radiotherapy were imaged with conventional CT (CCT, 120kV, 300mAs), HDVCT (120kV, 2300mAs, 80 slices of volumetric scan) and 3T MRI (T2W) all with 2mm thickness. Five radiation oncologists delineated prostate gland on all three image sets, totaling 150 contoured target volumes. Inter-observer variability was measured along base/middle/apex, posterior/anterior, and left/right directions. Degree of target confidence was measured in terms of membership by counting the number of times that each image voxel (0.2mmx0.2mmx2.0mm) were enclosed by contours delineated by five observers. A modal target volume was defined by the voxels with the membership of 50% or more in each imaging modality used. PTV margin was calculated by expanding every 150 contours with a step size of 0.5mm to 10mm that guarantees 95% of the prescription dose to the modal target volume to more than 90% of patient population. When contours to be expanded and the modal target volume to be covered are from the same image modality, the PTV is called intra modal PTV margin, and with different imaging modality, it is called inter modal PTV margin. Intra and inter modal PTV were compared for each image modality. **Results:** Inter-observer variability was 2.0mm, 2.0mm, and 1.7mm on average and 2.5mm, 2.1mm and 2.0mm with the maximum in apex region for CCT, HDVCT, and MRI, respectively (**pConclusion:** Inter-observer variability in target delineation is a source of systematic uncertainty. HDVCT CT and MRI imaging demonstrated significant reduction in inter-observer variability and intra PTV margin compared to CCT. Inter modal PTV margin appears minimal with HDVCT (5mm) than CCT or MRI (6mm) although the average volume of HDVCT is smaller than that of CCT. Smaller target volume together with smaller inter/intra PTV margin for HDVCT is promising for radiotherapy planning of prostate cancer.

SSG16-07 Early Urinary and Sexual Toxicity Outcomes for Patients Receiving Proton Radiation for Prostate Cancer

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S104A

Awards

Student Travel Stipend Award

Participants

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PURPOSE

While proton therapy becomes increasingly available to patients with prostate cancer, only a few centers have published their clinical results to date. We present our 2-year results using proton beam therapy (PBT) to treat patients with prostate cancer.

METHOD AND MATERIALS

82 patients on an IRB approved institutional registry were treated with PBT from 2013-2015. CTCAE v4.0 was used to score toxicity. Univariate and multivariate Cox regression were performed to identify clinical and dosimetric predictors of toxicity.

RESULTS

For the 82 patients treated, 23 had low risk prostate cancer, 42 intermediate risk, and 17 high risk. 95% of patients received ≥ 78 CGE. 25 patients received androgen deprivation therapy (ADT). Median follow up was 2 years. Time to PSA nadir was 1 year, with an average nadir of 0.5 ng/mL for patients treated with radiation alone without androgen deprivation. Two-year grade 2 and 3 GU toxicity were 22.0% and 1.2% respectively. Median time-to-event for G2+ urinary toxicity was 8 months. Univariate analysis showed a significant correlation between grade 2+ urinary toxicity and pretreatment prostate reductive procedures such as TURP

($p=0.009$), ADT use ($p=0.006$), baseline IPSS score ($p=0.02$) and baseline IPSS bother score ($p=0.01$). Relative volume of bladder receiving 81 Gy was also significantly related to G2+ urinary toxicity ($p=0.04$). On multivariate analysis, ADT use and baseline IPSS bother score correlated significantly with grade 2+ toxicity ($p=0.006$ and $p=0.01$). Two year rates of grade 2 and 3 decline in erectile function were 19.5% and 1.2%, respectively. On univariate analysis, only age was significant for grade 2+ sexual toxicity ($p=0.001$). There were only two events of grade 2 hip pain.

CONCLUSION

Rates of grade 2+ urinary, sexual, and hip toxicities were acceptable after proton therapy for prostate cancer. The highest risk subgroup for developing urinary toxicity was men on ADT with high baseline IPSS bother scores. Future analysis will include larger patient numbers and longer follow up to better assess late treatment toxicities and PSA trends.

CLINICAL RELEVANCE/APPLICATION

Our preliminary results show acceptable rates of urinary, sexual, and hip toxicity in patients with prostate cancer treated with proton therapy, with adequate PSA response.

SSG16-08 Analysis of 2-Year Gastrointestinal Toxicity in Patients Receiving Proton Radiation Therapy for Prostate Cancer

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S104A

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Increasing numbers of patients with prostate cancer are being treated with proton therapy. Theoretically, proton beam therapy (PBT) may have dosimetric advantages over photon radiation in treating a smaller region of the rectum. An ongoing randomized trial of proton versus photon therapy for prostate cancer has bowel toxicity as the primary endpoint (PARTIQoL). We present the 2-year bowel toxicity data for patients treated for prostate cancer at our proton center.

METHOD AND MATERIALS

82 patients on an IRB approved registry were treated with PBT from 2013-2015. CTCAE v4.0 was used to score bowel toxicity. Univariate Cox regression was performed to test correlations of baseline patient and dosimetric features with grade 2 or higher bowel toxicity.

RESULTS

For the 82 patients treated, 23 had low risk prostate cancer, 42 intermediate risk, and 17 high risk. Ninety-five percent of patients received ≥ 78 CGE, and 4 patients received pelvic node radiation. 25 patients received androgen deprivation therapy. 33 patients were treated with uniform scanning, and 49 patients were treated with pencil beam scanning. Median follow-up was 2 years. Radiation proctitis with transient rectal bleeding was the predominant bowel toxicity after PT, accounting for 95% of events. Grade 1 toxicity occurred in 15 patients (18%), grade 2 in 20 patients (24%), and grade 3 in 1 patient (1.2%). There were no grade 4 or 5 events. Median time to developing rectal bleeding was 14 months (range 5-33). Univariate analyses showed borderline correlation between grade 2+ toxicity and hyperlipidemia ($p=0.05$). No other associations to clinical variables, including use of anticoagulation, were observed. Dose-volume histogram parameters did not show a statistically significant correlation with grade 2+ toxicity, but the best correlation was with rectal V70 ($p=0.11$). No difference in toxicity risk was found between uniform scanning versus pencil beam scanning techniques.

CONCLUSION

We report 2-year bowel toxicity results from our proton center experience treating prostate cancer. A larger patient series with longer follow up is underway to better delineate the risk factors for development of bowel toxicity with proton radiation.

CLINICAL RELEVANCE/APPLICATION

Our preliminary results show acceptable rates of bowel toxicity in patients with prostate cancer treated with proton therapy, our studies are ongoing with larger patient numbers and longer follow up.

SSG16-09 The Impact of Magnetic Resonance Imaging on Clinical Decision-Making in Patients Undergoing Prostate Brachytherapy

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S104A

Participants

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ABSTRACT

Purpose/Objective(s): Multiparametric magnetic resonance imaging (MRI) is increasingly being used to manage patients with prostate cancer. For brachytherapy (BT) patients, it can identify frank radiographic extracapsular extension (ECE) or seminal vesicle invasion (SVI) that may not be adequately covered by BT monotherapy. The objectives of our study were to identify predictors of ECE and SVI on MRI and determine how often MRI findings alter management in patients electing BT. **Materials/Methods:** We performed a retrospective cohort study of prostate cancer patients at our institution electing low dose rate (LDR) or high dose rate (HDR) BT and who underwent MRI prior to treatment. Patients with frank ECE or SVI on MRI were not recommended to undergo BT monotherapy and were offered either combined external beam radiotherapy + BT boost (CMT) or another approach. Clinical records were used to determine changes in physician recommendations due to MRI findings. Chi-Square tests were performed for univariate analysis (UVA) to determine covariates associated with ECE or SVI, including risk group, T-stage, Gleason score and group, prostate-specific antigen (PSA), percent positive cores (ppc; $\geq 50\%$ vs. $< 50\%$). **Results:** The study cohort included 54 patients evaluated from August 2013 to January 2017 who elected BT (8 low risk, 40 intermediate risk and 6 high risk). 40 patients had cT1c disease, and 14 patients had cT2 disease. Median PSA was 6.51. 12 (22%), 30 (55%), 11 (20%), and 2 (4%) had Gleason group 1, 2, 3, and 5, respectively. 19 patients (35%) had $\geq 50\%$ ppc. 13 patients had radiographic ECE (24%) and 2 (4%) had SVI. Only ppc $\geq 50\%$ was associated with ECE ($p=0.02$); 15% of patients with ppc $\geq 50\%$ continued to be associated with ECE (Odds Ratio 4.36, 95% Confidence Interval 1.17-16.3; $p=0.29$), but Gleason group did not ($p=0.99$). No variables predicted for SVI on UVA or MVA. No low risk or high risk patients had a change in recommendation due to MRI findings, but 20% ($n=8$) of the intermediate risk patients had a change in recommendation. 6 of these patients were switched from monotherapy to CMT due to ECE (and also SVI in 1 patient). One patient had hormonal therapy added to planned CMT. One patient had HDR recommended instead of LDR due to large gland size. **Conclusion:** MRI should be considered to help determine candidacy for BT monotherapy in intermediate risk prostate cancer patients and those with $\geq 50\%$ ppc due to a higher risk of radiographic ECE that may not be adequately covered with monotherapy. Longer follow-up is needed to determine the impact on disease control.

SSG17

Vascular Interventional (Portal Hypertension/Transplant)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E351

GI IR VA

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

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSG17-01 Systematic Screening and Treatment Policy of Arterial Complications after Orthotopic Liver Transplantation: Long-Term Follow-Up

Tuesday, Nov. 28 10:30AM - 10:40AM Room: E351

Participants

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PURPOSE

Vascular arterial complications after orthotopic liver transplantation (OLT) are actively searched for and treated to prevent the development of ischemic cholangiopathy (IC). To date, very few studies have analyzed the long-term outcome of this policy. Therefore the aim of this study was to evaluate the long-term results of a systematic screening and treatment policy of impaired hepatic artery after OLT.

METHOD AND MATERIALS

Between 2003 and 2013, over 1048 liver transplantations, a total of 53 patients (42 men, age 19-69) were diagnosed and treated by endovascular techniques for early or late arterial complications such as stenosis, thrombosis, dissection or kinking of the hepatic artery. Radiological and surgical data were retrospectively analyzed and survivors were recalled to undergo follow-up Magnetic Resonance Cholangiopancreatography (MRCP) and duplex ultrasound (DUS) of the liver to identify vascular anomalies and ischemic cholangiopathy. Factors associated with IC were identified.

RESULTS

Technical success was 94%, and 6 patients experienced serious adverse event. After a median follow-up of 56.7 months (range 15.6-123.6) DUS of the hepatic artery showed normal values (resistive index, time to peak and maximum velocity) in 72% of the patients. Over the same period, 17 patients (32%) developed radiological features of IC with a mortality rate of 13% compare to 10% in patients without IC ($p=0.0163$). Patients with arterial complication appearing before 3 months have significantly more IC when compared to others ($p=0.028$). No other factor was associated with the occurrence of IC. Patients with IC had a significantly lower survival (median 77 months (95% IC 53 - 101) vs. not reached in patients without IC, $p = 0.0163$).

CONCLUSION

Systematic screening and endovascular treatment of arterial complication after OLT appears safe, efficient and is associated with good long-term outcome. Nevertheless, one third of the patients eventually develop IC, especially if arterial complications appear early after OLT.

CLINICAL RELEVANCE/APPLICATION

Systematic screening and endovascular treatment of arterial complication after OLT appears safe, efficient and is associated with good long-term outcome, even though one third of the patients eventually develop IC.

SSG17-02 Volumetric Phase Contrast MR Imaging (4D Flow) of Transjugular Intrahepatic Portosystemic Shunts

Tuesday, Nov. 28 10:40AM - 10:50AM Room: E351

Participants

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PURPOSE

To demonstrate feasibility of interrogating transjugular intrahepatic portosystemic shunts (TIPS) with 4D Flow MR in patients with suspected TIPS dysfunction.

METHOD AND MATERIALS

Adult patients with suspected TIPS dysfunction were eligible for enrollment. A volumetric phase contrast sequence, with VENC 75-225 cm/sec, was used to image TIPS stents. Particle tracing CINE images were used for qualitative assessment of stenosis and stents were segmented to generate quantitative data sets of peak velocity. MR parameters were modified to improve image quality and post processing. Segmentation and quantitative measurement of flow throughout an entire TIPS stent defined technical success. Comparison was made to Doppler US and venogram (reference standards).

RESULTS

4D Flow MRA was performed in 23 encounters, was technically successful in 16/23 encounters, and failed in 7/23 encounters. The 3 cases which demonstrated both focal aliasing and abnormal velocities ($>190\text{cm/s}$ or $<90\text{cm/s}$) on 4D Flow had venogram confirmed stenosis. The 4 cases which demonstrated elevated in-stent velocities $>190\text{cm/s}$ without focal aliasing, and the 2 cases with aliasing but normal velocities, did not have stenosis. Suboptimal imaging was due to low signal-to-noise related to FOV (3/5), ascites (1/5), or incorrect VENC selection (1/5). Failure of imaging occurred due to presence of stainless steel stent (2/7), improper FOV (3/7), incorrect VENC (1/7), and data corruption (1/7).

CONCLUSION

4D Flow MRA may be a feasible modality for the evaluation of TIPS stent dysfunction after protocol optimization and with careful patient selection to increase technical success

CLINICAL RELEVANCE/APPLICATION

4D Flow MRA is a promising modality for the evaluation of transjugular intrahepatic portosystemic shunt (TIPS) dysfunction, and could be incorporated into routine Liver MR protocols for improved surveillance of TIPS stents.

SSG17-03 Transhepatic Portomesenteric Stenting Improves Outcomes in Cancer Patients with Extrahepatic Portomesenteric Venous Stenosis/Occlusion

Tuesday, Nov. 28 10:50AM - 11:00AM Room: E351

Participants

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Rahul A. Sheth, MD, Boston, MA (*Presenter*) Nothing to Disclose

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PURPOSE

To compare serologic and clinical outcomes between conservative management versus stenting in cancer patients with extrahepatic portomesenteric venous stenosis or occlusion.

METHOD AND MATERIALS

A single institution, IRB-approved retrospective review of all patients with extrahepatic portomesenteric venous occlusion or stenosis (PVO) from 2007-2015 was performed. A total of 347 patients were identified, of whom 38 underwent portomesenteric venous stenting (PVS). To reduce selection bias, a propensity score matching algorithm was used in a 2:1 ratio to create a subset of non-stent patients from the remainder of the 309 patients that were matched with the PVS cohort in age, underlying malignancy, and extent of PVO. These matched 76 patients comprised the non-stent comparison cohort. Univariate and multivariate analyses of serologic and clinical parameters was performed between the two cohorts.

RESULTS

Of the 114 patients, pancreatic cancer was the most common malignancy (68/114, 60%), followed by cholangiocarcinoma (16/114, 14%). Stenosis or occlusion involved greater than one portomesenteric vein in the majority of patients (93/114, 82%). In the PVS cohort, stent deployment involved greater than one portomesenteric vein in most patients (32/38, 84%). Technical success for PVS was 95% (36/38), with no major or minor complications. In the non-stent cohort, 50% of patients (38/76) were treated with systemic anticoagulation, with 50% of patients unable to be anticoagulated due to history of bleeding and/or thrombocytopenia. While there was a significant decrease in serum albumin ($P < 0.01$) and platelet counts ($P = 0.01$) in the non-stent cohort at 6 months following the diagnosis of PVO, albumin ($P = 0.4$) and platelet levels ($P = 0.8$) were maintained in the PVS cohort after stenting. There was also a significant increase in the proportion of non-stent patients with symptomatic ascites ($P < 0.001$) following PVO diagnosis compared to a significant decrease in the PVS group ($P < 0.01$). There was a significant increase in survival amongst the PVS cohort ($P = 0.02$).

CONCLUSION

In appropriately selected cancer patients with PVO, PVS can reduce the development of ascites, maintain platelet and albumin counts, and possibly increase survival.

CLINICAL RELEVANCE/APPLICATION

PVS is a safe, highly technically feasible intervention that improves clinical and serologic outcomes in cancer patients with PVO.

SSG17-04 Cross-Sectional Imaging (CSI) Findings Predict Clinically Significant Portal Hypertension (pHTN): Correlation with Direct Hepato-Portal Venous Gradient (HPVG) and Portosystemic Gradient (PSG) Manometry

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E351

Participants

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PURPOSE

To investigate the prognostic value of CSI findings of pHTN through correlation with direct HPVG and PSG manometry values.

METHOD AND MATERIALS

IRB approved HIPAA compliant study of 100 consecutive patients (Mean age 55.4 [20-77] yrs, 44% female, 56% male) with suspected pHTN who underwent transjugular liver biopsies from Nov 2014 to Nov 2016. PSGs (difference between right atrial and wedge pressures) and HPVGs (difference between free hepatic and wedge pressures) were recorded for all cases. CT and MRI were used to record secondary signs of pHTN (i.e., hepatic hydrothorax, ascites, varices, umbilical vein recanalization, venous shunts) and measure liver, spleen, left renal, and main portal vein diameters. Overall liver morphologies were noted. Portal venous flow direction was confirmed with Doppler. Each variable was correlated with PSGs and HPVGs. Pressure gradients >5 mmHg defined pHTN, while >=10 mmHg defined clinically significant pHTN. Characteristic differences between groups were compared using Chi-Square utilizing SPSS software v20.0 (IBM, Armonk, NY). Significance was set at <0.05.

RESULTS

Of the 100 subjects, 90% had pHTN (30% alcohol-related, 19% Hep C, 3% Hep B, 9% NASH, 29% cryptogenic), 10% had normal pressures, and 70% had stage III/ IV fibrosis. Average PSG was 17 mmHg (s=9), while the average HPVG was 13 mmHg (s=8). Variables predicting a PSG >10 mmHg included hepatofugal flow (p=0.000), liver diameter <15 cm (p=0.034), spleen >11 cm (p=0.029), hydrothorax (p=0.004), ascites (p=0.000), esophageal varices (p=0.000), gastric varices (p=0.006), perisplenic varices (p=0.031), omental varices (p=0.001), recanalized umbilical vein (p=0.029), gastroduodenal shunt (p=0.000), and an IMV to superior rectal shunt (p=0.023). Variables predicting HPVG >10 included a hepatofugal flow (p=0.000), liver diameter <15 cm (p=0.047), spleen >11 cm (p=0.002), hydrothorax (p=0.018), ascites (p=0.001), esophageal varices (p=0.001), gastric varices (p=0.006), perisplenic varices (p=0.002), omental varices (p=0.000), recanalized umbilical vein (p=0.001), gastroduodenal shunt (p=0.001), and an IMV to superior rectal shunt (p=0.017).

CONCLUSION

CSI findings can predict clinically significant pHTN and may thus guide patient prognosis and clinical decision-making for specific associated pathologies.

CLINICAL RELEVANCE/APPLICATION

Specific findings on CSI reliably correspond to PSGs and HPVGs, can predict clinically significant pHTN, and may justify forgoing additional invasive interventions.

SSG17-05 Hepatofugal Flow in the Main Portal Vein Prior to Transjugular Intrahepatic Portosystemic Shunt (TIPS) as a Predictor for Post-TIPS Variceal Embolization in Patients with Gastrointestinal Bleeding

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E351

Participants

Sujoy Mukherjee, San Francisco, CA (*Presenter*) Nothing to Disclose
Ryan M. Kohlbrenner, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Ernest J. Ring, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To investigate whether hepatofugal flow (HF) in the main portal vein (MPV) prior to transjugular intrahepatic portosystemic shunt (TIPS) creation can serve as a predictor for post TIPS variceal embolization in patients with gastrointestinal (GI) bleeding.

METHOD AND MATERIALS

A retrospective review of consecutive patients with GI bleeding who underwent TIPS from 1/2007 to 1/2017 was conducted. Pre-

and post-TIPS portosystemic pressure gradients and embolization of varices were reviewed. The directionality of the blood flow in the MPV prior to TIPS creation was determined to be HF or hepatopedal (HP) by a fellowship trained interventional radiologist blinded to the purpose of this study. Variceal embolization data was analyzed using the Fisher's exact test and mean post-TIPS portosystemic pressure gradients was analyzed using the student's T -test. A P value less than 0.05 was considered statistically significant.

RESULTS

40 patients were identified. The predominant causes of cirrhosis were hepatitis C and alcohol abuse. 24 patients demonstrated HP flow and 16 patients had HF flow. Of the 24 patients with HP flow, 6 patients (25%) required coil embolization post TIPS. This is compared to the 10 out of 16 patients (62.5%) with HF flow who underwent post-TIPS embolization, ($p = 0.0245$). Post TIPS portosystemic pressure gradient in the HP group was 6 mm Hg compared to 8 mm Hg ($p = 0.058$). Pre-TIPS portosystemic pressure gradient was not significantly different between the two groups.

CONCLUSION

In the setting of GI bleeding, HF blood flow in the MPV prior to TIPS creation may serve as a predictor for requiring post-TIPS variceal embolization.

CLINICAL RELEVANCE/APPLICATION

Pre-TIPS portograms are an essential part of imaging required for measuring the length of the shunt. Our group continues derive as much information from this imaging study, including consistent markers, that can be used best prepare Interventional Radiologists prior to TIPS procedures. In this study, we have demonstrated an association between the presence of HF flow on pre-TIPS portograms and the probable need for coil embolization in-TIPS procedure. Of course, larger scale studies are required to validate the data, including prospective randomized trials. In addition, we have shown a possible trend between HF flow demonstrated on pre-TIPS imaging predicting a post-TIPS pressure gradient of 6 mm Hg or more. Further data is required to validate this trend.

SSG17-06 Large Spontaneous Portosystemic Shunts in Therapy-Refractory Cirrhotic Patients: A Clear Definition of Risks and Tricks of Endovascular Management

Tuesday, Nov. 28 11:20AM - 11:30AM Room: E351

Participants

Carmen Parra-Farinas, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose
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Iratxe Diez Miranda, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
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Queralt Ordi I Camprubi, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Shelagh C. Dyer, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

This study aimed to analyze the efficacy and safety of embolization of large spontaneous portosystemic shunts (SPSS) in cirrhotic patients with recurrent hepatic encephalopathy (HE).

METHOD AND MATERIALS

From February 2002 to January 2017, a prospective study of chronic therapy-refractory HE patients who underwent SPSS embolization was performed. Inclusion criteria: refractory chronic HE (recurrent episodes of HE without known precipitant and ≥ 2 hospital admissions because of HE after the start of standard therapy), exclusion criteria: absence of cirrhosis, surgical shunt or TIPS graft, portal vein thrombosis, preexisting hepatocellular carcinoma, Child-Pugh class C13. Analysis and outcome parameters: baseline characteristics, diagnostic workup, therapeutic method, clinical and radiological outcomes.

RESULTS

Forty consecutive patients were found eligible according to inclusion and exclusion criteria. Mean age at treatment was 62.5 ± 13.9 , 55.0% male. Chronic liver damage: alcoholic abuse (36.7%), HCV (23.4%), cryptogenic (20.0%), non-alcoholic steatohepatitis (13.3%), primary biliary cirrhosis (3.3%), autoimmune hepatitis (3.3%). Prior to embolization, five patients had liver transplants. SPSS characterization: Doppler-Color Ultrasound, CT-Angiography, indirect Portography. SPSS types: spleno-renal (68.4%), meso-caval/renal (15.8%), gastro-acygos/renal (10.5%), recanalized para-umbilical veins (5.3%). Approaches: common femoral vein (60.0%), internal jugular vein (30.0%), transhepatic (6.7%), transplenic (3.3%). Materials: coils (28.5%), occlusion devices (25.0%), liquid agents (7.2%), combination (39.3%). Secondary procedures were performed in four patients after identification of revascularized SPSS. Follow-up range: 3-31 months. All patients improved autonomy and decreased severity of the worst HE episode. One patient had transient low cardiac output due to acute shunt-closure. There were no other procedure-related complications, portal hypertensive gastropathy or varices development.

CONCLUSION

SPSS embolization is an effective and safe complementary or curative treatment for HE persistence in cirrhotic patients, even after liver transplantation, improving quality of life by reduction of hospitalizations.

CLINICAL RELEVANCE/APPLICATION

The presence of large SPSS provides an explanation for hepatic encephalopathy persistence in cirrhotic patients and represents a therapeutic target in chronic medically refractory HE patients.

SSG17-07 Non-Invasive Pressure Monitoring After Transjugular Intrahepatic Portosystemic Shunt Implantation with Integrated Stent-Graft

Participants

Clemens Spink, Hamburg, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

In vitro and ex vivo testing of a novel stent-graft with integrated pressure sensors capable of wireless digital data transmission for non-invasive pressure monitoring after TIPS.

METHOD AND MATERIALS

Ten stent-grafts for TIPS-implantation (100x10 mm) were designed including integrated pressure sensors at both ends within layers of polytetrafluorethylen (PTFE). Digital data conversion could be performed by integrated microcontrollers within the PTFE-membrane providing energy and data transfer by inductive coupling. The stent-grafts were placed in a silicone liver phantom and in explanted porcine livers via 16F applicators.

RESULTS

First in vitro and ex vivo testing demonstrated a capable TIPS stent-graft design with integrated sensors in a stable PTFE-covering after crimping and application into a liver phantom and 4 porcine livers. In both setups measurements were simultaneously taken from the two sensors with an accuracy of ± 1.2 mmHg up to a distance of 10 cm in a liver phantom and a distance of 8 cm in a porcine liver.

CONCLUSION

First in vitro and ex vivo results demonstrate a successful approach for non-invasive pressure monitoring after TIPS by integrated sensors within a PTFE-cover. Further in vivo tests are required before the potential implementation into a product.

CLINICAL RELEVANCE/APPLICATION

Non-invasive pressure acquisition after TIPS via integrated sensors with the PTFE-membrane provides a suitable and precise way of monitoring patency.

SSG17-08 Clinical Significance of Abnormal findings on Baseline Transjugular Intrahepatic Portosystemic Shunt Doppler Sonography

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E351

Participants

Peiman Habibollahi, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
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Anil Chauhan, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Doppler Sonography (DS) is frequently performed as a screening and diagnostic modality to evaluate the transjugular intrahepatic portosystemic shunt (TIPS). However, the clinical significance of initial frequently observed abnormalities of flow velocities, gradient and flow direction on baseline DS is less studied.

METHOD AND MATERIALS

A retrospective study was performed at a large referral center between 2002 and 2010 and all patients undergoing TIPS procedure for the management of portal hypertension (PHTN) were initially included. Patients without sufficient medical records or US examinations were excluded. Electronic medical records were reviewed and baseline DS findings as well as clinical data regarding recurrent symptoms of portal hypertension, and findings of TIPS angiography/revision studies were recorded. Abnormal DS indices were defined as peak intra-shunt velocities (PSV) <90 or >190 cm/sec, intra-shunt gradient >50 cm/s and abnormal flow direction in main, right or left portal veins.

RESULTS

195 patients underwent TIPS during the study period. 34 patients were excluded due to lack of clinical or sonographic follow up. Indication for TIPS was uncontrolled ascites in 95 (59%) and bleeding secondary to PHTN in 66 patients (41%). Median follow up was 24.6 months. During follow up period, PHTN symptoms recurred in 37 patients out of which 33 patients underwent TIPS angiography/revision. With regards to baseline US, Low PSVs were present in 54 (33.5%), normal PSVs in 96 (59.6%) and high PSVs in 9 patients (5.6%) while in 2 patients shunts were occluded. There was significantly lower rate of stenosis diagnosed on TIPS angiography/revision in patients with baseline low velocity PSVs (2/10 (20%) in patients with low PSVs compared to 14/21 (66.7%) and 1/2 (50%) in patient with normal and high baseline PSVs, p -value=0.02). There was no significant relationship between presence of abnormal intra-shunt gradient or abnormal flow direction on baseline DS and development of stenosis during follow up ($p>0.05$).

CONCLUSION

These findings suggest that in the absence of clinical findings of shunt failure, abnormal findings on baseline TIPS DS have low yield

for predicting development stenosis and recurrent PHTN.

CLINICAL RELEVANCE/APPLICATION

In the absence of other indicators of portal hypertension and shunt failure, abnormal findings on TIPS baseline DS may be safely observed without need for immediate invasive procedures.

SSG17-09 Delineation of Hepatic Veins: Comparison of Magnetic Resonance Angiography Using Spatial Labeling with Multiple Inversion Pulses, Perfusion-Weighted Imaging and Computer Tomography Angiography

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E351

Participants

Di Zhu, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Zhen Li, MD, PhD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate and compare the visualization of hepatic veins by non-contrast-enhanced magnetic resonance angiography (MRA) using spatial labeling with multiple inversion pulses (SLEEK) with magnetic resonance perfusion-weighted imaging (PWI) and computer tomography angiography (CTA).

METHOD AND MATERIALS

SLEEK-MRA and CTA were performed on 20 patients with liver diseases. For visualization of hepatic veins, one inversion pulse was placed to cover the heart to suppress the signal in the hepatic artery, while the other beneath the bottom edge of liver to suppress the inflow signal of portal system. Subsequently 9 of the patients were examined with PWI. The visualization quality score of hepatic veins was scored on a four-point scale for assessment of left hepatic vein (LHV), middle hepatic vein (MHV) and right hepatic vein (RHV). On the original images of SLEEK-MRA, PWI and CTA, regions of interest were placed in LHV, MHV, RHV and homogenous liver parenchyma to acquire signal intensity and standard deviation. Contrast ratio (CR) of vessels to liver parenchyma, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated. The visualization quality was analyzed with Wilcoxon signed-rank test. The CR, SNR and CNR were analyzed with paired t-test. A p value of <0.05 was considered statistically significant.

RESULTS

Compared to CTA, SLEEK-MRA revealed significantly higher visualization quality score, SNR, CNR and CR in MHV (3.2 ± 0.6 vs 2.1 ± 1.0 , 37.3 ± 10.2 vs 6.3 ± 1.6 , 19.1 ± 9.1 vs 1.5 ± 0.5 , 2.1 ± 0.5 vs 1.3 ± 0.1) and RHV (3.0 ± 0.7 vs 2.1 ± 1.0 , 36.3 ± 7.5 vs 6.5 ± 1.6 , 18.2 ± 5.6 vs 1.7 ± 0.8 , 2.0 ± 0.3 vs 1.4 ± 0.2) ($p < 0.01$), while significantly higher SNR, CNR and CR in LHV (32.1 ± 8.6 vs 6.2 ± 1.8 , 12.9 ± 6.7 vs 1.5 ± 0.8 , 1.7 ± 0.3 vs 1.3 ± 0.1) ($p < 0.01$). Compared to PWI, SLEEK-MRA revealed significantly higher CNR and CR in LHV (11.2 ± 4.0 vs 6.0 ± 3.8 , 1.6 ± 0.2 vs 1.2 ± 0.2) and MHV (18.3 ± 8.7 vs 7.3 ± 2.6 , 2.0 ± 0.4 vs 1.3 ± 0.1) ($p < 0.01$), as well as in RHV (16.7 ± 6.4 vs 9.3 ± 2.9 , 1.9 ± 0.3 vs 1.4 ± 0.2) ($p < 0.05$). No statistically significant difference was found for visualization quality score and SNR in hepatic veins.

CONCLUSION

SLEEK-MRA visualizes hepatic veins in high quality and better contrast than traditional contrast-enhanced CTA and PWI.

CLINICAL RELEVANCE/APPLICATION

SLEEK-MRA provides a method to selectively delineate hepatic veins with high image quality and contrast to the liver background, while free from exogenous contrast media.

RCA33

Case Review: Introduction to LI-RADS (Hands-on)

Tuesday, Nov. 28 12:30PM - 2:00PM Room: S401AB



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

Participants

Ania Z. Kielar, MD, Ottawa, ON (*Presenter*) Research Grant, General Electric Company
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LEARNING OBJECTIVES

1) Implement CT/MRI LI-RADS version 2017 when assessing liver observations in patients at risk for HCC 2) Recognize CT/MRI ancillary features and integrate these features into the final LI-RADS categorization 3) Integrate newly developed 2017 CT/MRI LI-RADS treatment response categories for HCC after locoregional therapies

ABSTRACT

In this 1.5 hour Hands-On Workshop, the participants will be seated at stand-alone computers and have the opportunity to review up to 25 MRI and CT cases of livers in patients at risk for HCC and characterize the observations based on the 2017 updated version of CT/MRI LI-RADS. The workshop will be led by world-renown experts in the field who are members of the LI-RADS steering committee. A short didactic review of LI-RADS 2017 updates will be offered at the start of the course. Following this introduction, workshop participants will have time to look at each case on their own, with support faculty available throughout the room to answer individual questions. Subsequently, each case will be reviewed by a faculty member in a didactic fashion, highlighting pearls for accurate use of LI-RADS in each case, with opportunity for questions. Focus will be on the overall integration of LI-RADS version 2017 into daily practice. This workshop will initially focus on the core imaging features post-contrast enhancement and work through the algorithm of how to assign a LI-RADS score. This workshop will also encompass ancillary imaging features and how to apply them to ensure standardized LI-RADS reporting of various types of liver observations. The workshop cases will include daily, non-academic practice examples, and include various levels of difficulty. Beginner cases as well as more challenging cases will be included in the workshop to help radiologists from all backgrounds integrate LI-RADS into their daily work. References: 1. LI-RADS major features: CT, MRI with extracellular agents, and MRI with hepatobiliary agents. Santillan C, Fowler K, Kono Y, Chernyak V. *Abdom Radiol* (NY). 2017 Aug 21. [Epub ahead of print] 2. LI-RADS: ancillary features on CT and MRI. Chernyak V, Tang A, Flusberg M, Papadatos D, Bijan B, Kono Y, Santillan C. *Abdom Radiol* (NY). 2017 Jun 24. [Epub ahead of print] 3. Management implications and outcomes of LI-RADS-2, -3, -4, and -M category observations. Mitchell DG, Bashir MR, Sirlin CB. *Abdom Radiol* (NY). 2017 Aug 4. [Epub ahead of print] 4. Locoregional therapies for hepatocellular carcinoma and the new LI-RADS treatment response algorithm.

Kielar A, Fowler KJ, Lewis S, Yaghmai V, Miller FH, Yarmohammadi H, Kim C, Chernyak V, Yokoo T, Meyer J, Newton I, Do RK. Abdom Radiol (NY). 2017 Aug 5. [Epub ahead of print]

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RCB33

Teaching Congenital Heart Disease with 3D Printed Models II: Criss-cross or Twisted Heart and Related Conditions (Hands-on)

Tuesday, Nov. 28 12:30PM - 2:00PM 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 criss-cross heart and related conditions. 2) Understand the pathologic and surgical anatomy of various forms of criss-cross heart and related conditions. 3) Develop ideas how to image the patients with criss-cross heart and related conditions for surgical management.

ABSTRACT

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

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RCC33

Technologies for Creating Educational Content and Teaching Files

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



AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credit: .50

Sub-Events

RCC33A Podcasting and Screencasting for Teaching

Participants

Mahesh M. Thapa, MD, Seattle, WA (*Presenter*) Nothing to Disclose

RCC33B ePublishing

Participants

Michael L. Richardson, MD, Seattle, WA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Be familiar with pros and cons of ePublishing in general. 2) Be aware of several free ePublishing programs and where to find them. 3) Be aware of the ramifications of digital rights management and book pricing. 4) Know how to convert an eBook into a physical paper book as needed.

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RCC33C Incorporating the iPad in Resident Education: Using Mobile Technology to Improve the Way We Teach

Participants

Harprit S. Bedi, MD, Boston, MA (*Presenter*) Nothing to Disclose

MSRP31

RSNA Resident and Fellow Symposium (An Interactive Session)

Tuesday, Nov. 28 1:00PM - 4:00PM Room: E451B



AMA PRA Category 1 Credits™: 3.00
ARRT Category A+ Credit: 0

Sub-Events

MSRP31A Session 1: Finding Your Career Path

Tuesday, Nov. 28 1:00PM - 1:50PM Room: E451B

MSRP31B What RSNA Has to Offer Members-In-Training

Tuesday, Nov. 28 1:00PM - 1:15PM Room: E451B

Participants

Courtney M. Tomblinson, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

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MSRP31C Panel Discussion: Academic, Private Practice, Hybrid Model, Telerad, Interventionalist

Tuesday, Nov. 28 1:15PM - 1:50PM Room: E451B

Participants

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Jonathan H. Chung, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Franklin G. Moser, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Rohini N. Nadgir, MD, Baltimore, MD (*Presenter*) Future royalties, Reed Elsevier
Reed A. Omary, MD, Nashville, TN (*Presenter*) Nothing to Disclose
Lauren P. Golding, MD, Summerfield, NC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Briefly contrast the workflow of the hybrid private/academic model with other practice and management styles. 2) Describe the challenges of functioning as a practicing radiologist in the hybrid model with an emphasis on responsibilities to the practice and to the learner/trainee. 3) Discuss the ways in which reimbursement may differ in this model compared to purely private and purely academic settings.

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MSRP31D Session 2: Landing the Job You Want

Tuesday, Nov. 28 1:50PM - 2:55PM Room: E451B

MSRP31E Interview to Win - How to Land the Job You Want

Tuesday, Nov. 28 1:50PM - 2:30PM Room: E451B

Participants

Lindsay Stratchko, DO, Hershey, PA (*Presenter*) Nothing to Disclose
Frank J. Lexa, MD, MBA, Philadelphia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the importance of interviewing in the current job market. 2) Avoid common interviewing mistakes. 3) Develop a deep understanding of what should happen during a productive interview.

ABSTRACT

Many radiologists coming out of training and beyond have little or no formal training in how to interview well. Advice that is given in training programs is often not organized and occasionally the advice you get from different mentors can be contradictory. This talk will review why the process surrounding an interview is important for both the interviewee and the interviewer. We will review

common mistakes that both sides make in medical job interviews. We will cover how to properly prepare to do well in an interview. We will cover the process- before the interview, the day or days of the interview(s) and how to follow up after the interview. We will define the domains of what constitutes appropriate, inappropriate and illegal questioning. Most importantly we will cover what you as an job applicant need to do to get the most out of an interview and maximize your chances of success.

MSRP31F Contract Negotiation

Tuesday, Nov. 28 2:30PM - 2:55PM Room: E451B

Participants

J. P. King, MD, Halifax, NS (*Presenter*) Nothing to Disclose

David M. Yousem, MD, Baltimore, MD (*Presenter*) Royalties, Reed Elsevier; Royalties, Oakstone Publishing, LLC; Employee, Medicolegal Consultation; ; ;

LEARNING OBJECTIVES

1) Understand the importance of having a clear mission statement to negotiate for the best contract. 2) Provide a plan for how to prioritize the items that will help the employee be successful. 3) Use win-win and synergy concepts to bring the employer to want to provide the essential items to a prospective employee's needs.

ABSTRACT

When negotiating with an employer, the most important "sales pitch" is to clearly state what your goals and objectives are so that you can eloquently define your career "mission". In so doing you define your priorities and can espouse the essential items that are needed for you to be successful. However the framework for the requests must be placed into the context of what it will bring to the employer, be it a private practice group or academic medical center. Being able to state, "If you allow me to have access to: this biopsy tray/software package/patient group thru marketing/research time on the MEG machine, I will be able to: cure spinal metastases/elevate our group to best in class status/fill our open scanners/create a new way to treat epilepsy" incorporates the employer into the partnership that leads to synergy. Painting a shared vision of "if....., then....." uses logic and probability terms that explains why your contract "demand" is in the interest of the employer to provide for you. Each such demand must be mission-centric. Remember that your success and happiness is not rooted in salary and compensation and benefits. It is based on having an enjoyable workplace, doing meaningful work, in an environment where you are appreciated. Potential pitfalls are exclusivity agreements, termination clauses, and abstractive regulations.

MSRP31G Session 3: Tips for a Successful Career

Tuesday, Nov. 28 2:55PM - 4:00PM Room: E451B

MSRP31H Challenging Conventional Wisdom

Tuesday, Nov. 28 2:55PM - 3:20PM Room: E451B

Participants

Thomas G. Tullius JR, MD, Chicago, IL (*Presenter*) Nothing to Disclose

Ronald L. Eisenberg, MD, JD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn the importance of challenging the notion that the way things have always been done is the correct way. 2) See how experimental studies can be designed to show that conventional wisdom is incorrect and that a new approach should be followed.

ABSTRACT

Conventional wisdom is define as 'a generally accepted belief, opinion, or judgment accepted as true by the public and/or experts in a field.' However, conventional wisdom often isn't. In response to questions from residents and fellows, radiology faculty members are often forced to reply that 'this is the way it always has been done.' If you wonder whether a longstanding practice is reasonable, consider doing a study to determine whether it is really true. By using examples from our institution, this sedsion shows a variety of situations in which testing the validity of conventional wisdom showed that it was not correct.

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/> Ronald L. Eisenberg, MD, JD - 2012 Honored Educator
Ronald L. Eisenberg, MD, JD - 2014 Honored Educator

MSRP31I Tips for Successful Leadership: What I Wish I Knew Back Then

Tuesday, Nov. 28 3:20PM - 3:45PM Room: E451B

Participants

Bryan M. Rabatic, MD, PhD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

Robert M. Barr, MD, Charlotte, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand what is unique about the private practice setting relevant to successful leadership. 2) Learn how to select and cultivate leaders. 3) Appreciate and recognize qualities of successful leaders. 4) Help develop successful leadership skills.

ABSTRACT

Leadership means different things to different people. This talk will address leadership challenges specific to hospital-based private practice, and is targeted for young professionals looking to develop, understand, or improve leadership strategies. What is unique about the leadership challenges in this environment? How does one become a leader in private practice? What are the keys to success as a leader? What is "rope-a-dope" and why does it work? What's the best show on TV to learn about leadership in this

environment and why? Why do we talk about "grooming" leaders instead of teaching leadership? This will be an informal address highlighting tips, pearls, and observations from the front lines of leadership in a hospital-based private practice.

MSRP31J Q & A

Tuesday, Nov. 28 3:45PM - 4:00PM Room: E451B

Participants

Courtney M. Tomblinson, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

MSAS33

Cyber Crimes and Radiology (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, Nov. 28 1:30PM - 3:00PM Room: S105AB



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

Participants

Dana Aragon, RT, Albuquerque, NM (*Moderator*) Nothing to Disclose

Sub-Events

MSAS33A Understanding an Elusive Enemy

Participants

Sam Khashman, Charlotte, NC (*Presenter*) Owner, Imagine Software Inc

LEARNING OBJECTIVES

- 1.) Gain a basic understanding of healthcare cyber-attacks
- 2.) Increase awareness of the risks, and potential costs associated with collecting, manipulating, and storing electronic health records
- 3.) Appreciate the motivations, and incentives of cyber-actors.
- 4.) Understand the vulnerabilities of healthcare organizations
- 5.) Learn preventive steps to safeguarding electronic health records.

ABSTRACT

Although recent cyber-attacks have received a significant amount of media attention, healthcare organizations continue to represent an easy, and lucrative target for bad actors. The presentation will provide an insight into the world of cyber-warfare aimed at healthcare organizations, the elusive enemy, his motivations, and incentives. Illustrating 'what is at stake', by analyzing recent breaches, and by understanding some of the preferred methods that bad actors use to infiltrate healthcare organizations, the session will help raise awareness, and provide actionable methods for loss prevention.

MSAS33B Cyber Insurance: What It Does and Doesn't Cover

Participants

Adam Cottini, Ny, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

- 1) Understand the basic offerings found under a 'Traditional' Cyber insurance policy.
- 2) Have an opportunity to understand common misunderstood exclusions (War and Terrorism, Prior Acts, Collection Exclusions, Bodily Injury & Property Damage).
- 3) Have an opportunity to troubleshoot common misunderstood conditions (Application requirements, other insurance clause, breach vendor panel requirements).
- 4) Lastly, a discussion on high level preventive priorities every organization should consider when assessing cyber risk.

MSCC33

Case-based Review of Nuclear Medicine: PET/CT Workshop-New PET Radiotracers in the Clinic (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 28 1:30PM - 3:00PM Room: S406A

CT **NM**

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

FDA Discussions may include off-label uses.

Participants

Katherine A. Zukotynski, MD, Hamilton, ON (*Director*) Nothing to Disclose
Samuel E. Almodovar-Regteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Chadwick L. Wright, MD, PhD, Lewis Center, OH (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the mechanism of uptake of the PET radiotracer fluciclovine and identify its normal biodistribution. 2) Identify the FDA approved clinical indication of fluciclovine and discuss the clinical interpretive criteria for fluciclovine PET. 3) Understand what somatostatin receptor PET is, and the normal biodistribution and physiologic variants. 4) Learn how to interpret somatostatin receptor PET imaging studies and when to appropriately use it.

ABSTRACT

In 2016, the U.S. Food and Drug Administration approved two new PET radiotracers for oncologic indications. The first new PET radiotracer is Fluoride-18 labeled fluciclovine (Axumin®) for men with suspected prostate cancer recurrence based on elevated prostate specific antigen (PSA) levels following prior treatment. The second new PET radiotracer is Gallium-68 labeled DOTATATE (NETSPOT®) for localization of somatostatin receptor positive neuroendocrine tumors. Our session will provide and highlight several examples of both fluciclovine and somatostatin receptor-positive PET imaging.

Sub-Events

MSCC33A Fluciclovine in Prostate Cancer

Participants

David M. Schuster, MD, Decatur, GA (*Presenter*) Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, Blue Earth Diagnostics Ltd; Consultant, WellPoint, Inc; Speaker, Siemens AG; ;

LEARNING OBJECTIVES

1) Describe the mechanism of uptake of the PET radiotracer fluciclovine. 2) Identify normal biodistribution of fluciclovine. 3) Identify the FDA approved clinical indication of fluciclovine. 4) Discuss clinical interpretive criteria of fluciclovine PET.

MSCC33B Somatostatin Receptor PET/CT

Participants

Thomas A. Hope, MD, San Francisco, CA (*Presenter*) Research Support, GE Healthcare

For information about this presentation, contact:

thomas.hope@ucsf.edu

LEARNING OBJECTIVES

1) Review the normal biodistribution of somatostatin receptor PET agents, examples of pathologic uptake as well as benign causes of uptake. 2) Review the role of conventional imaging in conjunction with somatostatin receptor PET as well as the various indications for use of the imaging agent.

MSES33

Essentials of Pediatric Imaging

Tuesday, Nov. 28 1:30PM - 3:00PM Room: S100AB

PD

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

Sub-Events

MSES33A Vascular Anomalies

Participants

C. Matthew Hawkins, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

hawkcm@gmail.com

LEARNING OBJECTIVES

1) Understand and use contemporary nomenclature for vascular anomalies. 2) Identify and classify vascular malformations as high-flow or low-flow. 3) Utilize a multi-disciplinary approach to diagnosis and treatment of vascular anomalies.

MSES33B CT of Atypical Pediatric Chest Infections

Participants

Daniel J. Podberesky, MD, Orlando, FL (*Presenter*) Author with royalties, Reed Elsevier; Speakers Bureau, Toshiba Medical Systems Corporation; Travel support, General Electric Company; Travel support, Koninklijke Philips NV; Travel support, Siemens AG; Consultant, Guerbet SA

For information about this presentation, contact:

daniel.podberesky@nemours.org

LEARNING OBJECTIVES

1) To review the CT imaging appearance of atypical pediatric pulmonary, chest wall, and mediastinal infections and their complications. 2) To review the CT imaging appearance of commonly encountered atypical chest infections in pediatric bone marrow transplant patients.

MSES33C Cervical Spine and Craniocervical Junction Injuries in Children

Participants

Luke L. Linscott, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand normal development and appearance of the cervical spine and craniocervical junction in the developing child. 2) Identify major differences between common cervical spine and craniocervical junction injuries in children versus adults. 3) Understand pearls and pitfalls of atlanto-occipital dislocation in the developing child.

MSES33D A Practical Approach to Imaging Vascular Rings

Participants

Alan E. Schlesinger, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

alanschlesinger@mac.com

LEARNING OBJECTIVES

1) Have a clearer understanding of the embryologic basis of the development of the normal left aortic arch, common normal variants of arch development, and common arch anomalies. 2) In addition, a practical approach to diagnosing aortic arch anomalies based on plain radiographic findings as well as the appearance on CT and MR will be stressed.

MSQI33

Quality Improvement Symposium: Organizational Learning in Radiology

Tuesday, Nov. 28 1:30PM - 3:00PM Room: S406B

PR

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

Participants

David B. Larson, MD, MBA, Stanford, CA (*Moderator*) Grant, Siemens AG; Grant, Koninklijke Philips NV

Sub-Events

MSQI33A The Learning Radiology Organization

Participants

David B. Larson, MD, MBA, Stanford, CA (*Presenter*) Grant, Siemens AG; Grant, Koninklijke Philips NV

Honored Educators

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MSQI33B Peer Learning: Positioning Peer Review to Foster Continuous Learning

Participants

Lane F. Donnelly, MD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review the important categories of change needed to switch from peer review to peer learning and improvement. 2) Sequestering learning and improvement activities from monitoring for deficient performance. 3) Method of case identification: moving from random sampling of cases to active inclusion of identified learning opportunities. 4) Replacing numerical scoring of errors with qualitative descriptions of learning opportunities. 5) Organizing the peer learning program. 6) Providing confidential, constructive feedback to individuals. 7) Conducting effective learning conferences. 8) Linking the peer learning program to process improvement. 9) Meeting requirements for Ongoing Professional Practice Evaluation (OPPE) and Focused Professional Practice Evaluation (FPPE).

ABSTRACT

To review the important categories of change needed to switch from peer review to peer learning and improvement: 1) sequestering learning and improvement activities from monitoring for deficient performance, 2) method of case identification: moving from random sampling of cases to active inclusion of identified learning opportunities, 3) replacing numerical scoring of errors with qualitative descriptions of learning opportunities, 4) organizing the peer learning program, 5) providing confidential, constructive feedback to individuals, 6) conducting effective learning conferences, 7) linking the peer learning program to process improvement, and 8) meeting requirements for Ongoing Professional Practice Evaluation (OPPE) and Focused Professional Practice Evaluation (FPPE).

MSQI33C Imaging Improvement: Aiming at Patient Outcomes

Participants

Olga R. Brook, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

obrook@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To demonstrate ways that may help to improve patient outcomes through imaging. 2) Focus on the imaging findings that will impact patient outcomes, rather on incidental findings which are unlikely to cause future morbidity and mortality is the important first step. 3) Evaluation of incidental findings causes significant patient anxiety, increases health care costs and may cause potential morbidity and mortality from procedures to diagnose potentially benign findings. 4) For certain findings, such as renal cysts, IPMNs, adrenal adenomas we already have sufficient evidence that follow up should be limited or not needed, while for others we still need to gather evidence. 5) Standardization of radiology practice whether it involves use of structured reporting, pre-procedure / post procedure checklists or standard but tailored imaging protocols has a potential to vastly improve patient outcomes. 6) Identifying best practices and adhering to them will go a long way to improve patient outcomes. 7) Focus on improving patient satisfaction with radiology services has a potential to improve actual patient outcomes as well; if we make imaging test convenient and pleasant as possible, we increase chances of the patient coming back for required follow-up or intervention.

MSRO37

Boost: Lung - The Confluence of Diagnostic Radiology and Radiation Oncology in Lung Cancer (An Interactive Session)

Tuesday, Nov. 28 1:30PM - 2:30PM Room: S103CD

CH **OI** **RO**

AMA PRA Category 1 Credit™: 1.00

ARRT Category A+ Credit: 1.00

Participants

Simon S. Lo, MD, Seattle, WA (*Moderator*) Research support, Elekta AB ;

For information about this presentation, contact:

simonslo@uw.edu

LEARNING OBJECTIVES

1) To describe the appropriate radiological evaluation of lung cancer for staging. 2) To describe the utilization of diagnostic/functional imaging for target delineation and functional avoidance. 3) To describe treatment response evaluation after chest radiotherapy.

Sub-Events

MSRO37A Pre-treatment Radiological Evaluation of Lung Cancer

Participants

Michelle S. Ginsberg, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ginsberm@mskcc.org

LEARNING OBJECTIVES

**View learning objectives in main course title.

MSRO37B Utilization of Diagnostic/Functional Imaging for Target Delineation and Functional Avoidance

Participants

Feng-Ming Kong, MD, PhD, Augusta, GA (*Presenter*) Research Grant, Varian Medical Systems, Inc Speaker, Varian Medical System, Inc Travel support, Varian Medical System, Inc

LEARNING OBJECTIVES

**View learning objectives in main course title.

MSRO37C Imaging Evaluation of Treatment Response after Radiation Therapy for Lung Cancer

Participants

David Palma, MD, FRCPC, London, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

**View learning objectives in main course title

PS30

Tuesday Afternoon Plenary Session

Tuesday, Nov. 28 1:30PM - 2:45PM Room: Arie Crown Theater

HP

AMA PRA Category 1 Credits TM: 1.25
ARRT Category A+ Credit: .75

Participants

Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

Honored Educators

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Sub-Events

PS30A Presentation of the Gold Medal of the Radiological Society of North America

Participants

George S. Bisset III, MD, Houston, TX (*Recipient*) Nothing to Disclose
J. William Charboneau, MD, Rochester, MN (*Recipient*) Nothing to Disclose
Roderic I. Pettigrew, PhD, MD, Bethesda, MD (*Recipient*) Nothing to Disclose

PS30B Dedication of the Annual Oration in Diagnostic Radiology to the Memory of Morton A. Bosniak, MD (1929-2016)

PS30C Annual Oration in Diagnostic Radiology: Strategies for Radiology to Thrive in the Value Era

Participants

Jonathan B. Kruskal, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose
David H. Kim, MD, Middleton, WI (*Presenter*) Co-founder, VirtuoCTC, LLC; Shareholder, Celectar Biosciences, Inc; Shareholder, Elucient Medical;

Despite several years of focus on improving value for patients through our services, radiologists continue to struggle with defining the value of imaging for external stakeholders. We have struggled to irrefutably demonstrate our value to patients, and we have failed to translate this value to broadly accepted metrics. Consequently, despite agreement on the importance of the word "value", defining the term in the context of medical imaging and finding metrics with relevance to both the patient and the radiologist still proves to be an elusive goal. Specialties with direct patient contact can effectively demonstrate how their services improve patient outcomes. Yet the continued lack of robust evidence or even a conceptual framework for describing this essential link in medical imaging is troubling. The hype around the value paradigm is ever-present and dedicated volunteers work diligently to improve our specialty's position within this paradigm. However, the impact of the value transformation for radiology has so far been a Sisyphean labor; newer and fancier metrics, more elaborate dashboards, more patient-centric activities yet ever-declining reimbursements and still little objective evidence or acceptance that these efforts truly improve human health. The addition of these new activities to the painstaking work that is required nearly every minute spent in front of an imaging workstation is being felt acutely in our reading rooms as practice leaders strive to relieve burnout on the faster-spinning hamster wheels. External forces are also on the rise, with premonitions of the extinction of human radiologists by the potentially disruptive innovations in machine learning. The disconnect between regulatory requirements, disruptive innovations, and what is humanly possible in a day's work raises stark questions. Have we become the Eastman Kodak of the digital imaging world? Are we polishing our taxis while Uber drives past us? To effectively respond to these challenges, the divide between volunteers who understand the policy, payment, and regulatory world driving healthcare reform and radiologists who still contribute tirelessly to patient care needs to be bridged. It is time for a thorough root cause analysis of why this increasing clinical and volunteer work is not easing our core mission: the interpretation of images. This is the essential first step to define a roadmap to get radiologists back to functioning as respected and essential physicians by providing the evidence-based, outcomes-focused, appropriate, and effective clinical care that each patient deserves. To thrive in the world that only rewards value contributions, we need to reassess and reorganize our roles in effectively managing health imaging information and become realistic about how we currently measure and manage our performance in healthcare delivery.

Honored Educators

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VSIO31

Interventional Oncology Series: Liver Mets and Immuno-Oncology

Tuesday, Nov. 28 1:30PM - 6:00PM Room: S405AB

GI IR

ARRT Category A+ Credits: 5.00
AMA PRA Category 1 Credits™: 4.25

FDA Discussions may include off-label uses.

Participants

Sarah B. White, MD,MS, Philadelphia, PA (*Moderator*) Research support, Guerbet SA; Research support, Siemens AG; Consultant, Guerbet SA; Consultant, IO Rad; Consultant, Cook Group Incorporated
Constantinos T. Sofocleous, MD, PhD, New York, NY (*Moderator*) Consultant, General Electric Company; Consultant, Johnson & Johnson;

Sub-Events

VSIO31-01 When to Ablate: NO - Ablation Only When Surgery is Not Indicated

Tuesday, Nov. 28 1:30PM - 1:45PM Room: S405AB

Participants

Michael D'Angelica, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

the learner will have obtained sufficient knowledge to make clinical decisions about patients with metastatic colorectal cancer to the liver who are potential candidates for surgery and ablation.

VSIO31-02 When to Ablate: YES - Ablation Should Be Offered as First Line Therapy

Tuesday, Nov. 28 1:45PM - 2:00PM Room: S405AB

Participants

Luigi Solbiati, MD, Rozzano, Italy (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lusolbia@tin.it

LEARNING OBJECTIVES

1) To review currently available data about the efficacy of ablation as first line therapy for small hepatic colorectal metastases . 2) To assess proper indications for ablation as local treatment of hepatic colorectal metastases. 3) To safely and precisely perform image-guided ablation, assessing preliminary risks and limitations.

VSIO31-03 Semi-automated 3D Ablation Margin Assessment: Retrospective Evaluation in Patients with Radiofrequency Ablation of Colorectal Liver Metastases

Tuesday, Nov. 28 2:00PM - 2:10PM Room: S405AB

Participants

Elena Kaye, PhD, New York, NY (*Presenter*) Consultant, Galil Medical Ltd
Francois Cornelis, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Waleed M. Shady, MBCh, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elena N. Petre, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Weiji Shi, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Zhigang Zhang, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Stephen B. Solomon, MD, New York, NY (*Abstract Co-Author*) Research Grant, General Electric Company
Constantinos T. Sofocleous, MD, PhD, New York, NY (*Abstract Co-Author*) Consultant, General Electric Company; Consultant, Johnson & Johnson;
Jeremy C. Durack, MD, New York, NY (*Abstract Co-Author*) Scientific Advisory Board, Adient Medical Inc; Investor, Adient Medical Inc;

For information about this presentation, contact:

kayee@mskcc.org

PURPOSE

To customize an existing imaging software currently applied to radiation therapy planning for semi-automated 3D margin assessment following radiofrequency ablation (RFA) of colorectal liver metastases.

METHOD AND MATERIALS

A workflow for RFA margin assessment was devised using imaging software (MIM Software, Inc.). First, semi-automated segmentation of tumor and ablation zone contours was performed using pre- and post-RFA (4-8 weeks after) contrast-enhanced CT images and a seed-growing algorithm. For each tumor, theoretical 5 and 10 mm ablation margins were then generated. Next, tumor (pre-RFA) and ablation zone (post-RFA) volumes were aligned using 3D semi-automated rigid registration. Finally, regions of unablated tumor, and regions with a minimal margin of less than 5 mm ($\Delta 5$ mm) were automatically generated. Technical success for this customized workflow was defined by the ability to perform acceptable rigid alignment between the pre- and post-RFA images (the distance between the landmarks in pre and post images is less than 3 mm). The prognostic power of the margin measurements versus local tumor progression (LTP)-free survival was assessed using the concordance probability estimate (CPE) based on the univariate Cox proportional hazards regression model.

RESULTS

174 colorectal metastasis ablation sites (129 patients) were retrospectively analyzed. In 87% of the cases, segmentation and rigid registration were technically successful. Tumor volume, minimum margin size and $\Delta 5$ mm margin volume were predictive of LTP with CPEs of 0.570, 0.680 and 0.698 ($p < 0.0001$), respectively. Prognostic power of minimum ablation margin size measured by the proposed technique was comparable to previous reports for patients with hepatocellular carcinoma performed with a different 3D margin assessment prototype. Both margin size and $\Delta 5$ mm margin volume were more predictive of LTP than the volume of the ablated tumors (both $p < 0.0001$).

CONCLUSION

Semi-automated 3D ablation margin assessment can be performed by adapting imaging software platforms already developed for radiation therapy planning. Further software customization can be performed to optimize the technique for intraprocedural ablation margin assessment.

CLINICAL RELEVANCE/APPLICATION

Harnessing software tools currently applied to radiation therapy planning to assess ablation margins helps predict LTP and could substantially improve ablation efficacy if applied at the time of procedure.

VSIO31-04 Y90 with First Line Chemo? What We Learned from SIFLOX

Tuesday, Nov. 28 2:10PM - 2:25PM Room: S405AB

Participants

James Thomas, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

VSIO31-05 Y-90 Radioembolization Combined with Drug-Eluting Irinotecan Bead Chemoembolization in Rabbit VX2 Liver Tumor Model

Tuesday, Nov. 28 2:25PM - 2:35PM Room: S405AB

Participants

Andrew C. Larson, PhD, Chicago, IL (*Presenter*) Co-founder, IORAD LLC; Research Grant, Biocompatibles International plc; Research Grant, Guerbet SA; Spouse, Employee, C. R. Bard, Inc

Andrew C. Gordon, MD, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Sarah B. White, MD, MS, Philadelphia, PA (*Abstract Co-Author*) Research support, Guerbet SA; Research support, Siemens AG; Consultant, Guerbet SA; Consultant, IO Rad; Consultant, Cook Group Incorporated

Matthew R. Dreher, PhD, West Conshohocken, PA (*Abstract Co-Author*) Technical Director, Biocompatibles International plc

Robert J. Lewandowski, MD, Chicago, IL (*Abstract Co-Author*) Consultant, BTG International Ltd; Advisory Board, Boston Scientific Corporation; Consultant, Cook Group Incorporated; Advisory Board, ABK Medical Inc; Advisory Board, Accurate Medical

Reed A. Omary, MD, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose

Zhuoli Zhang, MD, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Vanessa L. Gates, MS, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Riad Salem, MD, MBA, Chicago, IL (*Abstract Co-Author*) Research Consultant, BTG International Ltd Research Grant, BTG International Ltd

For information about this presentation, contact:

a-larson@northwestern.edu

PURPOSE

The purpose of this study was to test the safety and efficacy of combining Y-90 radioembolization with concurrent irinotecan drug-eluting bead (DEBIRI) chemoembolization in the rabbit VX2 liver tumor model.

METHOD AND MATERIALS

All studies received IACUC approval. A dose escalation study was used to determine the Y-90 TheraSphere dose necessary to induce a partial response while avoiding complete responses at 2-weeks; we compared doses ranging from 0.28 to 2.55 mCi. The therapeutic study involved 28 rabbits in 4 treatment groups: control (n=8); Y-90 (n=7); DEBIRI (n=6); and Y-90 + DEBIRI (n=7). Rabbits were followed for 2 weeks to compare serologic liver function as an indicator of safety and contrast-enhanced MRI was performed to assess response. Both total tumor volumes (primary outcome) and enhancing tumor volumes (secondary outcome) were measured before and after therapy. Outcomes were compared using one-way ANOVA.

RESULTS

Dose escalation study demonstrated that Y-90 could be performed safely in rabbits with multiple VX2 tumors with survival up to 2 weeks. While rabbits tolerated all Y-90 doses, the higher doses were better suited for combination therapy studies (i.e., limited response at lower Y-90 dose). Liver transaminases were elevated days 1-7 post-treatment with Y-90, DEBIRI, and Y-90+DEBIRI compared to control; however, all serologic tests returned to normal on day 14. There were no significant differences between serologic liver function tests in DEBIRI and Y-90+DEBIRI treatment groups ($p > 0.05$). Significant differences in imaging response were seen at 2 weeks. According to tumor volume measurements, Y-90+DEBIRI was the only treatment to show favorable responses compared to control ($p = 0.012$). According to changes in tumor volume, both DEBIRI+Y-90 and Y-90 groups showed favorable responses compared to controls ($p = 0.002$ and $p = 0.019$, respectively).

CONCLUSION

All treatment groups elevated some liver function tests post-treatment in rabbits but these return to normal within 2 weeks. Y-90+DEBIRI demonstrated a favorable imaging response suggesting that a combined treatment approach may yield improved efficacy in patients who are candidates for liver-directed therapy.

CLINICAL RELEVANCE/APPLICATION

Y-90 radioembolization combined with concurrent irinotecan drug-eluting bead chemoembolization may yield improved outcomes in patients who are candidates for liver-directed therapy.

VSIO31-06 Y90 in Earlier Lines: Best Clinical Care

Tuesday, Nov. 28 2:35PM - 2:50PM Room: S405AB

Participants

Michael C. Soulen, MD, Philadelphia, PA (*Presenter*) Royalties, Cambridge University Press; Consultant, Guerbet SA; Research support, Guerbet SA; Research support, BTG International Ltd; Consultant, Merit Medical Systems, Inc; Speaker, Sirtex Medical Ltd; Consultant, Terumo Corporation; Consultant, Bayer AG

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To integrate Y90 TARE with systemic chemotherapy regimens for common liver metastases. 2) To hold or dose-adjust systemic medications when providing concurrent TARE. 3) To review available data on synergistic benefits of integrated TARE with systemic drug therapy.

VSIO31-07 Y90 at Earlier Lines: Only in Trial

Tuesday, Nov. 28 2:50PM - 3:05PM Room: S405AB

Participants

James Thomas, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

VSIO31-08 Role of PVE: Would It Make Sense to Combine with IAT Prior to Resection?

Tuesday, Nov. 28 3:05PM - 3:20PM Room: S405AB

Participants

David C. Madoff, MD, New York, NY (*Presenter*) Advisory Board, Renovorx

VSIO31-09 Surgery and IAT (Y90 vs DEBIRI vs IA Chemo): Is IAT Helpful before Surgery?

Tuesday, Nov. 28 3:20PM - 3:35PM Room: S405AB

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

VSIO31-10 Biomarkers Impacting Outcomes in Interventional Oncology for Colorectal Liver Metastasis

Tuesday, Nov. 28 3:50PM - 4:05PM Room: S405AB

Participants

Hyun S. Kim, MD, New Haven, CT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Importance of biomarkers in Interventional Oncology. 2) Importance of biomarkers in treatments of metastatic colorectal cancer. 3) Published biomarkers for mCRC and Interventional Oncology.

VSIO31-11 3D Quantitative Tumor Burden Analysis in Patients with Neuroendocrine Tumor Liver Metastases before Intra-Arterial Therapy

Tuesday, Nov. 28 4:05PM - 4:15PM Room: S405AB

Participants

Milena A. Miszczuk, New Haven, CT (*Presenter*) Nothing to Disclose
Johanna M. van Breugel, MSc, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Vinayak Thakur, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Fabian Laage-Gaupp, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Duc Do Minh, BSc, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Susanne Smolka, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Sonia P. Sahu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Irvin Rexha, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Bruno R. Tegel, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Ming De Lin, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, 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 assess the ability of 3D tumor analysis on baseline MRI to predict overall survival (OS) in patients with neuroendocrine tumor (NET) metastases to the liver before intra-arterial therapy.

METHOD AND MATERIALS

This retrospective study included 122 patients with neuroendocrine tumor liver metastases. Primary tumors were originated in bowel (n=48), pancreas (n=38), stomach (n=4), other organs (n=8) or were of unknown origin (n=24). Patients received treatment with conventional TACE (n=74), DEB-TACE (n=20) or 90Yttrium-radioembolization (n=28) between 2000 and 2014. Up to 3 largest lesions were chosen and their tumor diameter (1D) and area (2D) were measured. A 3D analysis on baseline MRI was performed to establish the total liver volume (TLV [cm³]), enhancing tumor volume (ETV [cm³]) and enhancing tumor burden (ETB [%], defined as ratio between ETV and TLV). The longest tumor diameters were measured. Patients were stratified into groups with low and high tumor burden by calculating the receiver operating characteristic curve. Statistical analysis included Kaplan-Meier survival curves and uni- and multivariate Cox proportional hazard ratios (HR).

RESULTS

Good separation of the survival curves was achieved for the 1D, 2D approach and ETB (all p<0.05). For 1D and 2D measurements, the MOS was 2.7 and 2.6 times higher in the low burden group for the tumor diameter and area, respectively (both p<0.001). MOS for ETB was 2.2 times longer in the low burden group (40.2 vs. 18.1 months for the low and high burden group, respectively, p=0.008). Multivariate analysis showed an HR of 0.38 (95%CI 0.24-0.60, p<0.001) and 0.41 (95%CI 0.27-0.65, p<0.001) for the tumor diameter and tumor area, respectively. This resulted in a 62 % and 59 % lower mortality in the low, compared with the high tumor burden groups. As for the ETB, HR represented 0.48 (95%CI 0.30-0.78, p=0.003) i.e. mortality rate for patients with low ETB was 52 % lower than those with high ETB.

CONCLUSION

1D measurements and assessing ETB before intervention will allow for identification of responders to intra-arterial therapy. Consequently, a better stratification of patients and planning of the therapy can be achieved.

CLINICAL RELEVANCE/APPLICATION

In patients with neuroendocrine tumor metastases, assessment of enhancing tumor burden and 1D and 2D measurements can predict patients' survival, allowing for decision if an intra-arterial therapy will be beneficent.

VSIO31-12 Imaging Biomarker and IO in CLM

Tuesday, Nov. 28 4:15PM - 4:30PM Room: S405AB

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

VSIO31-13 Pretreatment Prognostic Factors of Transarterial Hepatic Chemoperfusion in Patients with Uveal Melanoma Liver Metastases

Tuesday, Nov. 28 4:30PM - 4:40PM Room: S405AB

Participants

Johannes M. Ludwig, MD, Essen, Germany (*Presenter*) Nothing to Disclose
Ophelia 4. Drescher, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Till A. Heusner, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Johannes Haubold, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Sebastian Bauer, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Jens M. Theysohn, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess pretreatment prognostic factors of patients with hepatic uveal melanoma metastases undergoing sequential transarterial hepatic chemoperfusion (THC).

METHOD AND MATERIALS

56 patients (48% male) with a median age of 63.5 yrs (range: 25-82) underwent a median of 4 (95%CI: 3.7-5.5) THC sessions. Mainly melphalan but also fotemustine, alkeran, dacarbazine, mitomycin, doxorubicin, or gemcitabine were used alone or in combination. Assessed pretreatment factors were measured within 1 week prior to first THC. Kaplan-Meier for survival (OS; 95%CI) and time to hepatic progression (TTP; 95%CI) (RECIST) as well as Cox proportional hazards model for uni- (UVA) & multivariate (MVA) hazard ratio (HR; 95%CI) analyses were performed.

RESULTS

Median OS of study cohort was 9.4 (5.5-13.3) months. Pretreatment lactate dehydrogenase (LDH) serum value was the strongest predictor of median OS with 19.8 (16-24.3) for normal (≤ 280 U/L), 9.7 (5.8-12.7) for intermediate (>280 - <1000 U/L) and 3.84 (1.5-4.3) months for high (≥ 1000 U/L) serum LDH values, p<0.0001. LDH also significantly predicts median TTP (cohort: 2.5; 1-5) with 8; 1-14, 4; 2-6 and 1; 1-1 months for normal to high LDH respectively, p<0.0001. UVA revealed intermediate (16.5; 5.2-73.6, p<0.0001) and high (77.3; 21.9-376, p<0.0001) serum LDH values, bilirubin $>$ the upper limit of normal (ULN) (2.89; 1.2-6.1, p=.036), alkaline phosphatase (ALP) >1.5 ULN (6.8; 3.5-13.8, p<0.0001), leukocytes $>ULN$ (4.2; 1.7-9.2, p=.0037), gamma-glutamyl transferase (GGT) $>ULN$ (7; 3.6-13.6), extrahepatic metastases (1.80; 1-3.1, p=.036) and size of largest liver lesion ≥ 5 cm (3.6; 2.0-6.8, p<0.0001) as predictors for worse survival. MVA confirmed intermediate (5; 1.3-25, p=.02) and high (27.1; 5.6-163, p<0.0001) LDH, bilirubin (5.7; 1.7-18.2, p=.006), GGT (2.9-1.2-7.2, p=.021) and the size of the largest liver lesion (3.7; 1.6-8.5, p=.0017) as independent predictors for worse survival.

CONCLUSION

Elevated serum levels of LDH, bilirubin, GGT as well as the size of largest liver lesion, as assessed prior to first chemoperfusion, are important determinants of survival potentially allowing for identification of patients with uveal melanoma liver metastases benefiting from transarterial hepatic chemoperfusion.

CLINICAL RELEVANCE/APPLICATION

The knowledge on relevant pretreatment prognostic factors of patients with uveal melanoma liver metastases treated with transarterial hepatic chemoperfusion may improve appropriate patient selection.

VSIO31-14 Systemic Treatments Including Check Point Inhibitors/Immunoscore vs TNM Staging

Tuesday, Nov. 28 4:40PM - 4:55PM Room: S405AB

Participants

Nikhil Joshi, PhD, New Haven, CT (*Presenter*) Nothing to Disclose

Active Handout: Nikhil Joshi

<http://abstract.rsna.org/uploads/2017/17001050/Table of Approved-Immune-Checkpoint-Inhibitors.pdf>

LEARNING OBJECTIVES

1) Describe the basic mechanistic principles underlying the success of immunotherapy. 2) Review current clinical results from immune checkpoint inhibitor trials. 3) Describe the challenges to improving efficacy of immunotherapy.

VSIO31-15 Dual Role of Hepatic Stellate Cells in Hepatocellular Carcinoma Growth and Arrest Purpose

Tuesday, Nov. 28 4:55PM - 5:05PM Room: S405AB

Participants

Xin Li, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Gordon McLennan, MD, Chagrin Falls, OH (*Presenter*) Research Grant, Siemens AG; Research Consultant, Medtronic plc; Advisory Board, Siemens AG; Advisory Board, Surefire Medical, Inc; Advisory Board, Stealth Medical; Advisory Board, Rene Medical; Data Safety Monitoring Board, B. Braun Melsungen AG

Dola Das, PhD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of the project is to elucidate the role of hepatic stellate cell (HSC) in tumor cell proliferation and invasion. HSC contributes to 90% of liver fibroblasts and is an important cell type of tumor microenvironment (TME). We aim to better understand the role of HSC in carcinogenesis. This will greatly enhance our understanding of the cross talk between HSC and tumorigenic cells, as well as future HCC therapy development.

METHOD AND MATERIALS

Human HSC LX2 was cultured and serum-deprived for 24 hours. LX2 conditioned media (CM) was collected. Rat HCC cell lines Morris and N1S1 were cultured, and treated accordingly with doxorubicin, LX2 CM, CuSO₄, TGF- β , and SB-43. Cell invasion assay utilized Cultrex® 24 well BME assay (N=3 for Morris, N=3 for N1S1), while cell proliferation assay was performed with CellTiter 96® assay (N=6 for Morris, N=8 for N1S1). Data collected with spectrofluorometer and spectrophotometer respectively.

RESULTS

Cell proliferation assay demonstrated a cytotoxic effect of LX2 CM on both Morris and N1S1 cells. LX2 CM showed an additive cytotoxic effect in combination with doxorubicin. In addition, cell invasion assay revealed an increased invasiveness in Morris and N1S1 cells treated with LX2 CM. LX2 CM in combination of a known TGF- β inhibitor, SB-43, showed increased invasiveness in Morris cell.

CONCLUSION

Our work has confirmed the previously known positive effect of cancer associated fibroblasts on solid tumor cell invasion. We further demonstrate that LX2 CM mediated cell invasion is independent of TGF- β . In addition, both Morris and N1S1 cell data has demonstrated a novel cytotoxic effect of LX2 CM not previously documented. Our previous work has demonstrated a predominant presence of HSC in TME. Since HSC exists either in a quiescent state or an activated myofibroblast state, our hypothesis is that the paradoxical findings may correlate with the state of HSC activation and function. Further research is required to understand the molecular mechanism involved in LX2 CM mediated tumor cytotoxicity and invasion.

CLINICAL RELEVANCE/APPLICATION

To better understand the cross talk between HSC and HCC in search for future molecular target therapy.

VSIO31-16 Current Clinical Trials in Immuno-oncology: An Overview Relevant for IO

Tuesday, Nov. 28 5:05PM - 5:20PM Room: S405AB

Participants

Ravi Murthy, MD, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review key Immuno-oncology Clinical trials involving Interventional Radiology. 2) Understand the principles of Image-guided delivery in Cancer Immunotherapy.

VSIO31-17 In-Vivo Evaluation of an Applicator Prototype for Interstitial Electrochemotherapy (ECT) of the Liver

Tuesday, Nov. 28 5:20PM - 5:30PM Room: S405AB

Participants

Federico Pedersoli, MD, Aachen, Germany (*Presenter*) Nothing to Disclose
Peter Isfort, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Andreas Ritter, DIPLING, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Martin Liebl, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Markus Zimmermann, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Maximilian F. Schulze-Hagen, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Ebba K. Dethlefsen, MD, MSc, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Jochen Pfeffer, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Martin Baumann, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Philipp Bruners, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Irreversible electroporation (IRE) is a non-thermal technique for local tumor ablation. Electrochemotherapy (ECT) is the combination of electroporation and local chemotherapy. This technique exploits the transitory increased permeability which occurs in the peripheral area of electroporated tissues to facilitate the intracellular uptake of chemotherapeutic agent in order to enlarge the ablation volume. So far ECT is only used to treat superficial tumors of skin and subcutaneous tissue. Aim of our study was to evaluate the feasibility of interstitial ECT using a newly developed, needle-shaped applicator prototype that features four expandable electrodes which allow an interstitial injection of chemotherapy as well as application of high voltage electric pulses. Goal is to establish ECT of tumors located in deep visceral organs such as the liver.

METHOD AND MATERIALS

After approval by the animal care authorities, experiments were conducted in nine domestic pigs under general anesthesia. The applicator prototype was placed in the right and left liver lobe under CT-guidance. In one lobe, the applicator was used for conventional IRE using standard settings (1500 V, 120 pulses, pulse length 100 µsec). In the respective other lobe, the same IRE procedure was performed, but followed by the injection of a doxorubicin mixture (50 mg Doxorubicin, 5 ml NaCl 0,9%, 1 ml 370 mg Iod/mL contrast medium) through the expandable electrodes (ECT). Location of ECT vs. IRE in left or right lobe was randomized. Contrast-enhanced CT and MRI studies were performed to evaluate ablation volumes with a maximum follow-up of one week. Histological analysis is currently undergoing.

RESULTS

Technical success was obtained in 9 out of 9 swines. Follow-up CT one day after intervention showed a significant ($p < 0,05$) difference in the ablation volumes of ECT vs. IRE (4.47 ± 1.78 ml vs. 2.51 ± 0.93 ml). This difference remained unchanged during follow-up and was confirmed by MRI.

CONCLUSION

ECT is associated with significantly larger ablation volumes compared to regular IRE without injection of chemotherapy. Further investigations are needed to evaluate its efficacy in a tumor model.

CLINICAL RELEVANCE/APPLICATION

Our current study demonstrates the utility of a novel applicator prototype for ECT of the liver. Ablations are larger when IRE is combined with local injection of chemotherapeutic agents (i.e. ECT).

VSIO31-18 Imaging the Immune System

Tuesday, Nov. 28 5:30PM - 5:45PM Room: S405AB

Participants

Omer Aras, MD, New York, NY (*Presenter*) Consultant, Kamrusepa Nuclear Products

LEARNING OBJECTIVES

1) To present a variety of different labeling techniques for visualization of "Immune cells" and also describe tumor model systems applicable for tracking functionally of these cells. 2) To emphasize on bench-to-bedside translation and discuss the advantages and disadvantages of different imaging methods.

VSIO31-19 Abscopal vs Tumorigenic Effects

Tuesday, Nov. 28 5:45PM - 6:00PM Room: S405AB

Participants

David A. Woodrum, MD, PhD, Rochester, MN (*Presenter*) Consultant, Galil Medical Ltd; Consultant, Clinical Laserthermia Systems AB

LEARNING OBJECTIVES

1) Define Abscopal Effect. 2) Define Tumorigenic Effect. 3) Identify why this is important to Radiology/Interventional Radiology as a whole. 4) Examine in brief some of the molecular mechanisms behind both effects and determine potential relevance to Radiology.

RCA34

Introduction to Machine Learning and Texture Analysis for Lesion Characterization (Hands-on)

Tuesday, Nov. 28 2:30PM - 4:00PM Room: S401AB

IN

AMA PRA Category 1 Credits TM: 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

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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.

ABSTRACT

During this course, an introduction to machine learning and image texture analysis will be provided through hands on examples. Participants will use 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.

RCB34

RSNA Diagnosis Live Interactive and Mobile Device Integrated Audience Response: Tips, Tricks, and How to Get Started (Hands-on)

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

ED **IN**

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 0

Participants

Christopher G. Roth, MD,MS, Philadelphia, PA (*Moderator*) Nothing to Disclose

Christopher G. Roth, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

Sandeep P. Deshmukh, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1. Appreciate the higher receptiveness of interactive content by learners compared with traditional didactic techniques.
2. Understand the basic operational features of the Diagnosis Live audience participation interactive tool.
3. Learn how to manage the Diagnosis Live administrator portal and launch and run interactive games.

RCC34

3D Printing Clinical II

Tuesday, Nov. 28 2:30PM - 4:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits TM: 1.50
ARRT Category A+ Credit: .75

FDA

Discussions may include off-label uses.

Sub-Events

RCC34A Introduction to 3D Printing

Participants

Dimitris Mitsouras, PhD, Boston, MA (*Presenter*) Research Grant, Toshiba Medical Systems Corporation;

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RCC34B 3D Printing in Orthopedics

Participants

Adnan M. Sheikh, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Become familiar with the role of imaging in 3D printing in orthopedics. 2) Learn how this new technology helps in the planning and treatment of complex orthopedic pathologies. 3) Know the future directions of 3D printing for orthopedics.

RCC34C 3D Printing in Prosthetics

Participants

Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how digital technology and 3D printing can be used for the creation of custom prosthetic components. 2) Make informed decisions on appropriate 3D printing materials. 3) Understand differences between military and civilian amputee populations. 4) Utilize computed tomography in the prosthetic component design process. 5) Give examples of assistive technology devices.

RCC34D 3D Printing in Taiwan

Participants

Yiwen Chen, PhD, Taichung City, Taiwan (*Presenter*) Nothing to Disclose

MSRO34

BOOST: Genitourinary—Case-based Review (An Interactive Session)

Tuesday, Nov. 28 3:00PM - 4:15PM Room: S103AB

GU **OI** **RO**

AMA PRA Category 1 Credits TM: 1.25

ARRT Category A+ Credits: 1.50

Participants

Matthew S. Davenport, MD, Cincinnati, OH (*Presenter*) Royalties, Wolters Kluwer nv; ;

Arvin K. George, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

Daniel A. Hamstra, MD, PhD, Dearborn, MI (*Presenter*) Advisory Board, Myriad Genetics, Inc; Consultant, Augmenix, Inc

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LEARNING OBJECTIVES

1) Understand typical imaging findings of prostate cancer on mpMRI. 2) Learn the positive predictive value of various PI-RADS v.2 scores. 3) Recognize the imaging findings of post-treatment prostate cancer recurrence.

MSRO38

BOOST: Lung-Case-based Review (An Interactive Session)

Tuesday, Nov. 28 3:00PM - 4:15PM Room: S103CD

CH **OI** **RO**

AMA PRA Category 1 Credits TM: 1.25
ARRT Category A+ Credits: 1.50

Participants

Simon S. Lo, MD, Seattle, WA (*Moderator*) Research support, Elekta AB ;
Philip A. Linden, Cleveland, OH (*Presenter*) Nothing to Disclose
Subba R. Digumarthy, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jyoti D. Patel, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Feng-Ming Kong, MD, PhD, Augusta, GA (*Presenter*) Research Grant, Varian Medical Systems, Inc Speaker, Varian Medical System, Inc Travel support, Varian Medical System, Inc
Alexander Louie, MD, FRCPC, London, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discuss the appropriate management of non-small cell lung cancer. 2) Discuss the appropriate management of small cell lung cancer.

ABSTRACT

Modern management of lung cancer typically involves interdisciplinary evaluation by radiologists, thoracic surgeons, medical oncologists, and radiation oncologists. This session reviews the most up-to-date multidisciplinary management of both non-small cell and small cell lung cancer through clinical cases.

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/> Subba R. Digumarthy, MD - 2013 Honored Educator

RC413

Pediatric Series: Gastrointestinal/Genitourinary

Tuesday, Nov. 28 3:00PM - 6:00PM Room: S102CD

GI GU PD

AMA PRA Category 1 Credits™: 2.75
ARRT Category A+ Credits: 3.25

FDA Discussions may include off-label uses.

Participants

Teresa Victoria, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose
C. Matthew Hawkins, MD, Atlanta, GA (*Moderator*) Nothing to Disclose
Lynn A. Fordham, MD, Chapel Hill, NC (*Moderator*) Nothing to Disclose
Susan E. Sharp, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose

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Sub-Events

RC413-01 Abdominal Wall Defects: Prenatal Imaging with Postnatal Implications

Tuesday, Nov. 28 3:00PM - 3:15PM Room: S102CD

Participants

Teresa Victoria, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review basic concepts in fetal abdominal wall defects (AWD). 2) To identify basic imaging tricks to correctly identify each AWD. 3) To review prenatal/postnatal treatments of these AWD.

RC413-02 Diagnostic Accuracy of Magnetic Resonance Imaging Hepatic Proton Density Fat Fraction in Pediatric Nonalcoholic Fatty Liver Disease

Tuesday, Nov. 28 3:15PM - 3:25PM Room: S102CD

Participants

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
Elhamy R. Heba, MBBCh, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Adina L. Alazraki, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Andrew T. Trout, MD, Cincinnati, OH (*Abstract Co-Author*) Author, Reed Elsevier; Research Grant, Siemens AG; Research Grant, Toshiba Medical Systems Corporation; Board Member, Joint Review Committee on Educational Programs in Nuclear Medicine Technology; Advisory Board, Perspectum Diagnostics Ltd
Prakash M. Masand, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Brunt, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
David Kleiner, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Edward Doo, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Mark Van Natta MHS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
James Tonascia, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Joel Lavine, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Wei Shen, MD, MPH, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Jeffrey B. Schwimmer, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Claude B. Sirlin, MD, San Diego, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Bayer AG; Research Grant, Arterys Inc; Research Grant, Koninklijke Philips NV; Consultant, Alexion Pharmaceuticals, Inc; Consultant, AstraZeneca PLC; Consultant, BioClinica, Inc; Consultant, Bristol-Myers Squibb Company; Consultant, Bracco Group; Consultant, Celgene Corporation; Consultant, FibroGen, Inc; Consultant, Galmed Pharmaceuticals Ltd; Consultant, F. Hoffmann-La Roche Ltd; Consultant, sanofi-aventis Group; Consultant, Gilead Sciences, Inc; Consultant, ICON plc; Consultant, Intercept Pharmaceuticals, Inc; Consultant, Ionis Pharmaceuticals, Inc; Consultant, Johnson & Johnson; Consultant, NuSirt Biopharma, Inc; Consultant, Perspectum Diagnostics Ltd; Consultant, Pfizer Inc; Consultant, Profil Institut für Stoffwechselforschung GmbH; Consultant, Shire plc; Consultant, Tobira Therapeutics, Inc; Consultant, Takeda Pharmaceutical Company Limited; Consultant, Virtual Scopics; ;

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PURPOSE

The purpose of this study was to assess cross-sectional and longitudinal diagnostic performance of hepatic proton density fat fraction (PDFF) to grade histologic steatosis in children with nonalcoholic fatty liver disease (NAFLD) using centrally-scored histology as the reference standard.

METHOD AND MATERIALS

We assessed the performance of magnetic resonance imaging (MRI) proton density fat fraction (PDFF) in children to stratify hepatic steatosis grade before and after treatment in the Cysteamine Bitartrate Delayed-Release for the Treatment of Nonalcoholic Fatty Liver Disease in Children (CyNCh) trial, using centrally-scored histology as reference. This study was conducted at nine clinical centers in the United States, with centrally-evaluated MRI. Participants had multi-echo 1.5T or 3T MRI on scanners from three manufacturers.

RESULTS

Of 169 enrolled children, 110 (65%) and 83 (49%) had MRI and liver biopsy at baseline and at end-of-treatment (EOT; 52-weeks), respectively. At baseline, 17% (19/110), 28% (31/110), and 55% (60/110) of liver biopsies showed grades 1, 2, and 3 histologic steatosis; corresponding PDFF (mean \pm standard deviation) values were $10.9 \pm 4.1\%$, $18.4 \pm 6.2\%$, and $25.7 \pm 9.7\%$, respectively. PDFF classified grade 1 vs. 2-3 and 1-2 vs. 3 steatosis with areas under receiving operator characteristic curves (AUROCs) of 0.87 (95% confidence interval [CI]: 0.80, 0.94) and 0.79 (0.70, 0.87), respectively. PDFF cut-offs at 90% specificity were 17.5% for grades 2-3 steatosis, and 23.3% for grade 3 steatosis. At EOT, 47% (39/83), 41% (34/83), and 12% (10/83) of biopsies showed improved, unchanged, and worsened steatosis grade, respectively, with corresponding PDFF (mean \pm standard deviation) changes of $-7.8 \pm 6.3\%$, $-1.2 \pm 7.8\%$ and $4.9 \pm 5.0\%$, respectively. PDFF change classified steatosis grade improvement and worsening with AUROCs (95% CI) of 0.76 (0.66, 0.87) and 0.83 (0.73, 0.92), respectively. PDFF change cut-off values at 90% specificity were -11.0% and +5.5% for improvement and worsening.

CONCLUSION

MRI-estimated PDFF has high diagnostic accuracy to both classify and predict histologic steatosis grade, and change in histologic steatosis grade in children with NAFLD.

CLINICAL RELEVANCE/APPLICATION

Our study results support the feasibility of using MRI-estimated PDFF in multi-center pediatric clinical trials as a biomarker of hepatic steatosis, and of change in hepatic steatosis.

RC413-03 Liver Stiffness Measurements with Supersonic Shearwave Elastography in the Preoperative Evaluation of the Liver Fibrosis for Infants with Biliary Atresia

Tuesday, Nov. 28 3:25PM - 3:35PM Room: S102CD

Participants

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PURPOSE

To investigate the value of Supersonic shear-wave elastography (SSWE) in the assessment of hepatic fibrosis in patients with biliary atresia (BA) and to analyze factors that might influence the SSWE value.

METHOD AND MATERIALS

The ethics committee approved this study, and informed parental consent was obtained. From January 2012 to January 2016, sixty-seven infants with BA who preoperatively had SSWE measurements and consequently underwent Kasai portoenterostomy were ruled in. All patients were also underwent preoperative serologic testing. Intraoperative liver specimens were reviewed in a blinded manner by two pathologists using METAVIR criteria. SSWE measurements were correlated with pathological results, age and serologic testing results. Performance of SSWE in differentiating liver fibrosis was determined by using areas under the receiver operating characteristic curve (AUCs).

RESULTS

The SSWE value of F0 (n=1), F1 (n=16), F2 (n=28), F3 (n=18), F4 (n=4) was 8.2Kpa, 11.0(8.4-12.2)Kpa, 12.6(10.1-13.9)Kpa, 16.6(14.7-24.0)Kpa, 20.3(13.4-37.2)Kpa, respectively. SSWE value were significantly correlated with γ -glutamyltranspeptidase ($P=0.010$), age ($P<0.001$) and liver fibrosis ($P<0.001$). Logistic regression analysis demonstrated that liver fibrosis ($P<0.001$) and age ($P=0.033$) were significantly associated with SSWE. The AUC for differentiating severe fibrosis or greater ($\geq F3$) was 0.896, with an optimal cutoff value of 13.2 Kpa.

CONCLUSION

Preoperative SSWE measurements for infants with BA could be used as a noninvasive tool for predicting severe fibrosis or greater ($\geq F3$). However, SSWE value might be influenced by infant's age.

CLINICAL RELEVANCE/APPLICATION

The severity of liver fibrosis at the time of surgery is predictive of the long-term success of portenterostomy. For BA infants with severe liver fibrosis, direct liver transplantation may be a better choice over portenterostomy. Thus, Preoperative SSWE measurements for infants with BA may help decide whether a Kasai surgery or a direct liver transplantation is better for infants with BA. Furthermore, the severity of liver fibrosis reflected by SSWE value may also be important in predicting the outcome of Kasai surgery.

RC413-04 The Detectability of Crohn's Disease Related Inflammatory Changes in Pediatric Population: Diffusion Weighted Non-Contrast Enhanced MR Enterography Compared with Contrast-Enhanced MR Enterography

Tuesday, Nov. 28 3:35PM - 3:45PM Room: S102CD

Participants

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PURPOSE

MR enterography (MRE) with contrast injection is the imaging modality of choice for diagnosing and monitoring Crohn's disease (CD). Since recent studies described intracranial gadolinium depositions in patients undergoing repeated contrast-enhanced MRI's, efforts have been made to reduce the use of gadolinium. Diffusion-weighted Imaging (DWI) sequence enables to detect inflammatory changes without the use of gadolinium. Our purpose is to estimate the accuracy and efficacy of DWI sequences in MRE (DWI-MRE) for assessment of CD in children.

METHOD AND MATERIALS

This study utilized 50 MRE's of children with CD performed as part of the large prospective ImageKids study in which children underwent MRE and ileocolonoscopy. MRE's were re-read, first, without the contrast injection sequences (DWI-MRE) and then including post contrast sequences (CE-MRE). Parameters evaluated in both readings included: involved segment, segment length, degree of inflammation, degree of fibrosis and severity of disease (inflammation and fibrosis). Comparisons were made between the different parameters in both readings and with Simple Endoscopic Score for Crohn's Disease (SES-CD) of the terminal Ileum (TI).

RESULTS

Comparison of DWI-MRE to CE-MRE: Affected bowel segments were identified with accuracy > 85% in the upper gastrointestinal tract, TI and colon. Accuracy was 82% in the ileum and 80% in the jejunum. Pearson correlation coefficient (PCC) for severity of disease was 0.86 in the colon and rectum, 0.81 in the jejunum, 0.77 in the ileum and 0.68 in the TI. PCC between the two readings for inflammation was 0.74 (jejunum), 0.68 (ileum), 0.7 (colon). PCC for fibrosis was highest for colon (0.68) but lower for the small intestine. PCC for segment length between the readings was 0.76 (colon), 0.61 (jejunum), 0.65 (TI). Comparison of MRE to SES-CD: PCC of 0.64 for degree of inflammation between the DWI-MRE and SES-CD and PCC of 0.52 for severity of disease between CE-MRE and SES-CD.

CONCLUSION

DWI-MRE is accurate enough for assessment of involved segments, length of segments and estimation of severity disease but less accurate for differentiating fibrotic from inflammatory lesions.

CLINICAL RELEVANCE/APPLICATION

There is an increasing concern regarding sedimentation of gadolinium in the brain after multiple examinations. DE-MRE can substitute CE-MRE in CD patients subject to multiple MRE exams.

RC413-05 Role Of Supersonic Shear Wave Elastography (SSWE) In Diagnosis Of Extrahepatic Biliary Atresia (EHBA)

Tuesday, Nov. 28 3:45PM - 3:55PM Room: S102CD

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To evaluate the role of SSWE in evaluation of infants with cholestatic jaundice.

METHOD AND MATERIALS

This was a prospective observational study which was approved by the ethics committee of our institute. Infants with biochemically proven cholestatic jaundice were evaluated using SSWE of the liver. The mean Shear Wave Speed (SWS) and mean Young's Modulus (YM) in the nine Couinaud's segments of liver and at the echogenicity anterior to the right portal vein were recorded. On the basis of histopathological findings, clinical follow up and other laboratory investigations, patients were placed in two groups: EHBA and non-EHBA. Shear wave sonographic findings were compared for these two groups. Sub group analysis was

performed for children < 90 days of age. P value <0.05 was considered significant. Receiver operating characteristic curves were drawn.

RESULTS

90 infants (58 boys, 32 girls; median age 85 days) were enrolled of which 51 were <90 days of age. There were 19 patients of EHBA of which 16 were <90 days of age. The mean SWS in the liver segments in the EHBA and Non-EHBA group were 3.43 ± 0.85 m/s and 2.81 ± 0.88 m/s respectively. The mean YM in the liver segments in the EHBA and Non-EHBA group were 39.04 ± 17.40 kPa and 26.78 ± 16.70 kPa respectively. These differences were statistically significant. Although the mean SWS and YM anterior to the right portal vein were higher in the EHBA group, the differences were not statistically significant. At a cut off mean SWS value of 2.14 m/s for the liver segments, the sensitivity to diagnose EHBA was 94.7 % and the specificity was 31.0 % while with a cut off mean SWS value of 4.43 m/s, the sensitivity to diagnose EHBA was 15.8 % and the specificity was 94.4 %. Similarly, at a cut off mean YM value of 16.31 kPa for the liver segments, the sensitivity to diagnose EHBA was 94.7% and the specificity was 40.8 % while with a cut off of mean YM value of 60.88 kPa, the sensitivity to diagnose EHBA was 15.8% and the specificity was 97.2 %. For the children <90 days of age, mean SWS and YM in liver segments and anterior to right portal vein were higher in EHBA group and the differences were statistically significant.

CONCLUSION

SSWE of liver can be used to differentiate between EHBA and other etiologies of infantile cholestatic jaundice.

CLINICAL RELEVANCE/APPLICATION

SSWE can be another tool in radiological armamentarium for segregating patients of EHBA from other causes of infantile cholestatic jaundice.

RC413-06 Segmental Correlation between Hepatic Proton Density Fat Fraction (PDFF) and R2* Using Magnitude (-M) and Complex (-C) Based MRI Techniques

Tuesday, Nov. 28 3:55PM - 4:05PM Room: S102CD

Participants

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PURPOSE

To determine segment-level correlation between hepatic PDFF and R2* using magnitude based (-M) and complex based (-C) MRI techniques.

METHOD AND MATERIALS

In this cross-sectional study, we conducted a secondary analysis of 3T MR exams performed as part of prospective research studies in children in whom conditions associated with iron overload were excluded clinically. Each exam included low-flip-angle, multi-echo magnitude and complex based chemical-shift-encoded MRI techniques with spectral modeling of fat to generate hepatic PDFF and R2* parametric maps. For each technique and each patient, regions of interest were placed on the maps in each of the nine Couinaud segments and the corresponding segmental PDFF and R2* values were recorded. For each segment and each MR technique, correlation between PDFF and R2* values was assessed using Pearson's correlation coefficient (r). Correlations were compared using Steiger's test; Bonferroni's correction was applied.

RESULTS

184 children (123 boys, 61 girls) were included in this analysis. Mean \pm STDEV values for segment-level PDFF estimated by MRI-M and MRI-C were 9.28 ± 8.97 % and 9.86 ± 8.98 %, respectively. Mean \pm STDEV values for segment-level R2* estimated by MRI-M and MRI-C were 48.23 ± 12.39 s-1 and 41.83 ± 11.45 s-1, respectively. Segment-level correlations between PDFF and R2* ranged from 0.626 to 0.843 for MRI-M and 0.516 to 0.785 for MRI-C. All segment-level correlations were significant for both techniques (p < 0.0001). For both techniques, the highest correlations were observed in segments 4b, 5, and 6 and the lowest in segments 2, 3 and 4a. The difference in correlations between MRI-M and MRI-C techniques was significant for segments 1 and 4a, and trend-wise significant for segment 6 after Bonferroni correction.

CONCLUSION

Hepatic PDFF and R2* are correlated in each Couinaud segment using two different techniques. For both techniques, the correlations were highest for segments 5, 6, 4b, 1 and 7, and lowest for segments 2, 3 and 4a. Correlation coefficients were higher for MRI-M than for MRI-C for all segments.

CLINICAL RELEVANCE/APPLICATION

Segments 4b, 5, and 6 exhibit the highest correlations between PDFF and R2*; whereas 2, 3, and 4a exhibit lower correlations than

other hepatic segments. Although further validation is needed, this may be because the proximity of left lobe segments to the lungs increases the contribution of large-scale susceptibility effects on R2* estimation.

RC413-07 Free-Breathing Pediatric Liver MRI Using a Multiecho 3D Stack-of-Radial Technique Enables Accurate and Repeatable Liver Fat Quantification

Tuesday, Nov. 28 4:05PM - 4:15PM Room: S102CD

Awards

Trainee Research Prize - Medical Student

Participants

Tess Armstrong, MS, Los Angeles, CA (*Presenter*) Research support, Siemens AG
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PURPOSE

MRI provides non-invasive liver fat quantification, but Cartesian MRI is susceptible to motion artifacts and limited to a breath-hold (BH). In children, BH may not be possible and anesthesia is undesired. In this work, we develop a new free-breathing 3D stack-of-radial pediatric liver fat quantification technique and assess accuracy and repeatability.

CONCLUSION

FB radial showed significant correlation and low mean difference compared to BH Cartesian and BH SVS. Accurate and repeatable free-breathing PDFF quantification in children is possible using a FB radial technique.

CLINICAL RELEVANCE/APPLICATION

The new FB radial technique achieves accurate and repeatable free-breathing liver fat quantification in children with NAFLD.

RC413-08 Pediatric Enteric Access

Tuesday, Nov. 28 4:15PM - 4:30PM Room: S102CD

Participants

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LEARNING OBJECTIVES

Understand the different devices that are available for percutaneous gastric and gastrojejunal access. Learn the basic technique involved in de novo gastric and gastrojejunal access. Learn the impact of post-procedural education on frequency of follow-up procedures.

LEARNING OBJECTIVES

1) Understand the different types of enteric access in children. 2) Apply appropriate patient selection when considering enteric access. 3) Understand the risks associated with different types of pediatric enteric access.

RC413-09 Urinary Tract Dilatation: Classification Opportunities and Challenges

Tuesday, Nov. 28 4:40PM - 4:55PM Room: S102CD

Participants

Lynn A. Fordham, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review and compare systems to grade antenatal and postnatal hydronephrosis. 2) Describe etiologies of antenatal and postnatal hydronephrosis. 3) Discuss benefits and limitations of classification systems.

ABSTRACT

Prenatal ultrasound is performed throughout the world to evaluate the fetus. Detection of anomalies can dramatically alter treatment plans and help predict postnatal outcomes. Renal and bladder anomalies are relatively common. Dilatation of the urinary tract is seen in 1-2% of fetuses and can be due to a variety of etiologies. Various ultrasonographic features have been used to grade the severity of the dilatation. In March of 2014, experts representing 8 professional societies convened and created a new scoring system to standardize classification of prenatal and postnatal urinary tract dilatation (UTD). Recommendations for further evaluation of these patients were then made based on the UTD grade. This talk will review the UTD grading system and publications evaluating the new method.

RC413-10 Shear Wave Elastography Ultrasound for Hepatic Veno-occlusive Disease in a Pediatric Population Undergoing Hematopoietic Stem Cell Transplantation

Tuesday, Nov. 28 4:55PM - 5:05PM Room: S102CD

Participants

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PURPOSE

To evaluate the feasibility of shear wave elastography ultrasound as a potential non-invasive tool to facilitate early diagnosis of hepatic veno-occlusive disease (HVOD) in a pediatric population undergoing hematopoietic stem cell transplantation (HSCT).

METHOD AND MATERIALS

Under IRB approval, HSCT patients with a clinical suspicion of HVOD were recruited for the study (N=11, age: 10.3 ± 6.4 y). Diagnosis of HVOD was made by fulfillment of the Revised Seattle Criteria as determined by a physician using the following clinical criteria: right upper quadrant pain, total bilirubin, percent weight gain, and ascites, as well as the detection of portal venous flow reversal. All patients underwent serial ultrasound examinations, which included evaluation by grayscale, Doppler, and elastographic techniques. Ten ultrasound exams were performed every other day using a GE Logic-E9 ultrasound unit with linear and curvilinear transducers. Four elastography measurements each were made in Couinaud's liver segments numbers 5 through 8 (16 total for each patient).

RESULTS

Of the eleven recruited patients, four completed fewer than 10 exams due to discharge or withdrawal of consent. The figure displays each patient's average SWE velocity (m/s) over all 10 exams obtained in liver segments 5 through 8. The mean SWE velocity from all patients in this population was 1.81 ± 0.18 m/s (range: 1.66 to 2.18 m/s), which was higher than the vendor specified cut-off for normal stiffness of 1.35 m/s. The patient with the highest measured SWE velocity (2.18 ± 0.28 m/s) was the only patient to die due to multi-organ failure as a complication of HVOD. This patient's SWE measurements were significantly higher than the rest of the cohort ($p=0.00085$), with a mean SWE velocity greater than 2.10 m/s delineating this severe patient from other patients with mild or moderate disease.

CONCLUSION

This study demonstrated elevated liver stiffness values with shear wave elastography in pediatric patients undergoing HSCT with clinically suspected HVOD, and the ability to delineate between mild and severe disease in this population.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates the potential diagnostic application of an emerging sonographic technique in a unique population of pediatric patients. Early detection of this disease has the potential to profoundly impact patient care.

RC413-11 HIDA and Surgical Pathological Correlation: Increasing the Accuracy of Diagnosis in Cholestatic Jaundice

Tuesday, Nov. 28 5:05PM - 5:15PM Room: S102CD

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Conventionally, non-visualization of the gallbladder (GB) and small bowel (SB) on a Hepatobiliary Iminodiacetic Acid (HIDA) scan indicates biliary atresia, however results are often confounded by the presence of hepatic dysfunction resulting in a high false positive rate. We aim to provide correlation between HIDA imaging and surgical/pathologic findings, and outline an alternate method of interpretation incorporating background activity on HIDA exams to differentiate biliary atresia and hepatic dysfunction.

METHOD AND MATERIALS

A retrospective study of all children under age 2 years with persistent jaundice who underwent HIDA scans at our institution between January 2002 and December 2016 followed by surgical/pathologic evaluation was performed. All HIDA scans were reviewed by a blinded pediatric radiologist; background radiotracer uptake was graded from 1+ to 3+, and visualization of the GB and SB was recorded. Increased background activity (2+, 3+) was presumed to indicate poor hepatic function. Pathology and surgical reports were used as the gold standard. Binary logistic regression analysis was used to determine correlation between HIDA and pathology findings utilizing the conventional and alternate methods of diagnosing biliary atresia.

RESULTS

A total of 735 HIDA scans were performed during the study period of which 61 cases met all the inclusion criteria with a male

predominance of 69% and mean age of 62 days. Of these, 19 (31.1%) patients were proven to have biliary atresia and 42 (68.9%) patients to have hepatic dysfunction per the gold standard. The conventional method yielded an accuracy of 65.6% without significant correlation with the gold standard ($p=0.998$), whereas using the alternate method resulted in an accuracy of 83.6% with significant correlation to the gold standard ($p=0.003$).

CONCLUSION

Background activity grading supplemented with visualization of the SB and GB increases accuracy of diagnosis of biliary atresia versus hepatic dysfunction on HIDA scan and provides a significant correlation with findings on surgery and histopathologic evaluation.

CLINICAL RELEVANCE/APPLICATION

Utilizing background activity can improve accuracy of diagnosis on HIDA scan and potentially result in avoidance of unnecessary invasive testing.

RC413-12 Early Detection of Ureteropelvic Obstruction from Diuresis Renography

Tuesday, Nov. 28 5:15PM - 5:25PM Room: S102CD

Participants

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PURPOSE

To provide early and accurate detection of severe ureteropelvic junction obstruction requiring surgical intervention from the evaluation of the drainage curves obtained from the first diuresis renography (DR) exam. We introduce the calculation of new metrics for surgical decision-making based on advanced signal analysis and machine learning techniques.

METHOD AND MATERIALS

Sixty DR studies (5 bilateral) from 55 patients (age 80 ± 70 days) were acquired, in which 34 kidneys needed surgery and 26 did not. Surgical decision was based on the clinical evaluation of the dynamic information embedded in longitudinal DR. Posterior dynamic images of the kidneys were obtained for 30 minutes, using a Siemens e-Cam Signature with 1.0 mCi 99mTechnetium MAG3. After administration of furosemide 1 mg/Kg, additional images were obtained for 30 minutes. In this study, we used the drainage curves from the first DR of each patient. We extracted 45 features using signal analysis including curve spatio-temporal descriptors. Feature selection was done within a leave-one-out analysis, selecting a group of features for each training dataset based on their weights on a linear support vector machine classifier. A histogram of selected features was created and those that were selected at least 95% of the times were chosen as final features. Then, a linear support vector machine classifier identified surgical or non-operative cases. Our method was evaluated in terms of accuracy, sensitivity and specificity, and compared with the results obtained from the widely used t-half time, which is the time to drain half of the radiotracer from the kidney.

RESULTS

We predicted ureteropelvic obstruction for which surgery was performed with an accuracy of 93% (91% sensitivity, 96% specificity), compared to the accuracies of 77% (71% sensitivity, 85% specificity) and 80% (67% sensitivity, 96% specificity) obtained using thresholds of 20 and 30 min on the t-half time ($p<0.05$).

CONCLUSION

Our signal analysis method for drainage curves from DR studies at the time of the first exam significantly improves the detection of ureteropelvic obstruction with accuracy to 93%. Earlier detection of surgical candidates could potentially improve patient outcome.

CLINICAL RELEVANCE/APPLICATION

Early detection of ureteropelvic junction obstruction has the potential to reduce the time and number of longitudinal DR exams required to determine course of treatment.

RC413-13 Testicular Adrenal Rest Tumor in Congenital Adrenal Hyperplasia Patients: Long-Term Follow-Up Study and Correlation with Sonographic Volume and Hormone Level

Tuesday, Nov. 28 5:25PM - 5:35PM Room: S102CD

Participants

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PURPOSE

To identify changes in testicular adrenal rest tumor (TART) during long-term follow-up and to evaluate the correlation between TART volumes and hormone levels in children with congenital adrenal hyperplasia.

METHOD AND MATERIALS

We retrospectively reviewed serial testicular ultrasonography and hormone levels from 39 children with congenital adrenal hyperplasia (mean age 15.7 years; range 5-19 years). The median follow-up period was 8 years (range 1-13 years). The volumes of each testis and TART were calculated using the prolate ellipsoid formula and the relative TART volume was defined as the ratio of TART volume divided by the testicular volume. Serum concentrations of renin and 17-hydroxyprogesterone (17-PG) around the time of testicular ultrasonography were collected. Serial changes in volumetric parameters of ultrasonography and hormone levels were analyzed with a linear mixed model, adjusting individual repeated measurement.

RESULTS

During follow-up, the mean testicular volume of all patients grew from 8.76 ± 4.39 cm³ to 9.68 ± 5.01 cm³. Among 39 children, thirty-six children (84.6%) had TARTs, bilaterally. At initial, the mean TART volume and mean relative TART volume were 1.16 cm³ (range, 0.0-12.3 cm³) and 0.12 (range, 0.0-0.5), respectively. The volume of TART was unchanged in 30 children and increased in 9 children (mean volume change of TART, 4.07 ± 3.41 cm³). Among 9 children with growing volume of TART, one patient was diagnosed as having an adrenocortical carcinoma. However, there was no malignant change in testicular mass. Relative TART volume was associated with a higher risk for increasing 17-PG serum concentration (Estimate = 114.87, 95% CI = 14.8 to 214.9, P = .025). The other volumetric parameters showed no significant correlation with hormone levels.

CONCLUSION

TART grew during follow-up in 9 (23%) out of 39 children under treatment for congenital adrenal hyperplasia and relative TART showed a significant correlation with 17-PG level.

CLINICAL RELEVANCE/APPLICATION

Testicular ultrasonography can be a useful imaging tool for monitoring growth of TARTs and development of malignant tumors in children with congenital adrenal hyperplasia, although these are not common.

RC413-14 Late Nephrotoxicity in Survivors of Wilms Tumor Treated with Radiation Therapy

Tuesday, Nov. 28 5:35PM - 5:45PM Room: S102CD

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Wilms tumor survivors have increased risk of developing late nephrotoxicity. We evaluated the prevalence of impaired renal function in survivors of Wilms tumor who were treated with radiation therapy (RT).

METHOD AND MATERIALS

Patients who were under the age of 21 at the time of RT for Wilms tumor and who had at least 2 years of follow-up were eligible for the study. All patients treated with RT between 1995-2016 at this institution were included. Renal function was assessed with estimated glomerular filtration rate (eGFR) using the modified Schwartz equation. Impaired renal function was defined as eGFR <90 mL/minute/1.73m². Secondary outcomes of interest were proteinuria and elevated systolic blood pressure (SBP).

RESULTS

28 patients met all inclusion parameters, with a median age at RT of 3.3 years (range, 0.4-17.5 years). There were 17 female and 11 male patients. There were 1 Stage I, 0 Stage II, 18 Stage III, 5 Stage IV, and 3 Stage V patients. RT was delivered to the hemiabdomen in 18 patients and to the whole abdomen in 10 patients. RT dose was ≤ 1080 Gy in 19 patients and >1080 Gy in 9 patients. All patients received chemotherapy and surgery. 25 of the patients received doxorubicin, actinomycin, and vincristine. Ipsilateral nephrectomy was the most common surgical procedure, in 23 patients. At median length of follow-up of 10.0 years (range, 2.5-28.1 years), 13 (46.4%) patients had impaired renal function. No patients had developed end-stage renal disease. 6 (21.4%) patients had elevated blood pressure (SBP > 120) and 4 (14.3%) patients had proteinuria. Age ≤ 3 at time of RT was not associated with the development of reduced eGFR (p = 0.151).

CONCLUSION

Patients requiring trimodality therapy for Wilms tumor are at substantial risk for developing late renal toxicity. Further studies are needed to clarify the effect of age at RT on the propensity to develop late nephrotoxicity.

CLINICAL RELEVANCE/APPLICATION

There is a high rate of late nephrotoxicity in children receiving radiation therapy for Wilms tumor and further efforts are needed to decrease treatment-related morbidity in this patient population.

RC413-15 Update on Nuclear Imaging of the Pediatric Urinary System

Tuesday, Nov. 28 5:45PM - 6:00PM Room: S102CD

Participants

Susan E. Sharp, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review radiopharmaceuticals commonly used for imaging the pediatric urinary system. 2) Discuss current utilization of nuclear

medicine for imaging the pediatric urinary system.

SSJ01

Breast Imaging (Tomosynthesis Screening Applications)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: Arie Crown Theater



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

Participants

Debra S. Copit, MD, Philadelphia, PA (*Moderator*) Grant, Hologic, Inc
Priscilla J. Slanetz, MD, MPH, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ01-01 Breast Cancer Screening with Tomosynthesis Detects More Cancers: Final Results of 14,848 Women in a Prospective, Population-Based Screening Trial

Tuesday, Nov. 28 3:00PM - 3:10PM Room: Arie Crown Theater

Participants

Sophia Zackrisson, Malmo, Sweden (*Presenter*) Speakers fees and travel support from Astra Zeneca and Siemens Healthineers
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PURPOSE

To assess one-view digital breast tomosynthesis (DBT) and a combination of one-view DBT and one-view digital mammography (DM) compared to two-view DM in population-based screening.

METHOD AND MATERIALS

This is a prospective, one-arm, single-institution, population-based screening trial involving 14,848 women aged 40-74 years randomly invited from the service screening programme in an urban area, Jan 2010-Feb 2015. Women underwent one-view DBT (mediolateral oblique view) with reduced compression force and two-view DM at one screening occasion. Images were read in two separate reading arms (DBT reading arm and DM reading arm) with independent double reading and scoring. The reading sequence in the DBT arm was: 1. one-view DBT; 2. one-view DBT + cranio-caudal view of DM; 3. addition of prior two-view DM if available. McNemar's test with 95 % confidence intervals was used to compare detection and recall rates.

RESULTS

In total, 137 women had screen-detected cancers in the trial (one bilateral case). Eighty-eight of the cases were detected with both DBT and DM, 41 were detected only in the DBT reading arm and eight only in the DM reading arm. The breast cancer detection rate was 8.7/1000 screened women in the DBT reading arm (95% CI: 7.3-10.3) and 6.5/1000 screened women in the DM reading arm (95% CI: 5.2-7.9). The relative increase in cancer detection in the DBT reading arm vs. DM was 34.4% (95% CI: 18.8-52.0, $p < 0.001$). All but two cancers in the DBT reading arm were detected in the first reading step, i.e. one-view DBT alone. The recall rate after arbitration in the DBT reading arm was 3.6% (95% CI 3.3-3.9) and for the DM reading arm 2.5% (95% CI 2.2 -2.8), a statistically significant increase, $p < 0.001$.

CONCLUSION

Breast cancer screening using one-view DBT with reduced compression increases cancer detection significantly at a reasonable recall rate and seems to be a feasible screening strategy.

CLINICAL RELEVANCE/APPLICATION

It is a well-recognized fact that DM has its limitations as a stand-alone screening modality. DBT represents an advancement of the mammographic technique. The results of the current trial indicate that DBT as a stand-alone screening modality is feasible and the reduced compression force may represent a further benefit potentially encouraging more women to attend screening.

SSJ01-02 Detection of Ductal Carcinoma in Situ in the Experimental Arm of a Trial Comparing Tomosynthesis plus Digital Mammography vs Digital Mammography

Tuesday, Nov. 28 3:10PM - 3:20PM Room: Arie Crown Theater

Participants

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PURPOSE

While higher sensitivity for invasive cancers of tomosynthesis (DBT) compared to digital mammography (DM) has been showed in many studies, there are inconsistent results if DBT is more sensitive than DM in detecting ductal carcinoma in situ (DCIS). Here we present the results of detection of DCIS in the preliminary analysis of the RETomo trial by arm and imaging results.

METHOD AND MATERIALS

Women (45-70yo) presenting for a screening mammography in Reggio Emilia, were asked to participate and, if willing, randomized to the experimental arm (DBT+DM), or to the control arm (DM), both with double reading. Results of the DBT alone were recorded separately, but women were managed according to the joined evaluation DBT+DM (NCT02698202). Relative detection rate of DCIS in the experimental arm compared to control arm is reported; DCIS detected in the experimental arm are presented in detail by results of DBT alone and DBT+DM. Images with discordant DBT and DBT+DM reports were submitted to informed review by a third independent radiologist.

RESULTS

From March 2014 to March 2016 approximately 19637 women were recruited, 9854 in the experimental arm. The overall detection rate was 8.2/1000 and 4.5/1000 in the experimental and control arm respectively (relative detection rate 1.83, 95% confidence interval (CI) 1.26-2.64). DCIS were 14 and 5 in the experimental and control arm respectively (relative DCIS detection 2.85, 95%CI 1.03-7.90). Six out of 14 DCIS of the experimental arm were reported as negative by both readings, while were recalled when DM was analysed together with DBT. Among invasive cancers in the experimental arm, only 2 out of 65 were negative to both DBT readings. The post-hoc informed revision showed that DBT-negative DCIS were visible as microcalcifications. Only the comparison of DM with previous screening mammograms led to suspect of malignancy.

CONCLUSION

DBT+DM increases the detection of DCIS compared to DM alone. In a low prevalence setting where low recall rate is pre-fixed target for readers, the identification of DCIS needs careful evaluation of priors to pose the suspect of malignancy.

CLINICAL RELEVANCE/APPLICATION

DBT+DM increases the detection of DCIS compared to DM alone, but, in the evaluation of microcalcifications, to pose the suspect of malignancy 2D images for comparison are needed.

SSJ01-03 Screening Mammography Findings from One Standard Projection Only in Era of Full Field Digital Mammography and Tomosynthesis

Tuesday, Nov. 28 3:20PM - 3:30PM Room: Arie Crown Theater

Participants

Ethan O. Cohen, MD, Houston, TX (*Presenter*) Spouse, Consultant, Medtronic plc; Spouse, Consultant, Novo Nordisk AS; Spouse, Consultant, Eli Lilly and Company; Spouse, Consultant, AstraZeneca PLC
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PURPOSE

To compare outcomes of findings seen on one view only from full-field digital screening mammograms (FFDM) and FFDM with tomosynthesis (FFDM-DBT).

METHOD AND MATERIALS

An IRB-approved, HIPAA-compliant retrospective review was performed of 103,070 consecutive screening mammograms obtained from February 2011 through June 2014 at two community-based breast centers. Recalled findings prospectively seen on one view only were analyzed. Pearson's chi-squared test and Fisher's exact test were performed, and 95% CIs were determined.

RESULTS

The study included 71,656 FFDM and 31,414 FFDM-DBT. Overall, 5641 of the 71,656 FFDM (7.9%) and 1914 of the 31,414 FFDM-DBT (6.1%) were recalled, and 2213 of the recalled FFDM and 433 of the recalled FFDM-DBT revealed findings on only one view. 689 FFDM and 92 FFDM-DBT were excluded for insufficient mammographic follow-up (<24 months). Significantly more FFDM than FFDM-DBT had a one-view-only finding (3.1% vs 1.4%; $p < 0.0001$). Summation artifacts accounted for more one-view-only findings from FFDM (1067 of 1592, 67.0%) than FFDM-DBT (190 of 354, 53.7%) ($p < 0.0001$). In the FFDM cohort, 28 one-view-only findings proved malignant (24 invasive ductal carcinoma [IDC], 1 invasive lobular carcinoma [ILC], 3 ductal carcinoma in situ [DCIS]). In the

FFDM-DBT cohort, 14 one-view-only findings proved malignant (11 IDC, 1 ILC, 2 DCIS). The positive predictive value (PPV) of a one-view-only finding was significantly lower for FFDM (1.76%) than FFDM-DBT (3.95%) ($p=0.010$).

CONCLUSION

One-view-only screening mammography findings that prompt recall are more frequent, are more likely to represent summation artifacts, and have a lower PPV with FFDM than with FFDM-DBT.

CLINICAL RELEVANCE/APPLICATION

One-view-only findings are not uncommonly recalled at screening mammography, and to our knowledge, their outcomes have not been analyzed since the advent of digital imaging. Radiologists should be aware of the differences between one-view-only findings from FFDM versus FFDM-DBT and apply this to clinical practice.

SSJ01-04 Radiation Dose from Tomosynthesis and Digital Mammography versus Quantitative Breast Density

Tuesday, Nov. 28 3:30PM - 3:40PM Room: Arie Crown Theater

Participants

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PURPOSE

To compare radiation dose by digital breast tomosynthesis (DBT) and digital mammography (FFDM) counting for breast density.

METHOD AND MATERIALS

4764 breast paired views (cranio-caudal, CC, and medio-lateral oblique, MLO) were obtained by the same acquisition system with DBT and FFDM, keeping the same breast compression (COMBO mode) and using the automatic exposure mode. Raw images were processed to compute volumetric breast density. Mean glandular dose (MGD) was calculated for both image modalities, according to the model proposed by Dance, using breast density (BD) to adjust the estimated MGD. Quantitative breast density values were grouped in four categories (A, B, C, D) and MGD of DBT and FFDM was compared for each BD class. The dose ratio was determined by dividing MGD DBT by MGD FFDM dose for each pair.

RESULTS

The mean MGDs for the four breast density categories (A, B, C, D) were higher with tomosynthesis than mammography (DBT: 3.062, 2.551, 1.832, 1.430 mGy, DM: 1.900, 1.721, 1.365, 1.121 mGy). DBT dose correlates differently with FFDM dose, depending on the breast density class. The mean dose ratio (DBT/FFDM) was 1.617 for breast density class A, 1.495 for class B, 1.375 for C, and 1.305 for D, showing that tomosynthesis dose increase compared to mammography is higher for fatty breasts than for dense breasts.

CONCLUSION

Radiation dose per-view is higher with tomosynthesis compared to mammography. Dose increase is higher for fatty breasts and lower for dense breasts.

CLINICAL RELEVANCE/APPLICATION

Digital breast tomosynthesis radiation dose is slightly higher than digital mammography. The increase is lower for dense breasts.

SSJ01-05 Digital Breast Tomosynthesis Cancer Screening versus Full Field Digital Mammography Cancer Screening: Imaging and Pathological Features

Tuesday, Nov. 28 3:40PM - 3:50PM Room: Arie Crown Theater

Participants

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PURPOSE

To evaluate imaging characteristics, size, grade, type, node status and biological features of cancers detected by digital breast tomosynthesis plus synthesized 2D images (DBT+synt2D) in a breast cancer screening program, compared with those found with full-field digital mammography (FFDM).

METHOD AND MATERIALS

All consecutive breast cancers diagnosed in 16666 women screened by DBT+synt2D (April 2015 to March 2016; DBT group) and in 14423 women screened by FFDM (April 2014 to March 2015; FFDM group) were retrospectively reviewed. Radiological characteristics, cancer size, grade, type (ductal, lobular, tubular, other), node status and biological features (oestrogen and progesterone receptors, Ki-67, HER2/neu) were compared between the two groups.

RESULTS

Cancer detection rate (CDR) was 9.78/1000 in DBT group versus 5.34/1000 in FFDM group (RR 1.83, 95% CI 1.40-2.40). DBT findings included opacity in 68.1% (versus 58.4% at FFDM) and architectural distortion in 9.2% of cases (versus 2.6% at FFDM) ($p=0.029$). The CDR for invasive cancers was 8.58/1000 in DBT group versus 4.02/1000 in FFDM group ($p=0.01$). The size of invasive cancers was significantly smaller in DBT group versus FFDM group (median 13.4 mm vs 16.4 mm, $p=0.001$). More low-grade invasive cancers were detected in DBT group versus FFDM group: 31.9% versus 11.7%, respectively ($p=0.01$). No differences were found in cancer type ($p=0.224$), with a prevalence of invasive ductal carcinoma in both groups (63.8% and 59.7%, respectively). Node status was similar between the two groups ($p=0.091$). More HER2 negative cancers were detected in DBT group (91.6%) versus FFDM group (79.3%; $p=0.01$) while no differences were found in oestrogen and progesterone receptors expression and in the Ki67 proliferation index ($p>0.05$).

CONCLUSION

Breast cancer screening with DBT+synt2D increases overall breast cancers detection, with a preferential increase in the detection of invasive cancers, improving visualization of opacities and architectural distortions. Additional breast cancers found are more likely to be smaller, low-grade, ductal type and HER2 negative, with important prognostic and predictive implications.

CLINICAL RELEVANCE/APPLICATION

The analysis of cancers detected by DBT has prognostic and treatment significance and could be the initial step to address concerns about DBT contributing to overdiagnosis.

SSJ01-06 Comparing Two Visualization Protocols for Tomosynthesis in Screening: Specificity and Sensitivity of Slabs vs Slabs plus Planes

Tuesday, Nov. 28 3:50PM - 4:00PM Room: Arie Crown Theater

Participants

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PURPOSE

There is growing evidence that tomosynthesis (DBT) is more sensitive than digital mammography (DM), but its introduction in screening is limited by longer reading times. Simplified visualization protocols have been designed to reduce reading time. In this study we compared the accuracy of simplified protocol with slab (1 cm thickness, overlapped 0.5 cm) alone vs. a standard protocol of slab plus planes (1 mm thickness, continuous). Both were integrated with synthetic-2D (Sy2D).

METHOD AND MATERIALS

Two expert screening radiologists retrospectively examined 906 randomly selected DBT from the RETomo screening trial experimental arm, where women received DBT+DM. Only women that were positive at the screening reading were assessed for cancer. All the DBT were read by both radiologists with both protocols after 3 months wash-out period. The order of reading was randomly assigned to have half of the sample read before with simplified and half with standard protocol. We present sensitivity, specificity and kappa values for inter-reader agreement.

RESULTS

Among the 906 women, 24 were recalled and 12 had a cancer (including 2 in situ). With the simplified protocol readers correctly classified as positive 15 out of 24 readings of women with cancer: 4 cancers were missed by both readers and one by only one, for a total of 9 false negative readings (sensitivity 63%, 95% confidence interval (CI) 41-81); 20 in the standard protocol (sensitivity 83%, 95%CI 62-95) ($p=0.1$). Among women who did not have evidence of cancer, the simplified protocol correctly classified as negative 1727 out of 1788 readings (specificity 96.6%, 95%CI 95.6-97.4); the standard protocol correctly classified 1699 readings (specificity 95.0%, 95%CI 93.9-96.0) ($p=0.006$). Inter-reader agreement was 0.53 and 0.36 with simplified and standard protocol, respectively.

CONCLUSION

A simplified protocol (Sy2D+slabs) increased the specificity and reproducibility of reading in a screening population, but had a negative impact on sensitivity. The study will be completed with the analysis of a DBT set enriched of cases in order to have a more precise estimate of sensitivity.

CLINICAL RELEVANCE/APPLICATION

To overcome the longer reading time for DBT in screening, a simplified protocol (synthetic2D+slabs) increased the specificity and reproducibility of readings, but with negative impact on sensitivity.

SSJ02

Breast Imaging (Ultrasound Advanced Applications)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E450A

BR US

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

FDA Discussions may include off-label uses.

Participants

Ellen B. Mendelson, MD, MA, Chicago, IL (*Moderator*) Medical Advisory Board, Delphinus Medical Technologies, Inc; Research support, Siemens AG; Speaker, Siemens AG; Consultant, Quantason LLC; Scientific Advisory Board, Seno Medical Instruments, Inc; ;
Regina J. Hooley, MD, New Haven, CT (*Moderator*) Consultant, Hologic, Inc

Sub-Events

SSJ02-01 Predictive Models for Contrast-Enhanced Ultrasound of the Breast: Is it Feasible, Does it Improve Imaging Reporting Performance and Data System Evaluation for Critical Breast Lesions? Primary Analysis from a Multi-Center Prospective Study

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E450A

Participants

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PURPOSE

To determine whether a predictive model for contrast-enhanced ultrasound (CEUS) of the breast can improve the precision of breast imaging reporting and data system (BI-RADS) categorization.

METHOD AND MATERIALS

A total of 730 patients with 742 solid breast lesions classified as BI-RADS 4 or 5 on conventional ultrasound and mammography were evaluated. CEUS was performed before core needle biopsy or surgical resection and a revised BI-RADS classification was assigned based on six predictive models for CEUS of malignant and benign breast lesions analyzed on 10 enhancing patterns. Receiver operating characteristic curve analysis was conducted to evaluate the diagnostic performance of CEUS-based BI-RADS assignment with pathological examination as reference criteria.

RESULTS

The CEUS-based BI-RADS evaluation classified 262/742 (35.31%) lesions into category 3, 43 (5.79%), 27 (3.64%), and 47 (6.33%) lesions into categories 4A, 4B and 4C, respectively, and 363 (48.92%) into category 5, compared with 276/742 (37.19%), 199 (26.82%), 93 (12.53%), and 172 (23.18%) in BI-RADS 4A, 4B, 4C, and 5 based on conventional ultrasound and mammography. Selecting CEUS-based BI-RADS category 3 as an appropriate cutoff resulted in accuracy, sensitivity, specificity, and positive and negative predictive values of 80.05%, 98.26%, 64.32%, 70.42%, and 97.71%, respectively, for the diagnosis of malignant disease. The cancer-to-biopsy yield was 64.3% with CEUS-based BI-RADS 3 selected as the biopsy threshold compared with 46.42% otherwise, while the biopsy rate was only 72.2% compared with 100% otherwise. Overall, only 1.74% of invasive cancers were misdiagnosed as BI-RADS 3, the category we use nowadays.

CONCLUSION

In our patient cohort, evaluation of BI-RADS 4 or 5 breast lesions with CEUS results in reduced biopsy rates and increased cancer-to-biopsy yield.

CLINICAL RELEVANCE/APPLICATION

CEUS can improve the BI-RADS with reduced biopsy rates and increased cancer-to-biopsy yield.

SSJ02-02 Correlation of Quantitative and Qualitative US Indexes of Tumor Vascularity with Histologic Vascular Parameters in Breast Masses: Superb Microvascular Imaging (SMI) and Contrast-enhanced US

(CEUS)

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E450A

Participants

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PURPOSE

To investigate the correlation between quantitative and qualitative ultrasound (US) indexes of tumor vascularity on Superb Microvascular Imaging (SMI) and contrast-enhanced ultrasound (CEUS) and histologic vascular parameters in breast masses.

METHOD AND MATERIALS

This prospective study was approved by the institutional review board and written informed consent was obtained. Ninety-eight suspicious solid breast masses (57 benign and 41 malignant) were examined by SMI and CEUS prior to biopsy. We used Aplio 500 US equipment (Toshiba Medical Systems Corporation, Japan) and SonoVue contrast agent (Bracco, Italy). Two radiologists analyzed quantitative and qualitative vascularity indexes of SMI (vascular index, vessel morphology, distribution, and penetrating vessel) and CEUS (time intensity curve parameters and enhancement pattern). Histological vascular parameters, including microvessel density and diameter, were measured. Histological parameters according to tumor type, grade, and hormone receptor were compared using t- and Mann-whitney test. Correlations analysis was performed between US indexes and histologic parameters using spearman's correlation and Kruskal-Wallis test with Bonferroni correction.

RESULTS

Microvessel density was significantly higher in malignant masses than benign masses and malignant masses with negative estrogen receptor or high grade had higher microvessel density than those with positive estrogen receptor or low grade ($P<.05$). Microvessel diameter was not different between benign and malignant masses ($P>.05$). Quantitative US indexes including peak intensity ($r=0.546$), slope ($r=0.462$) and area ($r=0.574$) on CEUS and vascular index ($r=0.634$) on SMI were correlated with microvessel density ($P<.01$ for all). Qualitative US indexes including enhancement degree, enhancement order, penetrating vessel, perfusion defect on CEUS and vessel morphology, distribution, penetrating vessel were significantly correlated with microvessel density ($P<.01$ for all).

CONCLUSION

Quantitative and qualitative US indexes of tumor vascularity on SMI and CEUS are significantly correlated with histologic microvessel density in the corresponding tumor region.

CLINICAL RELEVANCE/APPLICATION

US vascularity indexes on SMI and CEUS could be used as surrogate markers representing histologic tumor microvessel density and may be used for predicting tumor angiogenesis in the preintervention period.

SSJ02-03 Optoacoustic Imaging of the Breast: Down-classification and Up-classification of Suspicious Breast Masses

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E450A

Participants

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PURPOSE

Optoacoustics (OA/US) imaging is a new technology based on laser light excitation. Combined with gray scale ultrasound, it enables simultaneous assessment of functional and anatomical information that may improve distinction between benign and malignant masses of the breast. The aim of this study was to assess OA/US's sensitivity, specificity and its ability to downgrade benign masses and upgrade malignant masses in terms of probability of malignancy (POM) and BI-RADS category.

METHOD AND MATERIALS

In this prospective, multi-center study, compliant with ISO14155 and applicable laws and regulations, we report results of 209 patients with 215 breast masses classified as BI-RADS 4a or 4b by conventional diagnostic ultrasound (CDU). Patients were enrolled

between 2015 and 2016. Institutional review board approval and written informed consent were obtained. All masses were evaluated with OA/US prior to biopsy. For each mass, the radiologist scored 5 OA/US features, and then adjusted the POM and BI-RADS category. OA/US sensitivity, specificity, BI-RADS downgrade and upgrade percentages were assessed with the contribution from an estimator.

RESULTS

OA/US specificity improvement over CDU was 41.1%. OA/US sensitivity was 95.5%. With OA/US, 41.1% of benign masses classified as BI-RADS 4a or 4b were downgraded to BI-RADS 3 or 2 and 49.2% of malignant masses were upgraded in BIRADS category.

CONCLUSION

OA/US improves the distinction between benign and malignant masses compared to CDU alone. Benign masses (particularly those classified as BI-RADS 4a) may be downgraded to BI-RADS 3 or 2 with OA/US, potentially decreasing negative biopsies and short interval follow-up imaging exams.

CLINICAL RELEVANCE/APPLICATION

With OA/US, many benign masses classified as BI-RADS 4a with CDU may be downgraded to BI-RADS 3 or 2, offering the potential to decrease biopsies of benign lesions and short interval follow-up imaging exams.

SSJ02-04 Targeted Axillary Dissection: Challenges with Axillary Lymph Node Clip Placement, Clip Identification, and Clip Retrieval post Neoadjuvant Therapy

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E450A

Participants

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PURPOSE

Clinically node-positive breast cancer patients often receive neoadjuvant chemotherapy (NAC) which eradicates nodal disease in 40-70% of patients. Clip placement in biopsy-confirmed metastatic lymph nodes (LNs) allows for selective removal in addition to sentinel node removal after NAC as part of targeted axillary dissection (TAD). We report success rates of clip placement, clip identification, and clip retrieval in metastatic axillary nodes to facilitate TAD.

METHOD AND MATERIALS

A retrospective institutional review board approved study was performed of 2 cohorts of patients: 223 LNs in 222 patients with clip placement from October 1, 2011 to December 30, 2015 [cohort 1]; 100 LNs in 100 patients from January 1, to November 30, 2016 [cohort 2; changes were made to the ultrasound image capture protocol for the documentation of clipped lymph nodes after the first 5 years of performing this procedure that included measurement of distance from clip to skin in transverse and longitudinal planes at the time of placement]. Success rates of clip placement, clip identification, and clip retrieval, were compared with clinico-pathologic features in cohort 1, and also between the 2 cohorts.

RESULTS

Overall, clip placement failure occurred in 14/323 LNs (4.3%) and 9/310 (2.9%) clips were not identified on follow-up ultrasound. Of 223 clipped LNs that underwent radioactive seed placement, the clip and seed were successfully retrieved in the same LN in 215 (96.4%). In cohort 1, failure in clip identification was associated with larger number of abnormal lymph nodes at diagnosis, perinodal clip placement, thinner cortex after neoadjuvant therapy, and greater distance of node from skin. Clip location in the cortex was a significant predictor for clip retrieval. Cohort 2 had a higher rate of successful clip placement (99% vs 94.2%, $p=.07$) and clip identification (100% vs 90.1%, $p=.0004$) than cohort 1.

CONCLUSION

Optimal techniques for clip placement, that include location within the cortex and detailed imaging after placement, help to improve the ability to identify and retrieve clipped axillary nodes after NAC.

CLINICAL RELEVANCE/APPLICATION

While there are clinico-pathologic features (clip location in cortex) that impact clip placement, clip identification, and clip retrieval success, appropriate training in clip documentation at diagnosis can mitigate against these challenges.

SSJ02-05 Cancer Detection in Breast Ultrasound Using an Industrial Grade Deep Learning Image Analysis Software

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E450A

Participants

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PURPOSE

To train a generic deep learning software (DLS) for the diagnosis of breast cancer in ultrasound images and to compare the performance to human readers with variable breast imaging experience.

METHOD AND MATERIALS

In this IRB-approved, HIPAA compliant, retrospective study, all breast ultrasound examinations from one year were reviewed. Patients with scars, initially indeterminate, or malignant lesions with histological diagnoses or 2-year follow-up were included. The DLS was trained with 70% of the images, the remaining 30% were used to validate the performance. Three readers with variable expertise also evaluated the validation set (radiologist, resident, medical student). Diagnostic accuracy was assessed with a receiver operating characteristic (ROC) analysis. Interreader agreement was measured with the concordance correlation coefficient (CCC).

RESULTS

Eighty-two patients with malignant and 550 with benign lesions were included. Time needed for training was 7 minutes (DLS). Evaluation times were 3.7 seconds (DLS) and 28, 22 and 25 minutes for human readers (decreasing experience). ROC analysis revealed non-significant differences in the area under the curve of 0.84 (DLS), 0.88 (experienced and intermediate readers) and 0.79 (inexperienced reader). Interreader agreement was best between the two more experienced readers (0.56, 95% CI 0.45-0.67) and the DLS and the reader with intermediate experience (0.49, 0.38-0.59), respectively.

CONCLUSION

DLS can diagnose cancer in breast ultrasound images with an accuracy comparable to radiologists. DLS learns substantially better and faster than a human reader with no prior experience given the same amount of training data.

CLINICAL RELEVANCE/APPLICATION

Real-time heatmaps embedded in an ultrasound examination could increase the radiologists sensitivity to subtle or atypical cancerous lesions.

SSJ02-06 Quantitative Analysis of Contrast-Enhanced Ultrasound of Lymph Nodes: A Novel Technique to Detect Early Metastasis

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E450A

Participants

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PURPOSE

To evaluate whether quantitative analysis of contrast-enhanced ultrasound (CE-US) can predict early lymph node (LN) metastasis in clinically node-negative breast cancer.

METHOD AND MATERIALS

This prospective study was approved by the institutional review board and informed consent was obtained from participants. In total, 56 patients who had no swelling LN using conventional CT, MR or US imaging underwent CE-US before surgery. Microbubble (Sonazoid; 0.015 mL/kg) was injected as a bolus with a 10-mL saline flush and continuous 75 s DICOM images were obtained. Time intensity-curve analysis was used to quantitatively analyze CE-US images. A region of interest (ROI) was placed within each LN where the highest signal increase was observed on CE-US images to obtain the peak intensity of the maximum enhanced area (P_{Imax}). A ROI was placed where the lowest signal increase was observed to obtain peak intensity of the minimum enhanced area (P_{Imin}). To evaluate heterogeneity of enhancement in LNs, the P_{Iratio} was calculated: P_{Iratio} = P_{Imax} / P_{Imin}. For visual analysis, the presence of a perfusion defect in LNs was evaluated. P_I ratios and visual analyses were compared between pathological positive- and negative-metastasis groups in breast cancer patients.

RESULTS

Fifteen patients were diagnosed histologically with positive LN metastases (median 4, range 2.5-12 mm) and the remaining 41 as negative. The P_{Iratio} was significantly higher in the positive-metastasis than in the negative-metastasis group (p = 0.0073). ROC analysis revealed that the most effective threshold of P_{Iratio} was 1.52 and the area under the curve was 0.74. Using this threshold, the sensitivity, specificity, PPV, and NPV were 53%, 93%, 73%, and 84%, respectively. No statistically significant difference was found in visual assessments between negative- and positive-metastasis groups (p = 0.09).

CONCLUSION

The P_{Iratio} in quantitative analysis of CE-US imaging may be useful for detecting the presence of early LN metastasis in clinically node-negative breast cancer.

CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of CE-US imaging may be useful for detecting the presence of early lymph node metastasis and is recommended in the initial evaluation of lymph node status.

SSJ03

Cardiac (Valve Disease)

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

CA CT

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

FDA Discussions may include off-label uses.

Participants

Vincent B. Ho, MD, MBA, Bethesda, MD (*Moderator*) Institution, In-kind support, General Electric Company
Diana Litmanovich, MD, Haifa, Israel (*Moderator*) Nothing to Disclose

Sub-Events

SSJ03-01 Quantitative Assessment of Mitral-Valve Using a Pre-Interventional Software: A Comparison between Patients with Mitral Valve Prolapse and Healthy Subjects

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

Participants

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PURPOSE

To characterize adaptive changes in mitral annulus anatomy in patients with mitral valve prolapse as compared to healthy subjects using mitral valve characterization software and multiphase cardiac CT datasets.

METHOD AND MATERIALS

In this retrospective study, 50 patients with known mitral valve prolapse who had previously undergone retrospective ECG-gated cardiac CTA using 1st generation dual-source CT (SOMATOM Definition, Siemens Healthcare) were evaluated. The control group comprised of 50 patients without mitral-valve pathology who underwent retrospective ECG-gated coronary CTA on 2nd generation dual-source CT (SOMATOM Definition Flash, Siemens Healthcare). Thin section, multiphase axial images were loaded into prototype mitral valve characterization software on a dedicated post processing workstation (Syngo.via VA30, Siemens Healthcare). Using 16 seeding points, the program semi-automatically segmented the saddle-shaped mitral valve annulus, generating the following parameters: annulus circumference (AC), surface area (SA), distance between the right and left trigone (TT), distance between the anterior and posterior horn (AP), distance between anterolateral and posteromedial annulus point (ALPM), ratio of AP and ALPM defined as ellipticity (E). Computed parameters were compared between the two groups.

RESULTS

Except E(0.81 [0.67-0.93] vs. 0.82 [0.65-0.92], $p = 0.44$), all other parameters were significantly different between the prolapsed and non-prolapsed groups ($p < .001$) with circumference (144 [115-173] vs. 117 [99-144] mm), SA (1533 [935 - 2223] vs. 1005 [717 - 1496] mm²), AP (38.4 [29.6 - 46.7] vs. 31.5 [26.5 - 37.9] mm) and ALPM (47.3 [37.1 - 57.4] vs. 38.5 [32.6 - 49.4] mm) being most prominent. Values over a cardiac cycle were more stable in the non-prolapsed valves, with more variation across the cardiac cycle seen in patients with prolapsing mitral valves.

CONCLUSION

This mitral valve characterization tool can be used to distinguish between prolapsed and non-prolapsed valves by using a set of standardized, quantitative parameters that may have relevance for the design and implementation of catheter-deployed mitral valve prostheses.

CLINICAL RELEVANCE/APPLICATION

Quantitative assessment of the mitral valve will enhance diagnosis of mitral valve prolapse and has the potential to improve procedure planning by allowing patient-specific prosthesis selection.

SSJ03-02 The Association between Morphological and Functional Characteristics of Bicuspid Aortic Valve and Bicuspid Aortopathy

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S502AB

Participants

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PURPOSE

The aims of this study were to determine the association between morphological and functional characteristics of bicuspid aortic valve (BAV) and bicuspid aortopathy and to identify the determinants of aortic dilatation using cardiac computed tomography (CCT).

METHOD AND MATERIALS

This study cohorts included 282 subjects (206 men, age 52±15 years) who underwent both CCT and transthoracic echocardiography. BAVs were classified as anterior-posterior (BAV-AP) or lateral (BAV-LA) and divided according to the presence (raphe+) or absence of a raphe (raphe-) based on CCT findings. The sinuses of Valsalva and proximal ascending aorta were measured by CCT. Factors related to aortic root and ascending aorta diameter were evaluated by multiple linear regression analysis. The determinants of aortic root and proximal ascending aortic dilatation (size index >2.1 cm/m²) were assessed by multiple logistic regression analysis.

RESULTS

BAV-AP was present in 173 patients (61%) and raphe+ in 168 (60%). BAV morphotype and raphe+ or raphe- were not associated with aortic root and ascending aortic diameters. The aortic root diameter were significantly associated with aortic stenosis (AS) severity (estimate -1.87, p=0.02) and sex (estimate -2.77, p<0.01) and the ascending aorta diameter with age (estimate 0.14, p<0.001). Patients with dilated aortic root (n=207) were older (p=0.02) and had a lower prevalence of male sex (p<0.03) and lower body surface area (BSA, p<0.001). Patients with dilated ascending aorta (n=217) were older (p<0.001) and had lower prevalence of male sex (p<0.001), lower BSA (p<0.001), higher prevalence of hypertension (p=0.04), raphe+ (p=0.017), BAV-LA (p=0.04), moderate-to-severe AS (p<0.001) and none or mild aortic regurgitation (p<0.001). BSA was the sole independent determinant of aortic root diameter (p<0.001). Independent determinants of ascending aortic diameter were age (p<0.001), New York Heart Association class (p=0.01), BSA (p<0.001), and AS severity (p=0.003).

CONCLUSION

BAV morphotype and presence or absence of raphe are not associated with aortic root and ascending aortic dilatation and not the determinants of aortic dilatation. Further studies are needed to investigate the discrepancy in the importance of BAV morphotype predicting phenotypes of bicuspid aortopathy.

CLINICAL RELEVANCE/APPLICATION

Morphological characteristics of BAV may not have a direct impact on clinical outcomes and management plan for BAV-associated aortopathy.

SSJ03-03 Aortic Annulus Sizing in Bicuspid and Tricuspid Aortic Valves Using CT: Comparison with Surgically Replaced Prosthetic Valve Size in 667 Patients

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S502AB

Participants

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PURPOSE

Controversy exists regarding measurement of bicuspid aortic annulus diameter on computed tomography. Although we routinely measure bicuspid aortic annulus size similar to the method for tricuspid aortic valve (AV) prior to aortic valve replacement (AVR) or transcatheter aortic valve implantation (TAVI), there has been no study to validate the method for bicuspid valve.

METHOD AND MATERIALS

Annular measurements (maximal diameter, mean diameter, area-derived diameter, and perimeter-derived diameter) were performed in 667 (362 tricuspid, 166 bicuspid with raphe and 139 bicuspid without raphe) patients who underwent surgical AVR between June 2011 and Mar 2016. The differences between CT measurements and prosthetic AV sizes were evaluated. To find factors to affect the differences between CT diameters and prosthetic AV size, patients with 10% more larger diameter (n=421) on CT from the prosthetic AV size were compared with those within 10% range.

RESULTS

Bicuspid AV parameters were well correlated with prosthetic AV size as well as tricuspid AV parameters. The most representative measurements correspond to prosthetic AV size were area-derived diameter in tricuspid ($r=0.69$, $p<0.001$) and bicuspid AV without raphe ($r=0.73$, $p<0.001$), and perimeter-derived diameter in bicuspid AV without raphe ($r=0.65$, $p<0.001$). In multivariable linear regression analysis, prosthetic AV size could be suggested using both area-derived diameter and sinus diameter ($r^2=0.59$, $p<0.001$). The difference between CT-derived diameter and prosthetic AV size is affected by prosthetic valve types (OR 9.5; 95%CI 4.0-22.4; $p<0.001$), surgeons (OR 2.5; 95%CI 1.1-5.5; $p=0.03$), sex (OR, 3.5; 95%CI 2.0-6.2; $p<0.001$) and area-derived diameters (OR, 2.0; 95%CI 1.7-2.3; $p<0.001$) in multivariate logistic regression analysis. Area-derived diameter and sex were remained after adjusting the effects of prosthetic valve types and surgeon factors ($p<0.01$). Bicuspid AV did not affect the differences between CT diameters and prosthetic AV sizes.

CONCLUSION

Bicuspid AV diameters measured on CT showed good correlation with prosthetic AV size as well as tricuspid AV parameters. The difference between CT-derived diameter and prosthetic AV size is affected by prosthetic valve types, surgeons, sex, and CT-derived diameters.

CLINICAL RELEVANCE/APPLICATION

CT is useful for AV sizing including bicuspid AV, and this information could be important to select optimal valve size for both surgical AVR and TAVI.

SSJ03-04 Utility of Cardiac CT for Preoperative Evaluation for Mitral Regurgitation: Localization of Mitral Valve Prolapse and Prediction of Repairability

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

Participants

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PURPOSE

We aimed to investigate the diagnostic accuracy of dual-source cardiac computed tomography (CT) for detection of the prolapsed segment in mitral regurgitation (MR) and for prediction of non-repairable mitral valve (MV) with surgical finding as standard reference.

METHOD AND MATERIALS

A total of 85 patients with severe MR who underwent preoperative cardiac CT before MV surgery (MV replacement or repair) were retrospectively enrolled. The prolapsed segment of MV was assessed using Carpentier classification. Non-repairable MV was defined when met one of followings: 1) anterior leaflet prolapse, 2) bi-leaflet prolapse, 3) severe thickening and/or calcification of leaflets. Diagnostic performance of CT for the detection of prolapsed segment was assessed per patient, per leaflet (anterior or posterior) and per segment, with surgical findings as the standard reference. Diagnostic performances of CT for the prediction non-repairable MV was assessed and compared between each criteria for non-repairable MV by area under the curve (AUC) of receiver operating characteristics curve.

RESULTS

On the surgical field, MV prolapse was identified in 73.5%, and the most common segment was P2 ($n=23$). The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy for detection of MV prolapse were 98.4% (60/61), 72.7% (16/22), 80.8% (60/66), 81.0% (16/17) and 91.6% (76/83) per patient, 97.2% (69/71), 94.7% (90/95), 93.2% (69/74), 97.8% (90/92) and 95.8% (159/166) per leaflet and 79.6% (74/93), 92.6% (375/405), 71.2% (74/104), 95.2% (375/394) and 90.2% (449/498) per segment. Forty-seven patients met the criteria of non-repairable MV by CT (sensitivity 87.5% and specificity 86.5%). Among criteria for non-repairable MV, criteria 3 (severe thickening and/or calcification of leaflets) showed higher diagnostic performance than other two findings (AUC; 0.569 for criteria 1, vs. 0.540 for criteria 2 vs. 0.819 for criteria 3; $P<0.05$).

CONCLUSION

Cardiac CT may have high diagnostic performance in detecting the prolapsed segment of MV and predicting non-repairable MV before surgery. Among CT findings, valve morphology such as severe leaflet thickening and/or calcification is the most important predictor for non-repairable MV.

CLINICAL RELEVANCE/APPLICATION

Cardiac CT can be helpful to predict non-repairable MV before surgery, and valve morphology is the most important predictor.

SSJ03-05 Semi-Automatic CT-Angiography Based Evaluation of the Aortic Annulus in Patients Prior to TAVR: Interchangeability with Manual Measurements

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

Participants

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PURPOSE

To compare a semi-automatic software tool to full manual measurement to obtain aortic annulus parameters and determine transcatheter aortic heart valve (THV) size in a large patient cohort prior to TAVR.

METHOD AND MATERIALS

We included 355 consecutive patients (156 male, median age 82 years) in this retrospective study. Two readers independently assessed aortic annulus size by manually determining long and short axis, circumference and area of the aortic valve annulus. A third independent reader performed annulus evaluation using a software tool for automatic detection and measurement of the aortic annulus plane ('Valve Pilot', 'CT Cardiac Function' tool, SyngoVia, Siemens Healthcare). Automatically detected annulus plane and contour could be manually changed if necessary. The parameter 'annulus area' was used to determine optimal size of a hypothetical THV based on an algorithm suggested before (Binder et al. 2013). We calculated the intraclass calculation coefficient (ICC) to compare both manual measurements as well as semi-automatic measurements to the mean of both manual measurements.

RESULTS

There was excellent correlation between both observers in manual measurement of annulus long (ICC 0.89[95% CI 0.87;0.91]) and short axis (0.89[0.86;0.91]), circumference (0.93[0.92;0.95]) and area (0.94[0.93;0.96]). Both readers agreed in 81% (287/355) of patients regarding proposed THV size. During semi-automatic measurements, manual adjustment of the annulus plane and minimal adjustment of the annulus contour without changes in the automatically selected plane were performed in 11% (38/355) and 79% (282/355) of cases, respectively. No change of the suggested annulus segmentation was required in 10% of cases (35/355). Again, there was excellent correlation between semi-automatic measurements and mean of both manual measurements of long (0.89[0.87;0.91]) and short axis (0.86[0.83;0.88]), circumference (0.95[0.93;0.96]) and area (0.95[0.94;0.96]). Semi-automatic measurements resulted in identical THV size selection in 82% (290/355) of patients.

CONCLUSION

Semi-automatic measurements of anatomic parameters of the aortic root show high agreement with manual measurements in CT-angiography prior to TAVR.

CLINICAL RELEVANCE/APPLICATION

Semi-automatic assessment of the aortic root is equal to full manual measurement and can facilitate the complex evaluation of the aortic annulus prior to TAVR.

SSJ03-06 Prognostic Value of Left Ventricular Fibrosis Volume as a Parameter for Long-Term Survival after TAVI

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

Participants

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PURPOSE

Patients with severe aortic stenosis develop left ventricular hypertrophy. They suffer from reduced left ventricular function. Due to the insufficient vascularization of the hypertrophic left ventricular myocardium the development of left ventricular fibrosis is a common problem in these patients. The transcatheter aortic valve implantation (TAVI) is an upcoming procedure to reduce the workload and improve the left ventricular function. The long-term-survival shows huge inter-individual differences. The assessment of NYHA class 30 days after TAVI has shown to be a strong and independent parameter for long-term-survival. The aim of this study was to assess the value of left ventricular fibrosis volume as a predictive parameter for the clinical outcome after TAVI.

METHOD AND MATERIALS

In the study 35 consecutive patients with TAVI procedure were enrolled. The mean characteristics were 81 ± 7 years, mean NYHA class 3.2 ± 1.4 , EF $48 \pm 9.3\%$. In each patient pre-interventional contrast enhanced cardiac MRI was performed at a Philips Ingenia 3T. The left ventricular fibrosis volume was measured. The functional recovery was assessed using the NYHA class 30 days after the procedure.

RESULTS

NYHA class after TAVI was reduced significantly (1.7 ± 1.3 ; $p < 0.001$). Twenty-two (63%) patients revealed a 2 class reduction. Twelve (34%) patients showed a reduction of 1 class. One Patient remained in the same NYHA class. The left ventricular fibrosis volume was inversely related to the reduction of NYHA class: patients with left ventricular fibrosis volume of $720 \pm 232 \text{ mm}^3$ had a NYHA reduction of 2 or more classes whereas patients with a left ventricular fibrosis volume of $1501 \pm 321 \text{ mm}^3$ had a reduction of less than 2 classes.

CONCLUSION

The left ventricular fibrosis volume seems to have an impact on the reduction of the NYHA class 30 days after successful TAVI implantation.

CLINICAL RELEVANCE/APPLICATION

The quantification of the left ventricular fibrosis volume may be used as a prognostic parameter for long-term survival in TAVI patients.

SSJ04

Cardiac (Coronary Artery Disease: Outcomes and Risk Stratification)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S504AB

CA CT MR

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

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Sub-Events

SSJ04-01 Low Coronary Endothelial Shear Stress (ESS) Measured from Computed Tomography Angiography (CTA) is Associated with Early Fibroatheroma, and High ESS is Associated with High-Risk Thin Cap Fibroatheroma as Determined by Histologic Examination

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S504AB

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PURPOSE

ESS is associated with coronary plaque progression and modulates development of high-risk plaque features. However, the relationship between ESS and existing disease toward identifying the plaques at high risk of rupture has not been studied to date. We assessed whether ESS calculated from non-invasive coronary CTA can detect vulnerable plaque as determined by histopathologic examination.

METHOD AND MATERIALS

CTA was performed for 5 donor hearts with coronary artery disease. Histology was obtained every 1mm along the length of the major coronary arteries and coregistered to CTA using surgical knots and anatomic landmarks. Plaques were classified based on histology using the modified American Heart Association scheme: adaptive (AIT) and pathological (PIT) intimal thickening, fibrous (FIB), and, early (EFA), late (LFA) and thin-cap (TCFA) fibroatheroma. Resting-state ESS was calculated from CTA using a previously validated computational fluid dynamics (CFD) approach (non-Newtonian blood, flow proportional to myocardial mass and distributed using Murray's law). ESS was coregistered automatically to CTA, blinded to histology. Mean ESS at 0.5 mm intervals in each major artery was analyzed with one-way analysis of variance (ANOVA) to determine differences in ESS between plaque types. For plaque types associated with significantly different ESS, logistic regression and receiver operating characteristic analyses (ROC) were used to determine diagnostic accuracy of ESS to predict that plaque type.

RESULTS

214 histology sections with plaque were analyzed (31 AIT, 98 PIT, 37 FIB, 29 EFA, 9 LFA, 10 TCFA). Mean ESS differed significantly for TCFA vs all other types ($p < 2.4 \times 10^{-4}$). Pa to detect TCFA were 80%, 87.3%, and 86.9%, respectively. ESS detected EFA (ROC AUC=0.86, odds ratio=40.6/1Pa drop); sensitivity, specificity and diagnostic accuracy of ESS<1.1Pa to detect EFA were 86%, 75.9%, and 84.6%, respectively.

CONCLUSION

ESS from CTA detects EFA (low ESS2.4Pa). The former finding is in keeping with knowledge suggesting low ESS leads to early fibroatheromas. The latter finding implies a mechanical pathway (when high flow velocities and thus high ESS are present) in fibrous cap thinning and development of TCFA.

CLINICAL RELEVANCE/APPLICATION

ESS from CTA detects thin-cap fibroatheroma and early fibroatheroma likely to progress to thin-cap. It can thus facilitate timely prevention or intervention, which no other non-invasive imaging offers.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying

educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/> Udo Hoffmann, MD - 2015 Honored Educator

SSJ04-02 Adjustment of CT-Fractional Flow Reserve Underestimation to Minimize 1-year Cardiac Events

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S504AB

Participants

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PURPOSE

CT-Fractional Flow Reserve (CT-FFR) is known to underestimate the FFR compared to invasive measurement, leading to considerable false-positive study results especially when the disease prevalence is low. The purpose of the study was to evaluate how an adjustment of CT-FFR's underestimation impacts the estimated clinical outcomes.

METHOD AND MATERIALS

This HIPAA-compliant, IRB-approved prospective study included 44 coronary arteries from 38 patients (67.8±9.6 yrs, ca score=347.7±459.3) who underwent a 1 heart-beat 320 row coronary CTA which showed 30-90% stenosis in at least one segment and also underwent invasive FFR. The CT-FFR was calculated onsite using a commercial software. We assessed the diagnostic accuracy of CT-FFR based on the receiver operating curve (ROC) using invasive FFR≤0.8 as a positive outcome. A hypothetical 1-year cardiac event incidence if revascularization (PCI) was decided based on CT-FFR was estimated, using previous evidences on incidences following invasive FFR (positive test (≤0.8) with PCI=0.03, without PCI=0.05, negative test (>0.8) with PCI=0.03, without PCI=0.01). We repeated the estimation with an adjustment of CT-FFR to minimize the deviation from invasive FFR, and assessed the change in the hypothetical cardiac events under four different disease prevalence (0.2, 1, 5, 10%).

RESULTS

A total of 16 vessels had significant ischemia (invasive FFR≤0.8). A cutoff CT-FFR of 0.8 achieved 94% sensitivity and 75% specificity (AUC of ROC=0.82), but it significantly underestimated the invasive FFR especially when CT-FFR was <0.7; estimated total cardiac events per 100,000 population was 158.7 under the 1% disease prevalence, 84.9 of which were events among patients with false-positive CT-FFR. After the adjustment of CT-FFR using a formula of $0.3X+0.634$ for CT-FFR<0.7 to counteract its underestimation, the estimated total cardiac event decreased to N=123.5 at the 0.8 cutoff and was minimized to N=110 (30.5% reduction) at a 0.75 cutoff. When the disease prevalence was 0.2, 5, and 10%, the % reduction of the events was 31.5%, 25.4% and 19.5%.

CONCLUSION

Adjustment of CT-FFR to counteract the underestimation decreased the estimated 1-year cardiac events up to 31.5% depending on the disease prevalence.

CLINICAL RELEVANCE/APPLICATION

When using a CT-FFR to decide revascularization, underestimation should be adjusted to reduce cardiac events attributable to false positive results, especially when the disease prevalence is low

SSJ04-03 Sexual Dimorphism in the Association between Coronary Plaque Burden and Coronary Wall Thickness in Asymptomatic Coronary Artery Disease

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S504AB

Awards

Trainee Research Prize - Fellow

Participants

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PURPOSE

To evaluate the relationship between coronary plaque burden measured by Computerized Tomography Angiography (CTA) and coronary wall thickness (VWT) using Magnetic Resonance Imaging (MRI) in a low/intermediate risk asymptomatic population. The study also is to assess the value of VWT-MRI as a surrogate marker of plaque burden alone or in tandem with traditional atherosclerosis risk factors.

METHOD AND MATERIALS

We prospectively evaluated 124 asymptomatic adults with one or more modifiable cardiovascular risk factors. All subjects signed

informed consent for this IRB approved study and underwent CTA and 3 Tesla (3T) VWT-MRI. Estimated risk for atherosclerotic disease, coronary calcification, and plaque burden scores including segment involvement (SIS), volume (SVS) and stenosis scores (SSS) were obtained for all subjects. Series of univariable and multivariable generalized nonlinear regression modeling with consideration for interactions with gender were performed to investigate the association of traditional atherosclerotic risk factors and VWT with plaque burden scores.

RESULTS

A total of 62 male and 62 age- and BMI-matched female asymptomatic subjects with low/intermediate Framingham score (FrS) <20% were successfully imaged. Age, gender, and VWT, individually, were significant predictors of all coronary plaque burden scores. Additionally, gender remained a significant effect modifier in all plaque burden scores. In women, VWT, while in men, age, were the only common statistically significant predictor of coronary plaque burden scores with a statistically significant interactions between VWT and sex for SIS ($\beta=0.792$, $P=0.024$) and for SSS ($\beta=1.292$, $P=0.009$).

CONCLUSION

In asymptomatic subjects with low/intermediate FRS there is evidence of a sex-dimorphic association between VWT and gender as a predictor of coronary plaque burden. MRI-based VWT could supplement traditional risk scores for CAD risk stratification in women. This is in line with the previous studies that demonstrated the suboptimal performance of CAD risk score models for women compared to men.

CLINICAL RELEVANCE/APPLICATION

Coronary wall thickness measured noninvasively by MRI is a surrogate for subclinical atherosclerosis in low and intermediate CAD risk asymptomatic women but not in a similar male population. This sex-specific difference is clinically relevant for CAD risk stratification, life style modification and therapy of CAD in women.

SSJ04-04 Prevalence of Unrecognized Myocardial Infarction Detected By Cardiac Magnetic Resonance and Its Relation to Coronary Artery Calcium Score in Asymptomatic Asian Cohort

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S504AB

Participants

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PURPOSE

To investigate the prevalence of unrecognized myocardial infarctions (UMIs) in asymptomatic Asian subjects, assessed with cardiac magnetic resonance (CMR), and to relate the findings to cardiovascular risk prediction scores and coronary artery calcium (CAC) scores.

METHOD AND MATERIALS

Total 519 asymptomatic subjects (male:female, 476:43; age, 54.54 ± 6.41) who underwent both CMR and CAC scoring CT, with their interval less than 1 year, were included. Those with prior hospital-reported cardiovascular event were not included. Framingham risk score (FRS), ACC/AHA risk score and CAC score were assessed based on clinico-laboratory results and imaging data. Comparison of variables between those with and without UMI was performed by use of Student's t-test, Mann-Whitney test, chi-square test and Fisher's exact test. The confidence level and cutoff value of CAC score was analyzed with the receiver operating characteristic (ROC) method.

RESULTS

Late gadolinium enhancement (LGE) indicating UMI was noted in 12 of 519 subjects (2.3%). However, none of them showed pathologic Q-wave or ST-segment change on electrocardiography (ECG). Among clinico-laboratory results and risk prediction scores, only CAC scores differed significantly between those with and without UMIs ($p < .001$). The prevalence of UMI was as follows: 10 of 275 (3.6 %) in subjects with CAC score > 0 and 2 of 244 (0.8 %) in subjects with CAC score = 0. Among those with CAC score > 0 , area under the ROC curve of CAC score for predicting UMI was 0.868 (95% CI, 0.823 - 0.906; $p < .001$). A CAC score with cutoff value of 301 demonstrated a sensitivity of 80.0% (95% CI, 44.4%-97.5%), a specificity of 86.0% (95% CI, 81.3%-90.0%), and a negative predictive value of 97.9% (95% CI, 95.0%-99.5%) in predicting UMI.

CONCLUSION

The prevalence of UMI in asymptomatic Asian subjects was 2.3%. CMR was a sensitive tool in depicting UMI and was superior to ECG. Those with CAC score above 301 can be potential candidates of CMR for UMI screening, as high CAC score is predictive of UMI.

CLINICAL RELEVANCE/APPLICATION

Asymptomatic individuals with CAC score above 301 are potential candidates of CMR for UMI screening, as high CAC score is predictive of UMI detected on CMR.

SSJ04-05 Correlation between Haptoglobin Phenotypes and Myocardial Reperfusion Injury in Consecutive ST-Elevation Myocardial Infarction as Detected by Cardiac Magnetic Resonance

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

Participants

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PURPOSE

Primary percutaneous coronary intervention (pPCI) has significantly reduced cardiovascular mortality of ST-segment elevation myocardial infarction (STEMI) patients. Cardiac magnetic resonance (CMR) has emerged as the gold standard technique for the measurement of the myocardial salvage index (MSI) and microvascular obstruction (MVO) over the traditional risk stratification. Aim of this study is to evaluate the correlation between variants of haptoglobin and myocardial reperfusion injury as detected by CMR in consecutive STEMI patients who underwent successful pPCI.

METHOD AND MATERIALS

Consecutive STEMI patients reperfused by primary PCI were enrolled. For each patient, the characterization of different phenotypes of haptoglobin was evaluated. Moreover, a CMR was performed by 1 week after STEMI evaluating: left ventricle ejection fraction (LVEF), MSI and prevalence and amount of MVO. The primary endpoint of study was to evaluate the correlation between different phenotypes of haptoglobin and myocardial reperfusion injury as detected by CMR.

CONCLUSION

Different variants of haptoglobin may play a crucial role in cardiac repair responses by reducing oxidative stress, maintaining microvascular integrity and proper scar formation. Further studies should be performed to evaluate if different therapeutic strategies should be developed based on phenotypes of haptoglobin of patients.

CLINICAL RELEVANCE/APPLICATION

haptoglobin may play a crucial role in cardiac repair responses and could represent a therapeutic target in order to reduce myocardial reperfusion injury.

SSJ04-06 Coronary to Pulmonary Artery Fistula in the Adult: Natural History and Management Strategies

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S504AB

Participants

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PURPOSE

To evaluate the natural history of coronary-to-pulmonary artery fistula (CPAF) detected on coronary CT angiography (CCTA) and to propose potential treatment strategies.

METHOD AND MATERIALS

The institutional review board approved this retrospective study and informed consent was waived. 12,436 CCTA scans were performed in our institute between March 2009 and June 2016, and 74 patients were diagnosed as CPAF. Among them, patients with a follow-up of at least 2 years were retrospectively reviewed. Demographics, clinical history, prior cardiac testing, and reasons for CCTA were collected by a review of electronic medical records. The morphologic features of CPAF were analyzed, including vessel of origin site and number, size, and the presence of an aneurysmal sac. All patients were examined to what treatment they received after the diagnosis of CPAF. We investigated whether there were major adverse cardiac events (MACE), which was defined as the presence of death, myocardial infarction, and the need for revascularization or percutaneous intervention during the follow-up period.

RESULTS

48 patients had a follow-up period of more than 2 years. The mean age of the study population was 62 years (range 43-84, 39% male), and average follow-up period was 5.1 years. Common causes of CCTA were chest pain, palpitation, asymptomatic in order. Underlying diseases were hypertension, coronary artery disease, hyperlipidemia, and diabetes. The origin of CPAF was the left coronary artery in 22, the right coronary artery in one and both coronary arteries in 23 cases. More than half of the fistula sizes were less than 2 mm (26 cases, 62%). 12 cases were associated with an aneurysm (mean 12±7.5 mm). 4 cases underwent surgical ligation due to continued chest pain or having a larger aneurysm (range 12-19 mm). After the operation, they were free of a symptom. Another 44 patients were observed with optical medical treatments (OMT) and their symptom was controlled well. All

patients treated either surgery or OMT did not experience MACE during the follow-up period.

CONCLUSION

The natural course of CPAF detected by CCTA is usually benign. Optimal medical treatment is sufficient in most of the cases. Continued symptom and aneurysmal size are determinant for surgical ligation.

CLINICAL RELEVANCE/APPLICATION

As a treatment strategy for CPAF, OMT and observation are first and in most cases that are enough.

SSJ05

Science Session with Keynote: Chest (Lung Nodule/MRI)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S404CD

CH MR OI

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

FDA Discussions may include off-label uses.

Participants

Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Moderator*) 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;
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Jurgen Biederer, MD, Heidelberg, Germany (*Moderator*) Nothing to Disclose

Sub-Events

SSJ05-01 Chest Keynote Speaker: Focal Lung Lesions: The Potential Role of MRI for the Assessment of Malignancy

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S404CD

Participants

Jurgen Biederer, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

ABSTRACT

In current practice, magnetic resonance imaging (MRI) of the lung is increasingly recognized as a valuable adjunct or even alternative to computed tomography (CT). Superior soft tissue contrast of morphologic sequences and the functional imaging capacities of MRI open new perspectives for detection and assessment of pulmonary malignancy. In a screening setting, applications range from lung MRI as the first choice screening modality to the role of an ad hoc on site test for the detailed evaluation of positive CT screening results with multi-parametric characterization of lung pathology. Malignant lung lesions, carcinoma, metastases, carcinoid and lymphoma usually show a nonspecific low or intermediate signal intensity on T1-weighted images and high signal intensity on T2-weighted images. Short tau inversion recovery (STIR) sequences achieve a sensitivity of approximately 80 % and a specificity of 60%. Dynamic contrast enhanced (DCE) MRI is based on the evaluation of contrast uptake in the assessed lesion after bolus injection. It achieves specificities of 50-95% and sensitivities of 50-100% with diagnostic accuracies of 75-94%, hence coming close to the accuracies of contrast enhanced MDCT and FDG PET/CT. As in dynamic CT, it can be assumed that DCE MRI of solid pulmonary lesions has a high negative predictive value in cases of very low or missing enhancement after intravenous contrast application. More recently, diffusion weighted imaging (DWI) has been advocated for the assessment of focal lung lesions. DWI yields sensitivities between 70% and 90% and specificities of 60-95% for malignancy. However, DCE and DWI MRI cannot yet be considered robust, highly standardized and simple techniques for clinical use. The applied protocols vary widely and solutions for basic problems such as compensation for respiratory motion and for the non-linearity of blood/tissue-signal with gadolinium-concentration are still subject to research. Further methods to evaluate tumor viability based on multi-parametric MRI are on an early, experimental level. The presentations comprised within this scientific session will contribute valuable insights into the further development, application, performance and diagnostic yield of these emerging techniques.

SSJ05-02 Diagnostic Performance of Diffusion-Weighted Imaging with Multiple Parameters for Assessment and Characterization of Pulmonary Lesions: A Meta-Analysis

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S404CD

Participants

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PURPOSE

Regarding DWI application in thoracic disease, several appropriate parameters have been reported, commonly including 5-point rank scale, lesion-to-spinal cord ratio (LSR) and apparent diffusion coefficient (ADC). This study aimed to evaluate the diagnostic performance of diffusion-weighted imaging (DWI) using these three parameters for the characterization of pulmonary lesions.

METHOD AND MATERIALS

After literature search in several databases (the PubMed, EMBASE, Cochrane library and China National Knowledge Infrastructure databases), two investigators independently selected studies, assessed methodological quality, and extracted data. On a per-lesion basis, we pooled and compared three parameters between malignant and benign pulmonary lesions. Then, we determined pooled sensitivity and specificity with individual 95% confidence intervals (CIs). In addition, the summary receiver operation characteristic curves (SROC) for DWI with area under the curve (AUC) and Q* index were constructed.

RESULTS

In total, 31 articles involving 2368 lesions were included. The score of 5-point scale of malignant and benign lesions were 3.83

(3.71-3.96) and 2.36 (2.18-2.54), respectively. The LSR of malignant and benign lesions were 1.15 (1.07-1.24) and 0.71 (0.62-0.79), respectively. The ADC values of malignant lesions and benign lesions were 1.23 (1.21-1.24) and 1.72 (1.68-1.77), respectively. All of three parameters differed significantly between malignant and benign lesions (Figure 1) ($p < 0.05$). With a cut-off value of 3, the pooled sensitivity and specificity were 0.88 (0.84-0.91) and 0.75 (0.68-0.80) for 5-point scale. The SROC curve displayed AUC of 0.9107 and Q^* index of 0.8429, respectively. For LSR, the pooled sensitivity, specificity, AUC and Q^* index were 0.80 (0.75-0.85), 0.85 (0.76-0.92), 0.9159 and 0.8487, respectively. The ADC measurements yielded the pooled sensitivity of 0.84 (0.82-0.86), pooled specificity of 0.84 (0.81-0.87), AUC of 0.9198, and Q^* index of 0.8532.

CONCLUSION

DWI can help to distinguish malignant from benign pulmonary lesions based on visual parameter (5-point scale), semiquantitative parameter (LSR) and quantitative parameter (ADC).

CLINICAL RELEVANCE/APPLICATION

In clinical practice, 5-point scale, LSR, and ADC were useful diagnostic parameters for pulmonary lesions, and the diagnostic performances of them did not show any significant differences.

SSJ05-03 Assessment of Intravoxel Incoherent Motion Diffusion-Weighted MR Imaging in Solitary Pulmonary Nodules: Comparison and Correlation with Dynamic Contrast-Enhanced MR Imaging

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S404CD

Participants

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PURPOSE

To compare intravoxel incoherent motion (IVIM) and dynamic contrast-enhanced MR imaging (DCE-MRI) in their ability to discriminate lung cancer (LC) from benign pulmonary lesions.

METHOD AND MATERIALS

57 consecutive patients with solitary pulmonary nodules underwent DW-IVIM (multi-b-factor DWI with b values of 0, 20, 50, 100, 150, 200, 400, 600, and 1000 s/mm²) and DCE-3.0T MRI. ADC_{total}, Tissue diffusivity (D), pseudo-diffusion coefficient (D*), and perfusion fraction (F) were calculated with mono-exponential and IVIM models. MER, T_{max}, SLE and washout were calculated with semi-quantitative DCE analysis. Receiver operating characteristic (ROC) curves were constructed to estimate the diagnostic performance of both methods in differentiating diagnosis and the optimal cut-off values were obtained.

RESULTS

ADC_{total} and D were significantly higher for benign lesions than for LC ([1.83±0.66] × 10⁻³ mm²/s vs. [1.30±0.40] × 10⁻³ mm²/s; $P = 0.005$; [1.33±0.43] × 10⁻³ mm²/s vs. [0.88±0.29] × 10⁻³ mm²/s; $P = 0.002$). D* was found to be significantly higher in LC than benignity ([50.65±46.08] × 10⁻³ mm²/s vs. [19.68±30.54] × 10⁻³ mm²/s; $P = 0.005$). No difference was observed in F between LC and benignity ($P = 0.06$). By DCE-MRI, T_{max} were significantly shorter in LC than that of benignity ([131.6±83.4] s vs. [309.7±126.0] s; $P = 0.005$).

Both IVIM model based on DWI and DCE-MRI were useful for discriminating benign lesions from malignant pulmonary nodules, and can provide quantitative diffusion and perfusion information by multiple parameters. We suggest that a combined DCE and IVIM could provide a more promising way in determination microstructure characteristics of solitary pulmonary nodules.

CLINICAL RELEVANCE/APPLICATION

Combination of DCE and IVIM could provide an alternative noninvasive method for diagnosis of SPN without radiation exposure.

SSJ05-04 How to Apply Computed Diffusion-Weighted Image for Improving Diagnostic Performance of Chest MR Imaging in Patients with Pulmonary Nodules?

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S404CD

Participants

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PURPOSE

To determine the utility of computed diffusion-weighted image (cDWI) for improving diagnostic performance on chest MR imaging in patients with pulmonary nodules.

METHOD AND MATERIALS

61 consecutive patients (38 men and 23 women; mean age, 69.1±9.7 years) with 82 pulmonary nodules underwent DWIs,

transbronchial or CT-guided biopsies, surgical resection, pathological, microbacterial and follow-up examinations. All DWI were obtained at a 3T MR system by using fast advanced spin-echo (FASE) sequence with b values at 0 and 1000s/mm². As well as actual DWI at 1000s/mm² (aDWI), cDWIs were generated at b value as 400 (cDWI400), 600 (cDWI600), 800 (cDWI800), 1000 (cDWI1000), 1500 (cDWI1500) and 2000 (cDWI2000) s/mm² by commercially available software. According to results of pathological and follow-up examinations, all nodules were divided into malignant (n=41) and benign (n=41) nodule groups. Then, signal-to-noise ratio (SNR) and contrast ratio (CR) between nodule and thoracic muscles were determined by ROI measurement at each nodule. To compare image quality between aDWI and each cDWI, SNRs were compared by Dunnett multiple comparison test. To determine the utility of cDWI with aDWI, the logistic regression analysis was also performed with aDWI and all cDWIs. To compare diagnostic performance of pulmonary nodule, ROC analyses were performed among aDWI, each DWI and combined aDWI with appropriate cDWI determined by logistic regression analysis. Finally, sensitivity, specificity and accuracy were compared by McNemar's test.

RESULTS

SNRs of cDWI400 (p=0.002) and cDWI600 (p=0.008) were significantly higher than that of aDWI1000, although that of cDWI1500 (p<0.001) and cDWI2000 (p<0.001) were significantly lower than that of aDWI1000. Logistic regression analysis showed aDWI and cDWI600 were significant predictors for diagnosis of malignancy (p<0.05). Accuracy of aDWI with cDWI600 (86.6 [71/82] %) was significantly higher than that of aDWI (81.7 [67/82] %, p<0.05).

CONCLUSION

Computed DWI has a potential to improve diagnostic performance of DWI in patients with pulmonary nodules, when generated at appropriate b value.

CLINICAL RELEVANCE/APPLICATION

Computed DWI has a potential to improve diagnostic performance of DWI in patients with pulmonary nodules, when generated at appropriate b value.

SSJ05-05 The Value of Differential Diagnosis the Invasive Adenocarcinoma of Lung in 3T MRI

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S404CD

Participants

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PURPOSE

To investigate the value of magnetic resonance imaging (MRI) in differential diagnosis of invasive pulmonary adenocarcinoma (IPA) appearing as ground-glass nodules

METHOD AND MATERIALS

Retrospective analysis was performed on CT and MRI findings in patients with pulmonary ground-glass nodules from December 2014 to December 2016. All patients were undergo the surgery and pathologically proved, they were pre-cancerous lesions or clinical stage 1 of lung adenocarcinoma. The image features of the lesions were analyzed by two readers who did not know the pathological results. Maximum diameter, T2 signal intensity and ADC value were measured. According to the pathology, the lesions were divided into two groups. One included pre-invasive lesion (AAHs and AISs) and MIAs, another included IPAs. Compared the 3 indicators between two groups. All statistical analyses were performed using SPSS 21.0. The measurement data were analyzed by using two independent samples t test, If it was suitable for the normal distribution, otherwise using Mann-Whitney U test. Count data were compared using chi square test. Receiver operating characteristic (ROC) curve analysis were performed to evaluate diagnostic test.

RESULTS

A total of 34 participants (14 male, 57.1±14.7 year-old; 20 female, 54.9±10.1 year-old) with 34 nodules were enrolled in the study. There were 15 cases in group A, including 4 AAH, 2 AIS and 9 MIA, and 19 cases in group B. There was no significant differences in the age of patient and gender between the two groups. The maximum diameter of lesions in group A was significantly less than that in group B (9.9±2.6mm vs 13.1±2.7mm). The T2 signal intensity of lesions in group A was significantly lower than that in group B (93.0±8.3 vs 113.6±22.9). The ADC value in group A (1.0±0.2*10⁻³ mm²/s) was also significantly lower than that in group B (1.3±0.3*10⁻³ mm²/s). The best index to distinguish the two groups is the maximum diameter of lesions. The optimal cut-off value for maximum diameter was 11.5mm (sensitivity, 73.7%; specificity, 73.3%). The AUC for maximum diameter was 0.791 (95% confidence interval: 0.640, 0.942).

CONCLUSION

The maximum diameter of the nodule, T2 signal intensity and ADC value are helpful for differential diagnosis of invasive lung adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION

The maximum diameter of the nodule, T2 signal intensity and ADC value are helpful for differential diagnosis of invasive lung adenocarcinoma.

SSJ05-06 Primary Tumor Cellularity Assessed on Diffusion Weighted MRI and Metabolism Assessed on PET/CT as Predictive Factors for Lymph Node Involvement in Non-Small Cell Lung Cancer (NSCLC)

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S404CD

Participants

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PURPOSE

The aim of this study was to prospectively analyze the potential role of primary tumor apparent diffusion coefficient (ADC) derived from whole body MRI (WB-MRI) with diffusion weighted imaging (DWI) and metabolic parameters derived from FDG PET/CT in predicting pathologically assessed lymph node metastasis in non-small cell lung cancer (NSCLC) patients before treatment.

METHOD AND MATERIALS

Ethic committee approval was obtained for this prospective study as well as written informed consent from every patient. The study group comprised 32 consecutive patients (mean age: 67yrs) with histologically proven NSCLC (SCC n= 8 and AC n=24) who underwent 1.5 T WB-MRI with DWI and FDG PET/CT before treatment. Maximum diameter (maxTD) and minimum and mean ADC (ADCmin and ADCmean) of primary tumor were calculated on DWI images (b-values 0-1000). Maximum standardized uptake value (SUVmax), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) were measured on FDG PET/CT. Presence of lymph node (LN) metastases was pathologically assessed and served as reference standard. Relationships between imaging metrics and LN status were evaluated using the Mann-Whitney U test. The area under the receiver operating characteristic (ROC) curve was used to evaluate accuracy.

RESULTS

Lymph node metastasis were documented in 11 patients (34%). There were significant correlations between primary tumor maxTD, ADCmean, MTV, TLG and presence of LN metastasis (p: 0.05, 0.05, 0.04 and 0.04 respectively). ADCmin and SUVmax were not associated with LN metastasis. On ROC curve analysis, the areas under the curve (AUC) for maxTD, ADCmean, MTV and TLG for were 0.71, 0.70, 0.71 and 0.73 respectively, for predicting LN status.

CONCLUSION

Parameters derived from pre-treatment WB-MRI with DWI (maxTD and ADCmean) and from FDG PET/CT (MTV and TLG) may serve as predictive biomarkers of lymph node metastasis in patients with non small cell lung cancer.

CLINICAL RELEVANCE/APPLICATION

Diffusion weighted MRI and FDG PET/CT functional characteristics of the primary tumor can be used for predicting pathologic lymph-node involvement in NSCLC patients.

SSJ06

Emergency Radiology (Neuroradiology)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: N227B

CT ER NR

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

Participants

Clint W. Sliker, MD, Ellicott City, MD (*Moderator*) Nothing to Disclose
Jamlik-Omari Johnson, MD, Atlanta, GA (*Moderator*) Research Grant, Koninklijke Philips NV; Royalties, Cambridge University Press

Sub-Events

SSJ06-01 Evaluation of CT Time Efficiency in Acute Stroke Response

Tuesday, Nov. 28 3:00PM - 3:10PM Room: N227B

Participants

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Aaron S. Field, MD, PhD, Madison, WI (*Abstract Co-Author*) Research Grant, General Electric Company
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Timothy P. Szczykutowicz, PhD, Madison, WI (*Abstract Co-Author*) Equipment support, General Electric Company; License agreement, General Electric Company; Founder, Protocolshare.org LLC

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PURPOSE

Time-efficient CT imaging in acute stroke is essential for improving patient outcomes. This can be systematically evaluated using imaging timestamps. In this work, we retrospectively analyzed CT imaging speed in acute stroke response and compared performance between different scanners, times of day, and technologists.

METHOD AND MATERIALS

We extracted timestamps related to image acquisition, reconstruction, and availability in PACS from 636 complete acute stroke CT exams at a single institution under IRB approval. Exams were sorted by technologist, scanner location, and time of day. To investigate differences in efficiency by scanner location and exam time, we used Mann-Whitney U tests to compare the time of acquisition and time to PACS for each of the four series in our stroke CT protocol (head without contrast, CTA, perfusion, head with contrast). Non-parametric tests were used to investigate differences in efficiency by scan operator, including a Kruskal-Wallis test and *post hoc* Mann-Whitney U tests.

RESULTS

A significant increase in time from exam start to image availability for interpretation was observed in all series from exams performed on the Emergency Department (ED) back-up scanner in Radiology compared to those performed on the dedicated CT in the ED ($p < 0.001$, median 3-4 min depending on series). This was despite there being no significant difference in image acquisition time. Despite increased acquisition time during overnight shifts, CTA, perfusion, and head with contrast series were available in PACS significantly sooner during the night shift ($p < 0.01$, median 2-3 min). Comparisons between CT technologists indicated significant differences between operators in exam acquisition time and time to image availability in PACS ($p < 0.05$, median time differed by up to 5.5 and 14 min, respectively).

CONCLUSION

There were significant differences in the speed of image acquisition, processing, and availability for interpretation based on scanner location, time of day, and operator. These findings can direct our efforts for improved training and more rapid acute stroke care. This method of quality analysis will be useful for continued monitoring of performance in the future.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates a method for performance monitoring in stroke care using imaging timestamps. The results indicate new areas for quality improvement in our institution's acute stroke workflow.

SSJ06-02 Dual Energy CT Angiogram of the Head: Quantifying Iodine Concentration in Acute Ischemic Stroke

Tuesday, Nov. 28 3:10PM - 3:20PM Room: N227B

Participants

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Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG

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PURPOSE

Non-contrast CT and CTA provides a rapid, accessible and accurate assessment of parenchymal infarction in acute ischemic stroke (AIS). CTA has also been shown to demonstrate areas of low cerebral blood volume in regions of infarction. The advent of dual energy/spectral imaging presents the potential to quantify iodine in the region of infarct. Our study aims to assess whether iodine quantification can reliably differentiate between infarcted and normal brain in patients presenting with AIS.

METHOD AND MATERIALS

A retrospective study on patients that presented to the Emergency Department (ED) at our institution between January and April, 2016, with clinical suspicion of acute MCA territory infarction within the last 4 hours and underwent contrast enhanced DECT angiogram of the head and neck (N = 34). Catheter angiography served as the reference standard. Images were acquired on a third generation dual-source, DECT scanner at 90 kV and Sn150 kV. Iodine Overlay (IO) images were reconstructed and iodine measurements were normalized to that of the precentral gyrus on the unaffected side. ROIs were drawn over the insular cortex, basal ganglia (BG) and white matter (WM) external capsule in the region of the ischemia and contralateral normal parenchyma to measure iodine concentration and calculate percentage uptake. Mean values were compared between normal and ischemic parenchyma.

RESULTS

The mean iodine concentration and percent iodine values for the normal and ischemic brain tissues were as follows: 1.01 ± 0.04 mg/ml and $92.69\% \pm 2.2$ for normal insula and $0.26 \text{ mg/ml} \pm 0.03$ and $23.41\% \pm 2.2$ for ischemic insula; $0.35 \text{ mg/ml} \pm 0.03$ and $29.75\% \pm 2.2$ for normal WM and $0.13 \text{ mg/ml} \pm 0.02$ and $10.48\% \pm 1.4$ for ischemic WM; and $0.7 \text{ mg/ml} \pm 0.05$ and $65.12\% \pm 3.7$ for normal BG and $0.28 \text{ mg/ml} \pm 0.04$ and $24.68\% \pm 3.5$ for ischemic BG. Infarcted brain GM, WM, and BG exhibited statistically significant less iodine concentration compared to their normal counterparts ($p < 0.0001$).

CONCLUSION

Iodine quantification in DECT reliably differentiated between normal and infarcted brain tissue in our study. Its use in the acute stroke imaging protocol improved detection of acute infarcts on DECTA images of the head.

CLINICAL RELEVANCE/APPLICATION

Iodine quantification in DECTA images may improve detection of acute infarcts in patients presenting with acute stroke symptoms.

SSJ06-03 Impact of Reader Experience and Greyscale Inversion on the Detection of Emergent Large Vessel Occlusion Stroke with CT Angiography

Tuesday, Nov. 28 3:20PM - 3:30PM Room: N227B

Participants

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PURPOSE

CT angiography (CTA) is now an essential component of acute stroke imaging protocols to confirm or exclude the presence of emergent large vessel occlusion (ELVO) stroke. ELVO detection must be possible at all levels of training and without sub-specialized training. This study examines sensitivity, specificity, agreement, reading time, time to detection, and self-reported confidence for ELVO detection between neuroradiologists, non-neuroradiologists, and residents using both greyscale inversion (black blood) and normal viewing conditions.

METHOD AND MATERIALS

A random and counterbalanced experimental design was used, where 16 radiologists (10 attendings, 6 residents) read the same patient images with and without greyscale inversion, counterbalanced by a one month separation, while being blinded to patient information (radiologist and patient were held constant). Positive and negative ELVO cases ($n=52$) were randomly ordered using a balanced design (26 vs. 26) to optimize detection of changes in sensitivity and specificity; PPV/NPV were used for group comparisons, not estimation. Diagnostic performance, including sensitivity, specificity, PPV, NPV, as well as confidence, and read and detection time were examined between by experience and greyscale inversion (on/off) using generalized mixed modeling assuming a binary, negative binomial, and binomial distributions, respectively, where observations were nested within radiologist

within patient (SAS/GLIMMIX).

RESULTS

No differences were detected between greyscale inversion on/off and between groups concerning diagnostic performance ($p=0.34$), detection time ($p=.15$), overall read time ($p=.97$), and confidence ($p=.06$). Differences were observed between level of training: residents were less confident than attendings, and neurorads were faster than non-neuro rads and residents concerning read time, all $p<.01$. Lack of differences between on/off are not surprising, given that sensitivity, specificity, PPV, NPV were very high to begin with little room for improvement (ceiling effect).

CONCLUSION

ELVO detection with CT angiography is accurate across all levels of training and experience. Greyscale inversion offered no significant detection advantage.

CLINICAL RELEVANCE/APPLICATION

These results show that diagnostic performance and time to detection are very good, regardless of training and specialty, for an examination that must be a part of the initial hospital evaluation of stroke patients.

SSJ06-04 The Utility of Virtual Non-Contrast Images in Assessment of Acute Intracranial Pathology

Tuesday, Nov. 28 3:30PM - 3:40PM Room: N227B

Participants

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PURPOSE

The purpose of this study is to evaluate whether virtual non-contrast (VNC) images derived from DE CT angiography (CTA) are as reliable as true non-contrast CT (NCCT) images in detecting brain hemorrhage and infarcts.

METHOD AND MATERIALS

A total of 56 patients with acute stroke symptoms were retrospectively identified between January and April 2016 from a single institution's emergency department. All the patients underwent both an NCCT and DE CTA. DE images were acquired at 90 kV and Sn 150 kV. Quantitative analysis of the NCCT and VNC Head images were performed using circular region of interests (ROIs) centered on the basal ganglia, internal capsule and the superior sagittal sinus. Mean Hounsfield Units (HU) \pm noise was calculated. Two radiologists were blinded and retrospectively interpreted the VNC CT images in comparison to the routine NCCT, assessing for pathology and diagnostic acceptability. The studies were graded on a 5 point Likert scale with 1 being a non-diagnostic examination and 5 representing a diagnostic study similar to a TNC scan. Sensitivity and specificity of VNC at detecting hyperdense-vessel sign, hemorrhage and infarction.

RESULTS

There was no significant difference between attenuation values for the basal ganglia, internal capsule and superior sagittal sinus on TNC ($38.6 \text{ HU} \pm 0.57$, $30.3 \text{ HU} \pm 0.56$ and $56.5 \text{ HU} \pm 1.4$) and VNC ($35.6 \text{ HU} \pm 1.6$, $30.5 \text{ HU} \pm 1$ and $56.2 \text{ HU} \pm 5.2$) ($p > 0.1$). Sensitivity and specificity of VNC for detection of hemorrhage, hyperdense-vessel sign and infarct was 100% and 100%, 80% and 77.4% and 38.2% and 100% respectively.

CONCLUSION

VNC images were as reliable as TNC images for detecting hemorrhage and demonstrated acceptable performance in detecting hyperdense-vessel sign. However, VNC images did not reliably detect infarct as compared to TNC images.

CLINICAL RELEVANCE/APPLICATION

VNC images can reliably diagnose intracranial hemorrhage, however, are not as of yet reliable to forgo the inclusion of a TNC scan in cases of suspected infarction.

SSJ06-06 Temporal Changes and Spectrum of Findings on Follow-up CT Angiogram in Patients with Suspected Post-traumatic Blunt Cerebrovascular Injury

Tuesday, Nov. 28 3:50PM - 4:00PM Room: N227B

Participants

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PURPOSE

Blunt cerebrovascular injury (BCVI) is a rare but potentially devastating diagnosis. If left undiagnosed and untreated, the incidence of ischemic stroke is reported to be as high as 64%. Follow-up imaging is recommended in suspected or confirmed cases of BCVI within 24-48 hours. Our study establishes the temporal changes and findings on follow-up imaging.

METHOD AND MATERIALS

For this retrospective, IRB-approved study, the hospital trauma registry was queried for all poly-trauma patients undergoing CTA scans performed in the emergency department between January 1, 2010 to December 31, 2016 with ISS \geq 16, yielding 3747 patients. A total of 205 patients had follow up CTs for BCVI. Note was made of the grade and location of injury as well as associated traumatic injuries. GCS at the time of admission was also recorded.

RESULTS

Vehicular collision was the most common mechanism of injury (66%). The majority of patients (62%) had a GCS of 10-15. 18 cases (9%) had GCS of 3-9 and 53 patients (26%) were unresponsive at the time of presentation. 6 patients were intubated at the scene. Vertebral fractures were the most common associated injuries (54%), Intracranial hemorrhage in 42%, skull fractures in 26% and facial fractures in 29% of patients. 16% of patients had no associated injuries. The overall incidence of BCVI in our study was 4.8%. 59% of injuries involved the vertebral arteries (101) and 41% involved the internal carotid arteries (71). On the initial CTA 48% of injuries were Grade I, 27% were Grade II, 6% were Grade III, 18% were Grade IV and 1% were Grade V. On follow-up CTA, Grade I injuries made up 43% of cases, 18% were Grade II, 18% were Grade III, 20% were Grade IV and there were no Grade V injuries on follow up. 45% of all BCVI remained unchanged on follow-up imaging, 42% improved and 13% worsened on follow-up imaging. All patients with diagnosis or suspicion of BCVI received medical therapy within 24 hours of diagnosis. 6 patients underwent image guided vascular intervention.

CONCLUSION

Aggressive screening for BCVI in trauma enables early diagnosis and management of injuries. Low grade injuries are more likely to demonstrate changes on follow-up imaging. The majority of cases demonstrated improvement compared baseline.

CLINICAL RELEVANCE/APPLICATION

It is important to recognize that BCVI may improve or worsen on follow up imaging, which may affect management and patient outcomes.

SSJ07

Gastrointestinal (Radiomics)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E350

CT **GI** **MR** **PH**

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

Participants

Andrew D. Smith, MD, PhD, Jackson, MS (*Moderator*) 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
Kathryn J. Fowler, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

SSJ07-01 Radiomics-Based Quantification and Classification of the Phenotype of Pancreas Cystic Neoplasms on Abdominal CT Images

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E350

Participants

Seyoun Park, Baltimore, MD (*Presenter*) Nothing to Disclose
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PURPOSE

Pancreatic cystic masses are detected in greater than 2% of abdominal CTs, and they vary in malignant potential based on underlying pathologic diagnosis. Many of these cystic masses share overlapping imaging features and are difficult to confidently diagnose based on visual assessment of these imaging features. The purposes of this study are to quantify the phenotype pancreas cystic neoplasms and to use these radiomics features to classify different types of pancreatic cystic masses.

METHOD AND MATERIALS

This was an IRB-approved retrospective study. 103 patients with pathologically proven pancreatic cystic masses with preoperative dual-phase pancreatic protocol CT were identified from the radiology and pathology database from 2003 to 2016. This included 60 intraductal papillary mucinous neoplasm (IPMN), 8 mucinous cystic neoplasm, 20 serous cystadenoma, 10 solid pseudopapillary epithelial neoplasm, and 5 pancreatic neuroendocrine tumor. Primary cystic masses and whole pancreas were manually segmented using dedicated software, the Medical Imaging Interaction Toolkit (MITK). The phenotype of each cyst was expressed by 478 radiomics features, including the first order statistics, shape, texture, and textures from wavelet and Laplacian of Gaussian. Additional 10 statistics from the whole pancreas and 2 demographic features of age and gender were also used for the analysis of the types of cyst. The minimum redundancy maximum relevance feature selection was applied for feature dimension reduction.

RESULTS

Among the whole 490 features, thirty features were found for the binary classification of IPMN. The matching results to clinical outcomes show 0.883 of sensitivity and 0.721 of specificity with 81.6% of overall accuracy (AOC area: 0.873). For all five types, thirty-five features were extracted with 72.8% of correctly classified cases by 10-fold cross validation. Age, median and mean intensities of wavelets, and fractal dimension were highly ranked for the both classifications.

CONCLUSION

Radiomics features were significantly different among different types of pancreatic cystic neoplasms and were helpful for the classification of pancreatic cystic neoplasms.

CLINICAL RELEVANCE/APPLICATION

Radiomics features can be used for the classification of pancreatic cystic neoplasms.

SSJ07-02 Radiomics Approach to Characterize Microsatellite Instability (MSI): A CT-Based Radiomic Signature for the Detection of the MSI-H Phenotype in Colorectal Cancer

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E350

Participants

Yanqi Huang, Guangzhou, China (*Presenter*) Nothing to Disclose
Zaiyi Liu, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop and validate a CT-based radiomic signature for the preoperative detection of the MSI-H (high levels of microsatellite instability) phenotype in patients with colorectal cancer.

METHOD AND MATERIALS

Ethical approval by the institutional review board was obtained for this retrospective analysis, and the informed consent was waived. The primary cohort of this study consisted of 140 patients with clinicopathologically confirmed CRC, with data gathered from January to December 2011; while the independent validation cohort consisting of 114 consecutive patients collected from January to December 2012. 591 radiomic features were extracted from preoperative portal venous-phase computed tomography (CT) of CRC. Lasso regression model was used for data dimension reduction, feature selection, and radiomics signature building. The discrimination and calibration performance of the developed radiomics signature was assessed in primary cohort and then validated in the independent validation cohort.

RESULTS

After feature reduction and selection, 29 radiomics features were used to develop the radiomic signature. In both the primary and validation cohort, the radiomic signature was significantly associated with the MSI-H phenotype ($P < 0.001$ for primary cohort; $P = 0.012$ for validation cohort). The radiomic signature showed good discrimination, with a C-index of 0.914 (95%CI: 0.901, 0.927) in primary cohort and 0.702 (95%CI: 0.677, 0.727) in validation cohort. Good calibration of the radiomic signature was depicted in calibration curves in both the primary and validation cohort.

CONCLUSION

This study presents a CT-based radiomic signature that can be conveniently used to facilitate the preoperative individualized detection of MSI-H phenotype in CRC patients, which could be useful for informing patient prognosis and guiding the personalized therapy of CRC including adjuvant chemotherapy, targeted therapy, and immune checkpoint inhibitor therapy.

CLINICAL RELEVANCE/APPLICATION

The developed and validated CT-based radiomic signature could facilitate the preoperative individualized detection of MSI-H phenotype CRC, which further advances the role of MSI in informing patient prognosis and guiding the personalized therapy of CRC including adjuvant chemotherapy, targeted therapy, and immune checkpoint inhibitor therapy.

SSJ07-03 Comparison between Radiomics Analysis and Subjective Visual Assessment of T2-weighted MRI Images for the Identification Of $\geq T3$ Rectal Cancer

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E350

Participants

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PURPOSE

To determine if radiomics outperforms visual assessment based on T2-weighted imaging (T2-W) for the discrimination between $\leq T2$ and $\geq T3$ rectal cancer

METHOD AND MATERIALS

The study included all patients with rectal cancer who underwent total mesorectal excision as primary curative treatment, without neoadjuvant therapy, at our institution, between October 2013 and December 2016 ($n=26$, 14 males, mean age=67 years). Two patient groups were formed based on pathological stage, $\leq T2$ ($n=13$) and $\geq T3$ ($n=13$). All patients underwent staging MRI before surgery comprising T2-W imaging in axial, coronal and sagittal planes. T2-W images were blindly reviewed in consensus by 2 radiologists and primary tumors were classified as $\geq T3$ or $\leq T2$. A volume of interest (VOI) was drawn in consensus by the 2 radiologists, based on axial T2-W images, encompassing the whole primary tumor and corresponding datasets were analyzed using the PyRadiomics package. Wilcoxon-Mann-Whitney test was used to define the discriminating power between the 2 groups, of each of the 1831 features separately. Feature reduction was done using a cut-off correlation coefficient of 0.99 to remove redundant features. Multiple comparisons correction was done based on an FDR test. The best performing feature was selected, and its diagnostic accuracy was compared to that of visual radiological assessment using DeLong's test

RESULTS

23 radiomics features provided with statistically significant differences ($p < 0.05$) between the 2 groups, while the best performing feature was the Low Gray Level Run Emphasis - GLRLM of the exponential of the original image with sensitivity, specificity and area under the ROC curve (AUROC) of 0.79, 0.92 and 0.92, respectively. Sensitivity, specificity and AUROC were 0.93, 0.67 and 0.80, respectively, for visual radiological evaluation. The performance difference between visual assessment and radiomics analysis was not statistically significant ($p=0.21$)

CONCLUSION

Our preliminary results indicate that radiomics analysis doesn't provide higher performance compared to visual radiological assessment for the identification of $\geq T3$ rectal cancer based on T2-W images.

CLINICAL RELEVANCE/APPLICATION

Radiomics analysis and difficult issues in rectal cancer staging: applicability in the identification of $\geq T3$ rectal cancer

SSJ07-04 Predicting Early Recurrence of Hepatocellular Carcinoma with Texture Analysis of Pre-Operative Magnetic Resonance Imaging: A Radiomics Study

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E350

Awards

Student Travel Stipend Award

Participants

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Zi Lin Tan, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose
Reena Divya, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose
Cher Heng Tan, MBBS, FRCS, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To study the feasibility of using texture analysis in pre-operative magnetic resonance imaging (MRI) to predict early recurrence (ER) in hepatocellular carcinoma (HCC) post-curative surgery.

METHOD AND MATERIALS

Institutional review board was obtained. A retrospective review of all patients who underwent hepatectomy between 1 Jan 2007 and 31 Dec 2015 was performed. Inclusion criteria: pre-operative MRI, tumor size ≥ 1 cm, new cases of HCC. Exclusion criteria: Loss-to-follow-up, ruptured HCCs, movement artifacts and previous hepatectomy or interval adjuvant therapy. Patients were divided into ER and late or no recurrence (LNR) groups. Early recurrence was defined as new foci of HCC within 730 days of curative surgery. Plain, diffusion-weighted, arterial and portovenous acquisitions were imported into MATLAB (Mathworks, Matick, MA, USA). Radiomics feature extraction was performed on the largest cross-sectional area of each tumor. MaZda software (version 4.6.2.0) was used to analyze 290 texture parameters and PRTtools was used for feature selection.

RESULTS

Fifty-seven patients (49 male, mean age 66.5 years) were divided into ER (n=21) and LNR (n=36) groups. Differences in alpha-fetoprotein level (p=0.021), tumor size (p=0.011), restricted diffusion (p=0.01) and vascular invasion (gross and/or microvascular, p=0.047) between the 2 groups were found to be statistically significant. Texture analysis revealed 79% accuracy in classifying arterial images using 1-nearest neighbor using parameters S(1,0)Contrast or S(5,-5)Entropy. The parameter S(5,-5)Entropy has also resulted in 77% accuracy in classifying T2 images.

CONCLUSION

Early recurrence of HCC can be predicted on pre-operative MRI with 79% accuracy using the appropriate texture analysis parameter.

CLINICAL RELEVANCE/APPLICATION

Post-operative recurrence of HCC results in mortality and the time-to-recurrence duration is an independent prognostic factor of survival. The ability to identify these high-risk patients pre-operatively will potentially guide both surgical management, such as resecting a wider margin or liver transplantation, as well as post-operative surveillance and therapeutic interventions.

SSJ07-05 Quantification of Hepatocellular Carcinoma Heterogeneity with Multiparametric Magnetic Resonance Imaging

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E350

Awards

Trainee Research Prize - Resident

Participants

Stefanie Hectors, PhD, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

To quantify heterogeneity in hepatocellular carcinoma (HCC) using multiparametric (mp) magnetic resonance imaging (MRI), and to

report preliminary data correlating quantitative MRI parameters with histopathology and gene expression in a subset of patients.

METHOD AND MATERIALS

Thirty-two HCC patients (M/F 26/6, mean age 59 years) with 39 HCC lesions were included in this prospective study. The mpMRI protocol consisted of diffusion-weighted imaging (DWI), blood-oxygenation-level-dependent (BOLD), tissue-oxygenation-level-dependent (TOLD) and dynamic contrast-enhanced (DCE)-MRI. Histogram characteristics [central tendency (mean, median) and heterogeneity (standard deviation, kurtosis, skewness) MRI parameters] in HCC and liver parenchyma were compared using Wilcoxon signed-rank tests. Histogram data was correlated between MRI methods in all patients and with histopathology and gene expression in 14 patients.

RESULTS

HCCs exhibited significantly higher intra-tissue heterogeneity vs. liver with all MRI methods ($P < 0.042$). Although central tendency parameters showed significant correlations between MRI methods and with each of histopathology and gene expression, heterogeneity parameters exhibited additional complementary correlations between BOLD and DCE-MRI and with histopathologic hypoxia marker HIF1a and gene expression of Wnt target GLUL, pharmacological target FGFR4, stemness markers EPCAM and KRT19 and immune checkpoint PDCCD1.

CONCLUSION

Histogram analysis combining central tendency and heterogeneity mpMRI features is promising for noninvasive HCC characterization on the imaging, histologic and genomics level.

CLINICAL RELEVANCE/APPLICATION

The proposed mpMRI approach could potentially be used to stratify hepatocellular carcinoma treatment and to noninvasively predict treatment outcome.

SSJ07-06 Prediction of Target Therapy Related Gene Expression Level for Hepatocellular Carcinoma: Preoperative Gd-EOB-DTPA Enhanced MRI and Histopathological Correlation

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E350

Participants

Kun Huang, Guiyang, China (*Presenter*) Nothing to Disclose
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PURPOSE

Our aim of the study is to investigate the feasibility of prediction for target therapy related gene expression level in hepatocellular carcinoma (HCC) using preoperative Gd-EOB-DTPA enhanced magnetic resonance imaging (MRI).

METHOD AND MATERIALS

91 patients with solitary HCC who underwent preoperative Gd-EOB-DTPA enhanced MRI were prospectively analyzed. Features including tumor size, signal homogeneity, tumor capsule, tumor margin, intratumoral vessels, peritumor enhancement in mid-arterial phase, peritumor hypointensity during hepatobiliary phase, signal intensity ratio on DWI and apparent diffusion coefficients (ADCs), T1 relaxation times and the reduction rate between pre- and post-contrast enhancement images were assessed. HCC target therapy related gene (B-Raf, Raf-1, VEGFR2, VEGFR3) expression level in excision specimens were evaluated using immunohistochemical staining. Correlation between these MRI features and B-Raf, Raf-1, VEGFR2, VEGFR3 gene expression level were analyzed by Rank sum test, Spearman correlation and multivariate logistic regression so as to establish a prediction model.

RESULTS

Univariate analysis showed that tumor incomplete or non capsule ($p < 0.001$), intratumoral vessels ($P = 0.002$) were significantly related with the B-Raf gene expression level, and tumor capsule status ($p = 0.001$), intratumoral vessels ($P = 0.013$) significantly correlated with the Raf-1 gene expression level. There was no significant association between the expression level of VEGFR2, VEGFR3 and all the MRI features. Multivariate logistic regression analysis demonstrated that incomplete tumor capsule ($P = 0.002$, OR=11.870, 95% CI: 2.473~56.975) or non capsule ($P = 0.004$, OR=15.750, 95% CI: 2.373~104.537) were independent risk factors of HCC with high B-Raf gene expression level, and incomplete tumour capsule ($P < 0.001$, OR=11.250, 95%CI: 3.206~39.474) or non capsule ($P = 0.040$, OR=5.556, 95%CI: 1.078~28.635) were independent risk factors of HCC with high Raf-1 gene expression level.

CONCLUSION

It is feasible to predict the expression level of B-Raf and Raf-1 gene using preoperative Gd-EOB-DTPA enhanced MRI.

CLINICAL RELEVANCE/APPLICATION

Incomplete or non capsule, or presence of intratumoral vessels are potential indicator for the high expression of B-Raf and Raf-1. Gd-EOB-DTPA enhanced MRI may facilitate the determination for choosing gene therapy for the patient with HCC.

SSJ08

Gastrointestinal (Liver-Fat/Iron)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E353A

BQ CT GI MR

AMA PRA Category 1 Credit™: 1.00

ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Scott B. Reeder, MD, PhD, Madison, WI (*Moderator*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Founder, Calimetrix, LLC; Shareholder, Elucet Medical
Sheela Agarwal, MD, MS, New York, NY (*Moderator*) Employee, Bayer AG

Sub-Events

SSJ08-01 Comparison of Fat Quantification Accuracy between Spectral CT Imaging and IDEAL-IQ Techniques: A Phantom Study

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E353A

Participants

CEN CHEN, Wuhan, China (*Presenter*) Nothing to Disclose
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Hongran Liu, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

In this study, we used spectral CT with fat material decomposition technique and magnetic resonance (MR) IDEAL-IQ to quantify fat content. The goal of this study was to evaluate the accuracy of the two methods at different fat concentrations.

METHOD AND MATERIALS

(1) For the fat-water model (model A), a series of concentrations containing homogeneous mixed fat and water were prepared, with a fat content of 0.00, 0.02, 0.04, 0.08, 0.16, 0.32, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.00 ml/ml, respectively. For the liver-fat model (model B), eleven homogeneous liver and fat tissue mixed samples with various fat content from 0-1.0 g/g (with an interval of 0.1 g fat/g). (2) All samples were scanned on GE Discovery HD750 CT. Fat material decomposition technique (water-fat base) was further applied to measure the fat density (MFD). IDEAL-IQ was utilized on GE Discovery 750w MR scanner to obtain the measured fat fraction (MFF). A linear regression was performed to analyze the relationship between the MFD or MFF and the actual fat fraction (AFF).

RESULTS

Both spectral CT fat material decomposition method and MR IDEAL-IQ method resulted good linear relationship between the measured fat content and AFF. In model A, it showed as: $R2MFD=0.9936$, $R2MFF=0.9987$. In Model B, it showed as: $R2MFD=0.9946$, $R2MFF=0.9941$. For Both models it had a P value less than 0.001. In particular at a lower fat concentration range in model A (AFF between 0-16%), the results were $R2MFD=0.8927$ and $R2MFF=0.9687$. In this circumstances, MFF showed a stronger linear correlation with AFF compared to MFD while MFD value can be well normalized to obtain AFF by the corresponding correlation equation.

CONCLUSION

Both spectral imaging fat material decomposition and MR IDEAL-IQ techniques can provide accurate and reliable quantification of fat content for both water-fat and liver-fat models. In particular, MFF has a more significant correlation with AFF in the low fat content scenario.

CLINICAL RELEVANCE/APPLICATION

This study demonstrated the feasibility of using CT spectral imaging - fat material decomposition and MR IDEAL-IQ technique to precisely quantify the fat content. The results indicated promising clinical applications of using these methods to study the fat metabolism in different tissues or organs (e.g. brain, breast, liver and bone) that contain different fat concentration in the future.

SSJ08-02 Automated Prediction of Nonalcoholic Fatty Liver Disease Activity Score (NAS) with an Advanced Multiparametric Magnetic Resonance Elastography and Machine Learning Technology

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E353A

Participants

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PURPOSE

Liver stiffness has become the most accurate noninvasive imaging biomarker for detecting hepatic fibrosis. However, much less work has been done for assessing the NAFLD activity score (NAS) - which is a numerical sum of histologic grading of steatosis, inflammation, and ballooning in biopsy specimens. In animal models, we have found that the NAS can be predicted by training a machine learning algorithm with data sets of multiple parameters obtained from MR elastography (MRE) (e.g., storage and loss moduli, volumetric strain) and MRI-assessed proton density fat fraction (PDFF). In this study, we tested the same approach in a pilot clinical study to assess the potential to predict the NAS using multiparametric MRE.

METHOD AND MATERIALS

62 clinically obese patients who underwent bariatric surgery and 12 normal volunteers (BMI<30) were included. Multifrequency MRE was used to measure the various mechanical properties that correlate with ballooning and inflammation, while PDFF was used to quantify steatosis. Liver biopsies were obtained in patients for histologic grading and calculating NAS based on the NASH CRN criteria. From the MRE/MRI parameters, the three parameters that best and most significantly correlated with NAS were selected ($p<0.05$ for all three parameters). Several machine learning regression algorithms were tested to minimize cross-validation error in the training set. An ordinal logistic model was used for ordinal NAS outputs in a confusion matrix with subsequent ROC analyses.

RESULTS

The clinical model included 74 subjects: 62 obese (35 NAFLD and 27 NASH) and 12 healthy volunteers. Liver stiffness at 60 Hz, loss modulus at 30 Hz, and fat fraction were all significantly associated with the NAS in the effect tests for both linear and nonlinear (neural networks) predictions (Fig. a,b). The ordinal logistic model showed less than ± 1 bias in 93% of subjects (69/74) in the resulting confusion matrix (Fig. c) and successfully distinguished each NAS score with excellent accuracy (AUROC>0.9 for all, Fig. d).

CONCLUSION

This preliminary study shows that multiparametric MRE/MRI can be used to accurately predict NAS score and represents a promising alternative to liver biopsy for NASH diagnosis and monitoring.

CLINICAL RELEVANCE/APPLICATION

Multiparametric MR elastography, coupled with machine learning, can provide a noninvasive prediction of the NAFLD activity score (NAS), which is an important metric for assessing disease severity.

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/> Richard L. Ehman, MD - 2016 Honored Educator Sudhakar K. Venkatesh, MD, FRCR - 2017 Honored Educator

SSJ08-03 A Simple Template-Matching Method for Liver Proton-Density Fat Fraction Determination by Multiecho Gradient-Echo MR Imaging

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E353A

Participants

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PURPOSE

Proton-density fat fraction (PDFF) is an accepted quantitative imaging biomarker of liver steatosis. However, the complexity of PDFF calculation by nonlinear curve-fitting has been a barrier to more widespread adoption. The purpose of this study was to validate a simple template-matching method for liver PDFF determination as an alternative to the conventional curve-fitting method.

METHOD AND MATERIALS

This is a secondary analysis of an IRB approved, HIPAA compliant clinical trial of diabetic adults undergoing liver MRE. Liver MRE

This is a secondary analysis of an IRB-approved, HIPAA-compliant clinical trial of diabetic adults undergoing liver MRI. Liver MRI exams were performed at 3T using 3D spoiled gradient echo sequence, acquired at 6 echo times (TEs): 1.05, 1.84, 2.63, 3.42, 4.21, 5.01ms. The T1-bias was minimized by flip angle 2 deg for repetition time 6.2ms. On the reconstructed magnitude images, a region of interest (ROI) was placed on the liver. ROI's mean signal magnitudes were recorded for each TE. The multiecho data were analyzed by two different methods: conventional nonlinear curve-fitting using a multipeak fat spectral model, and template-matching, as follows. First, a library of signal templates (synthetic 6-element signal vectors) was pre-generated for a 2D parameter grid: PDFF 0-50% and R2* 0-1000ms. Second, the observed 6-echo signal vector was compared to each template by vector inner-product. The template resulting in the maximum inner-product was selected as the "match". Computation times for both methods were recorded.

RESULTS

51 subjects (mean age 35 yrs, range [36-71] yrs) underwent liver MRI, 40 of which completed both pre- and post-treatment MRI. All available 91 MRI exams were analyzed. Figure 1 shows near-perfect linear regression agreement between the template-matching and curve-fitting liver PDFF values. The intercept and slope were slightly different from 0 and 1, respectively ($p=0.006$ and <0.001), but their small effect sizes are likely not clinically relevant. Bland-Altman (Figure 2) analysis demonstrates that template-matching has $<1\%$ error margin in absolute PDFF. Per-ROI computation time was 0.9ms and 19.6ms for template-matching and curve-fitting, respectively.

CONCLUSION

Liver PDFF calculation using template-matching is equivalent to curve-fitting within 1% error margin in absolute PDFF.

CLINICAL RELEVANCE/APPLICATION

Template-matching permits simple liver PDFF calculation without complex nonlinear curve-fitting and may facilitate more widespread use worldwide.

SSJ08-04 Dual-Layer Detector Spectral CT versus Magnetic Resonance Imaging for the Assessment of Iron Overload in Myelodysplastic Syndromes and Aplastic Anemia

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E353A

Participants

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PURPOSE

To investigate the performance of dual-layer detector spectral CT for iron deposition in myelodysplastic syndromes and aplastic anemia, and to compare the results to MRI T2* imaging

METHOD AND MATERIALS

Thirty patients with clinical history of myelodysplastic syndromes and aplastic anemia underwent T2*-weighted hepatic and cardiac MRI on a three-tesla MRI scanner (Ingenia, Philips, Netherlands) and were scanned on a 128-row spectral detector CT (IQon, Philips, Netherlands) latterly. T2* values of liver and septal muscle were calculated with a dedicated software tool (CMR Tools©, Imperial College). HU differences (Δ HU) in liver and septal muscle were calculated between the lower (50 kVp) and higher (120 kVp) energy resulted from mono-energetic spectral imaging ranging from 40 to 200 keV, which was based on spectral base image (SBI). Regression and correlation analyses were conducted between T2* and HU differences (Δ HU) in the liver and cardiac muscle.

RESULTS

Table time for spectral CT was significantly shorter compared to MRI (mean: 3.3 min vs. 25.2 min). Liver and cardiac T2* were 13.68 ± 12.52 , 27.89 ± 35.01 ms, respectively. Liver and cardiac signal intensity ratio to muscle were $0.650.44$, 1.44 ± 0.60 , respectively. Liver and cardiac Δ HU were 3.12 ± 1.89 , 2.35 ± 2.89 Hu, respectively. The results showed strong ($r = 0.8$ and $P < 0.05$) linear correlation between liver T2* and liver Δ HU, and moderate linear correlation ($r = 0.61$ and $P < 0.05$) between cardiac T2* and cardiac Δ HU. Strong linear correlation ($r = 0.85$ and $P < 0.05$) was found between liver to muscle (L/M) signal intensity ratio and Δ HU, and moderate linear correlation ($r = 0.65$ and $P < 0.05$) between heart to muscle (H/M) signal intensity ratio and cardiac Δ HU.

CONCLUSION

Dual-layer detector spectral CT seem to be equivalent valuable for evaluating liver and myocardial iron overload, compared to MRI T2* imaging, which might help in patient staging based on the severity of iron overload.

CLINICAL RELEVANCE/APPLICATION

Dual-layer detector spectral CT might help in patient with iron overload.

SSJ08-05 Non-invasive Quantification and Grading of Liver Iron Content with Spectral CT: An Iron Overload Rabbit Model Study

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E353A

Participants

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PURPOSE

To assess the accuracy of spectral CT in liver iron concentration (LIC) quantification and grading at different clinically significant LIC thresholds.

METHOD AND MATERIALS

Fifty-one rabbits of iron-loaded model were established by intravenous injection of iron dextran. Abdomen CT was then performed with fast kilovolt peak switching dual energy CT. Hepatic iron concentration (HIC) imaging was derived from an iron/water, two-material decomposition using gemstone spectral imaging analysis. Hepatic attenuation on 40 Kev and 140 Kev monochromatic energy image were measured. The difference between 40 Kev and 140 Kev (ΔH) was calculated. Ex vivo hepatic pathology was obtained and postmortem assessment of LIC was conducted on inductively-coupled plasma (ICP) spectrometer. The correlations between CT measurements (HIC and ΔH) and LIC were analyzed. HIC was fitted against LIC to build linear regression. Then the prediction accuracy of the regression was tested. Diagnostic performance of HIC and ΔH in discriminating different LIC thresholds (1.8, 3.2, 7.0, 15.0mg/g dry tissue) were evaluated by receiver operating characteristic (ROC) analysis.

RESULTS

According to the pathological analysis, the iron staining increased with increasing dose of injected dextran iron. LIC was from 0.20 to 39.59mg/g measured by ICP. HIC (range, -37.41-118.03 mg/mL) had a positive linear correlation with LIC ($r^2=0.943, P<0.001$). The predicted HIC obtained by derived equation calculation showed a high consistency with ICP results. For discriminating clinically significant LIC thresholds (1.8, 3.2, 7.0, 15.0mg/g dry tissue), ROC analysis revealed that the corresponding optimal cutoff value of HIC was -17.56, -0.92, 7.6, 48.28 mg/mL. With the cutoff value of HIC= 48.28 mg/mL, the highest sensitivity (100%) and specificity (100%) were obtained at LIC threshold of 15.0mg/g dry tissue. HIC showed no significant differences with ΔH at different clinically iron accumulation thresholds ($P>0.05$).

CONCLUSION

HIC was highly linear with titrated LIC in the iron overload rabbit models. HIC could quantify LIC and had high accuracy for grading LIC especially at graveness iron accumulation situation.

CLINICAL RELEVANCE/APPLICATION

With excellent diagnostic performance for discriminating clinically significant LIC thresholds, HIC imaging might be used to guide iron chelation therapy in the clinical practice in the future.

SSJ08-06 Virtual Unenhanced Algorithms for Fast-Kilovolt Switching Dual-Energy CT: Comparison Between Dedicated and Non-dedicated Softwares for Assessment of Liver Fat Content

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E353A

Participants

Tomoko Hyodo, MD, Osaka-Sayama, Japan (*Presenter*) Nothing to Disclose
Norihsa Yada, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Osamu Maenishi, MD, Osaka-Sayama, Japan (*Abstract Co-Author*) Nothing to Disclose
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Takamichi Murakami, MD, PhD, Osakasayama, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In fast kV-switching dual-energy CT (DECT), a new multi-material decomposition (MMD) algorithm developed for the quantification of liver fat content includes virtual unenhanced (VUE) algorithm based on the attenuation coefficient of liver tissue. This study aims to compare the accuracy of the dedicated and non-dedicated VUE algorithms for liver fat content estimation.

METHOD AND MATERIALS

Forty-seven patients with suspected hepatic steatosis (BMI, 18-40) underwent unenhanced and tri-phase dynamic contrast-enhanced DECT scans within 4 weeks prior to liver biopsy. Hepatic fat volume fraction (FVF, %) images using MMD and CT attenuation value (CTav, HU) images using non-dedicated VUE were generated from DECT data. FVF and CTav were compared with histologic steatosis grade (0-3, as defined by the non-alcoholic fatty liver disease activity score [NAS] system) using Jonckheere-Terpstra trend tests. Agreement of the measurement between real- and virtual unenhanced images was assessed using generalized estimating equation (GEE) model and Bland-Altman analysis.

RESULTS

NAS steatosis scores were score 0 in 11 patients; 1 in 21; 2 in 12; and 3 in 3. FVF increased and CTav decreased with increasing histologic steatosis grade (trend test, $P < .001$ for each). GEE models revealed that scan phase was significantly associated with CTav ($\beta = 0.8$; $P < .016$) but not with FVF ($\beta = 0.06$; $P = .730$). The differences between real non-contrast-enhanced and contrast-enhanced FVFs for arterial, portal venous, and equilibrium phases tended to be larger (limits of agreement, -8.4 to 9.5) but there was no systemic bias. Bland-Altman analysis of real non-contrast-enhanced and each of three contrast-enhanced CTav showed significant proportional bias ($r = -0.38$ to -0.44 ; $P < .001$ for all).

CONCLUSION

VUE in MMD algorithm for the quantification of liver fat content is more accurate than CT attenuation value calculated with non-dedicated VUE.

CLINICAL RELEVANCE/APPLICATION

The MMD algorithm is a promising technique for less-invasively assessment of hepatic fat content, as fat volume fraction data can be derived from the contrast-enhanced scan, eliminating the need for a separate non-contrast CT scan to derive fat volume fraction.

SSJ09

Gastrointestinal (Biliary Imaging)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E353C



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

Participants

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Achille Mileto, MD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ09-01 Novel Radiologic Model to Predict Disease Severity of Primary Sclerosing Cholangitis: Association of Quantitative Liver Volume with Mayo Risk Score

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E353C

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To evaluate the association of absolute total liver (T), lobar (right and left; R, L), and caudate volume (C), as well as ratios of left lobe and caudate to total liver volume (L/T and C/T) with the disease severity of PSC as determined by Mayo score. The second aim was to develop a novel radiologic model to predict Mayo score.

METHOD AND MATERIALS

This HIPAA compliant, retrospective single center study included 79 PSC patients who were imaged between 2000 and 2017. T, R, L and C were measured using Advantage Workstation (GE) on the imaging study (MR/CT) within an average of 4 months of risk score calculation. L/T and C/T ratios were then calculated. Patients were stratified into group A (low and intermediate risk; Mayo score <2) and group B (high risk; Mayo score ≥2). The differences in liver volumes between the 2 groups were assessed using T test. Regression analysis was performed to test the correlation between the liver volumes and Mayo score. To assess the prognostic performance of liver volume, area under the receiver operating characteristic (AUC-ROC) curve was evaluated. P value <0.05 was considered significant.

RESULTS

Our cohort included 49 males and 30 females with the mean age of 43, with no significant differences in age between males and females (p=0.74). T, L, and C were significantly higher in group B than in group A (p<0.05). However, the difference in R was not significant (p=0.07). The differences of L/T and C/T between Group A and B were statistically significant (p<0.005). L/T had the best positive correlation with Mayo score (r=0.55). Linear regression analysis identified L/T as a significant variable for predicting Mayo score, with the prediction model as follows (p<0.001): Mayo risk score = 5.6*(L/T) - 1.5 L/T showed good ability to distinguish between mild/moderate and severe PSC patients (AUC-ROC 0.8).

CONCLUSION

Patients with severe PSC have larger total liver, left lobe, and caudate volume, and higher left and caudate to total ratio compared to patients with mild/moderate disease. Left lobe to total liver volume ratio was associated with Mayo score and it may be used to predict disease severity in patients with PSC.

CLINICAL RELEVANCE/APPLICATION

Novel volumetric liver measurements correlate with Mayo scores and may potentially be useful in supplementing Mayo score and predicting disease severity.

SSJ09-02 Postprandial Changes in Flow Dynamics of the Bile within the Common Bile Duct: Evaluation with Cine Dynamic MRCP and a Spatially Selective IR Pulse

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E353C

Participants

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PURPOSE

To evaluate the influence of oral ingestion in flow dynamics of the bile within the common bile duct in healthy subjects by using cine dynamic MRCP and a spatially selective IR pulse non-invasively.

RESULTS

The median grading score of antegrade bile flow after oral ingestion (score=0.85-1.18) was significantly ($P<0.01$) higher than that before oral ingestion (score=0.53), indicating that bile excretion was stimulated by oral ingestion. Grading score of antegrade bile flow showed a maximum peak of 1.18 at 26 minutes after ingestion, and then, began to gradually decline with a statistical difference ($P<0.01$). Contraction of gallbladder was associated with increased grading score of antegrade bile flow after oral ingestion with a statistical significance ($p<0.01$). Regarding reversed bile flow, there were no significant differences in median grading score before (0.18) and after (0.15-0.23) oral ingestion, suggesting that oral ingestion has little effect on the function of oddi sphincter.

CONCLUSION

Non-invasive cine dynamic MRCP using spatially selective IR pulse showed potential for evaluating postprandial changes of flow dynamics of bile as a physiological reaction.

CLINICAL RELEVANCE/APPLICATION

Cine dynamic MRCP using spatially selective IR pulse may contribute to the assessment of flow dynamic changes of the bile such as the impaired bile excretion in patients with digestive malabsorption.

SSJ09-03 Intrahepatic Cholangiocarcinoma: Can Imaging Phenotypes Predict Survival and Tumor Genetics?

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E353C

Participants

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PURPOSE

On CT, intrahepatic cholangiocarcinomas (ICC) are phenotypically heterogeneous tumors. The purpose of this study was to investigate the associations between CT imaging phenotypes, patient survival and known genetic markers. We hypothesize that visibly different tumor subtypes may be associated with survival or known genetic pathways of ICC.

METHOD AND MATERIALS

An institutional review board approved, HIPAA-compliant, retrospective study was performed with 66 patients who had surgically resected ICC. Preprocedure CT images of ICC were assessed using predominantly qualitative radiographic descriptors while blinded to tumor genetics and patient clinical data. Associations between radiographic features and overall survival (OS) and disease free survival (DFS) were performed with Cox proportional hazards regression and visualized with Kaplan Meier plots. The associations between radiographic features and imaging pathways (IDH1, Chromatin and RAS-MAPK) were assessed with Fisher's Exact test and the Wilcoxon Rank sum test, where appropriate and corrected for multiple comparisons within each pathway using the False Discovery Rate correction.

RESULTS

Three imaging features were significantly associated with a higher risk of death: necrosis (HR:2.95 95%CI:1.44-6.04, $p=0.029$), satellite nodules (HR:3.29, 95%CI:1.35-8.02, $p=0.029$), and vascular encasement (HR:2.63, 95%CI:1.28-5.41, $p=0.029$). Additionally, with each increase in axial size, the risk of death increased (HR:1.14, 95%CI:1.03-1.26, $p=0.029$). Similar to findings for OS, satellite nodules (HR:3.81, 95%CI:1.88-7.71, $p=0.002$) and vascular encasement (HR:2.25, 95%CI:1.24-4.06, $p=0.019$) were associated with increased risk of recurrence/death. No significant associations were found between radiographic features and genes in the IDH1, Chromatin or RAS-MAPK pathways ($p=0.63-84$).

CONCLUSION

This preliminary analysis of resected ICC suggests associations between CT imaging features and OS and DFS. No association was identified between imaging features and currently known genetic pathways.

CLINICAL RELEVANCE/APPLICATION

Intrahepatic cholangiocarcinomas are heterogeneous on CT and have qualitative radiographic features associated with survival. Possible associations with tumor genetics were not identified.

SSJ09-04 Multiparametric Response Assessment of Unresectable Intrahepatic Cholangiocarcinoma Treated with TACE: Role of Contrast Enhanced 3-D Volumetric Functional MRI Using Apparent Diffusion Coefficient Maps

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E353C

Participants

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PURPOSE

To assess multiparametric changes in 3-D volumetric functional parameters on contrast enhanced MRI and DWI in predicting early response of unresectable intrahepatic cholangiocarcinoma (iCCA) after transcatheter arterial chemoembolization (TACE).

METHOD AND MATERIALS

This retrospective IRB-approved, HIPAA-compliant study with waived patient consent included 94 patients (mean age, 68±12 years; 40 men) with unresectable iCCA. All patients underwent baseline and follow up MRI after TACE, and were followed up until death or December 2016. Index lesions were analysed for changes in anatomical (RECIST, volume) and functional (viable tumor, tumor burden, ADC) volumetric MR parameters. Overall survival (OS) was used to stratify cohort into low (≤15 months) and high (>15 months) OS groups. Changes in MRI and confounding clinical parameters were compared between the two groups. Their effect on OS was assessed using Cox-regression and Kaplan-Meier analysis. P <0.05 was considered significant.

RESULTS

Tumor volume did not show significant change after TACE (P=0.07) while RECIST diameter showed a small change (-2.6 mm, P=0.02). Mean absolute and percent viable tumor volume, and mean tumor burden decreased (P<0.0001, for each) while mean ADC increased (P<0.0001) after TACE. The only parameter showing significantly different change between low and high OS groups was mean ADC, both absolute (215.4±260.5 x 10⁻⁶ mm²/s vs 341.9±313.5 x 10⁻⁶ mm²/s; P=0.040) and percent (12.8±14.7 % vs 28.8±27.4 %; P=0.001) change. In Cox regression analysis, significant effect on survival outcomes was seen for percent ADC change adjusted for confounding clinical parameters. (Hazard ratio, 0.93; P<0.05). Significant differences in survival were noted when percent change in mean ADC cut off of 25%, 30% and 35% were used to classify responders and non-responders (log rank test, P=0.035, 0.019 and 0.001, respectively).

CONCLUSION

After TACE, iCCA lesions showed increase in volumetric ADC (19.9%), decrease in viable tumor volume (25.9%), and decrease in percent viable tumor volume (16.3%). Thresholds of 25%, 30% and 35% change in ADC resulted in survival differences with a 7% reduction in risk of death for a unit increase in percent ADC change.

CLINICAL RELEVANCE/APPLICATION

Volumetric functional MR changes can allow individualization of TACE therapy in iCCA with prediction of early oncologic response and overall survival. These may be utilized in future clinical trials.

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

SSJ09-05 Influence of Cholecystectomy on the Flow Dynamic Pattern of Bile in the Extrahepatic Bile Duct: Assessment by Cine-Dynamic MRCP with Spatially-Selective IR Pulse

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E353C

Participants

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PURPOSE

To evaluate the influence of cholecystectomy on the flow dynamic pattern of bile in the extrahepatic bile duct by using cine-

dynamic MRCP with spatially-selective inversion-recovery (IR) pulse non-invasively.

RESULTS

Antegrade bile flow was observed more frequently in the cholecystectomy group than in the non-cholecystectomy group (5.1 times vs 2.9 times, $P=0.005$). Mean grading score of antegrade bile flow was significantly greater in the cholecystectomy group than in the non-cholecystectomy group (mean grade, 0.33 vs 0.21; $P=0.007$). These facts suggested that antegrade bile flow is probably generated by increased intraductal pressure of CBD collecting bile, and that the common bile duct plays function of the gallbladder such as contraction and buffering. Regarding reversed bile flow, there were no significant differences in the frequency and grading score between cholecystectomy group and non-cholecystectomy group, suggesting that contraction pressure in the sphincter of Oddi is extremely higher than CBD pressure even in patients after cholecystectomy.

CONCLUSION

Antegrade bile flow was observed more frequently and predominantly in patients after cholecystectomy in cine-dynamic MRCP with a spatially selective IR pulse probably due to the increased intraductal pressure of CBD collecting the bile while reversed bile flow was observed equivalently because of the preserved function of Oddi sphincter.

CLINICAL RELEVANCE/APPLICATION

Cine-dynamic MRCP with a spatially selective IR pulse may play a role in evaluating the alteration of bile flow pattern in patients with postcholecystectomy syndrome and sphincter of Oddi dysfunction.

SSJ09-06 Can MRI Distinguish Between Hepatocellular Carcinoma, Intrahepatic Cholangiocarcinoma and Biphenotypic Tumors?

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E353C

Participants

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PURPOSE

Accurate differentiation between hepatocellular carcinoma (HCC), intrahepatic cholangiocarcinoma (ICC) and biphenotypic tumors (BPT) at imaging is clinically important but often a challenge. The purpose of this multi reader study was to assess the ability of contrast enhanced multiphase MRI to differentiate between HCC, ICC, and BPT.

METHOD AND MATERIALS

Patients with histologically confirmed HCC, ICC or BPT and who had undergone liver MRI were identified using pathology and radiology databases. Patients with therapy prior to imaging were excluded. MRI studies were reviewed by 4 abdominal radiologists blinded to tumor type. Disagreement was resolved by majority and if necessary, a blinded fifth reader. Readers reviewed imaging findings of each tumor on T2W, DWI and T1W images. Dynamic enhancement (arterial, portal and delayed phase) characteristics were reviewed and 1 of 4 enhancement patterns (see figure) was assigned to each tumor. The most likely diagnosis (HCC, ICC or BPT) was recorded. Fisher's exact test was used to compare proportions. Krippendorff's α was used to compare variability amongst readers.

RESULTS

MRI exams from 50 patients (age 64 ± 12 years, 19M, 31F) with 24 HCC, 20 ICC and 6 BPT were included. 20 (83%) HCC, 3 (50%) BPT and 19 (95%) ICC were correctly identified. 21 (88%) HCC had type 1 and 18 (90%) ICC had type 2 enhancement pattern while BPT showed a mix of type 1 (33%), type 2 (50%) and type 4 (17%) enhancement. Type 1 was seen more frequently in HCC than ICC or BPT and type 2 was seen more frequently in ICC than in HCC. Rate of T2 hyperintensity was seen more frequently in ICC than BPT (100% vs 66%), while washout was seen more frequently in HCC compared to either BPT and ICC (83% versus 0% and 5% respectively). Capsule was seen more frequently in HCC than ICC (58% vs 5%) ($p < 0.05$ for all listed comparisons). Krippendorff's α ranged from 0.308 to 0.515 for individual findings and was 0.739 for final diagnosis.

CONCLUSION

While characteristic enhancement patterns allow accurate diagnosis of HCC and ICC, BPT were more diverse in their enhancement pattern and therefore more difficult to diagnose. BPT should be considered in the differential diagnosis of a hepatic mass which lacks characteristic features of HCC or ICC such as T2 hyperintensity, washout or capsule.

CLINICAL RELEVANCE/APPLICATION

Biphenotypic tumors cannot be accurately differentiated from HCC and ICC using multiphasic MRI.

SSJ10

Genitourinary (Imaging of Pregnancy)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E351

GU MR OB

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

Participants

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Elaine M. Caoili, MD, MS, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

SSJ10-01 Symptomatic Fibroids in Pregnancy: MR Imaging Features and Differentiation from Non-Symptomatic Fibroids

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E351

Awards

Student Travel Stipend Award

Participants

Dinushi S. Perera, MD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate MRI findings of symptomatic fibroids causing acute lower abdominal and/or pelvic pain in pregnancy and compare them with non-symptomatic fibroids.

METHOD AND MATERIALS

MRI studies of pregnant patients with uterine fibroids performed for acute lower abdominal and/or pelvic pain between 1/2010-9/2016 were retrospectively evaluated. Patient age, gestational age, fibroid size, fibroid number, fibroid location, signal intensity of the fibroid relative to myometrium on T1-weighted imaging, T2-weighted imaging, and diffusion weighted imaging (DWI), and ADC values were recorded along with final discharge diagnoses. Kruskal-Wallis and chi-squared tests compared continuous and categorical variables, respectively, between symptomatic and non-symptomatic fibroids.

RESULTS

Twenty-seven pregnant patients (mean age of 33 [range: 24-47] and mean gestational age of 18 [range: 4-33]) with a total of 57 fibroids comprised the study cohort, with 13 fibroids in 13 patients ultimately identified as the cause of pain based on clinical examination and final discharge diagnoses. Larger size (5.8 versus 3.4 cm in diameter, $p = 0.00012$), T2 hyperintensity relative to myometrium ($p = 0.000049$), and hyperintensity on DWI ($p = 0.00054$) were significantly associated with symptomatic fibroids. ADC values were slightly lower in symptomatic fibroids but not statistically significant (1401 versus 1493 $\times 10^{-6}$ mm²/s, $p = 0.32$). No difference in T1 signal intensity was seen between symptomatic and non-symptomatic fibroids ($p = 0.73$).

CONCLUSION

MRI characteristics of fibroids causing acute pain in the setting of pregnancy have not previously been described, with the exception of T1 hyperintensity seen with red degeneration. In our cohort, larger size and hyperintensity on DWI and T2-weighted imaging relative to myometrium are significantly associated with symptomatic fibroids. These imaging features may also be useful indicators of fibroid degeneration.

CLINICAL RELEVANCE/APPLICATION

MR signal characteristics associated with symptomatic fibroids are described in our cohort of pregnant patients presenting with acute pain, and may be useful indicators of fibroid degeneration.

SSJ10-02 Malformations of Cortical Development Associated with Corpus Callosum Dysgenesis (CCD): Diagnostic Value of Fetal MRI in Prenatal Counseling

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E351

Awards

Student Travel Stipend Award

Participants

Amanda Antonelli, MD, Rome, Italy (*Presenter*) Nothing to Disclose
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PURPOSE

To define the diagnostic role of fetal MRI in the assessment of cortical dysplasias and other malformations of the developing cerebral cortex, in fetuses with different forms of Agenesis of the Corpus Callosum (ACC).

METHOD AND MATERIALS

104 MR images of fetal CNS with a US suspicion of ACC were retrospectively reviewed. Fetal MRI was performed at 1.5 T Magnetom Avanto (Siemens, Erlangen, Germany) without mother-fetal sedation. Polymicrogyria, lissencephaly, schizencephaly, subependymal heterotopias and migration disorders were evaluated. Cortical findings were compared to three types of ACC (complete agenesis, partial agenesis and hypoplasia). Genetic tests were collected. Post-natal MRI or fetopsy for diagnostic confirmation were collected.

RESULTS

On 104 fetuses, fetal MRI was able to detect cortical malformations in 32 cases even in early gestational ages (<24GW). The mean Gestational Weeks (GW) at MR diagnosis was 26 (range: 22-36GW). MR imaging found 13/32 polymicrogyria, 7/32 lissencephaly, 5/32 schizencephaly, 4/32 subependymal heterotopias and 3/32 neuronal migration disorders. 22/32 had complete ACC, 4/32 had partial ACC and 6/32 had CC hypoplasia. Statistically significant correlations ($p < 0.005$) between complete ACC, focal polymicrogyria and cortical dysmorphism affecting frontal lobes were found.

CONCLUSION

Fetal CNS MRI can detect cortical development malformations in complex ACC, providing further information for the clinician to assess the severity of perinatal outcome.

CLINICAL RELEVANCE/APPLICATION

MRI is a useful tool in improving obstetrical genetic prenatal counselling to predict pregnancy and fetal prognosis.

SSJ10-03 The Safety of MR Imaging at 3.0 T in Fetuses: Is Fetal Birth Weight or Hearing Impaired?

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E351

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To evaluate the effects of magnetic resonance imaging at 3.0 T during pregnancy on fetal growth and neonatal hearing in healthy newborns who are at low risk for congenital hearing impairment and brain or chromosomal abnormalities.

METHOD AND MATERIALS

This single-center retrospective case-control study was IRB approved. Informed consent was waived. 81 consecutive healthy newborns who were exposed to MR imaging at 3.0 T while in utero and were born between January 2011 and January 2016 were included. Each MR exposed newborn was matched 1:2 by birth date to a randomly selected healthy control newborn who was not exposed to MR imaging as a fetus. A total of 162 control newborns were included. For each MR exposed newborn, the estimated gestational age at MR exposure was recorded. For each MR exposed and control newborn, infant birth weight was recorded. In concordance with national guidelines, neonatal hearing screening was performed using auditory brain stem response. All hearing tests for the MR exposed and control neonates were recorded. Comparison of the average birth weight between the two groups was performed using an unpaired Student *t* test. The prevalence of hearing impairment was compared between the two groups by using Fisher's exact test.

RESULTS

The average estimated gestational age of fetal MR exposure was 148 days (range 35 days to 265 days). There was no significant difference in average birth weight between the MR exposed and control neonates; 3398 grams vs. 3510 grams, respectively [$P = 0.06$]. The prevalence of hearing impairment in the MR exposed neonates was 0% (0 out of 81); the prevalence of hearing impairment in the control group was 1.8% (3 out of 162). There was no significant difference between the two groups [$P = 0.55$].

CONCLUSION

This study showed no evidence that fetal exposure to MR imaging at 3.0 T is associated with fetal growth restriction or neonatal hearing impairment.

CLINICAL RELEVANCE/APPLICATION

The data from this study suggests that fetal exposure to MR imaging at 3.0 T is safe.

SSJ10-04 Use of a Telerobotic Ultrasound System for Prenatal Imaging

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E351

Awards

Trainee Research Prize - Resident

Participants

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PURPOSE

To determine the feasibility of using a telerobotic ultrasound system to remotely perform prenatal ultrasound examinations and generate images of diagnostic quality, and determine the acceptability of the system to patients and sonographers.

METHOD AND MATERIALS

Thirty participants (mean gestational age 22.8 weeks, range 15-36 weeks) were prospectively recruited. Participants underwent a limited examination (consisting of biometry, placental location, and amniotic fluid; n=21) or detailed examination (biometry, placental location, amniotic fluid, and fetal anatomic survey; n=9) performed using a conventional ultrasound system (EPIQ 5, Philips). This was immediately followed by an equivalent examination performed by a different sonographer using a telerobotic system consisting of a robotic arm (MELODY System, AdEchoTech), ultrasound unit (SonixTablet, BK Ultrasound), and videoconferencing system. Using this system, radiologists or sonographers remotely control all ultrasound settings and fine movements of a transducer from a distance. Telerobotic images were read independently from conventional images. Patients and sonographers were surveyed to assess acceptability of the system.

RESULTS

A paired sample t-test showed no statistically significant difference between conventional and telerobotic measurements of fetal head circumference or single deepest vertical pocket of amniotic fluid; however, a small but statistically significant difference was observed in measurements of biparietal diameter, abdominal circumference, and femur length (p-values <0.05). Intraclass correlations displayed excellent agreement (>0.90) between telerobotic and conventional measurements of all four biometric parameters. Of 21 fetal structures included in the anatomic survey, 82% (range 68-100%) of the structures attempted were sufficiently visualized using the telerobotic system. Ninety-seven percent of patients strongly or somewhat agreed they would be willing to have another telerobotic examination in the future.

CONCLUSION

The telerobotic ultrasound system assessed is feasible for performing prenatal ultrasound examinations. Telerobotic ultrasound systems may allow for the development of satellite ultrasound clinics in rural, remote, or low-volume communities, thereby increasing access to prenatal imaging.

CLINICAL RELEVANCE/APPLICATION

Telerobotic sonography may increase access to prenatal imaging for patients in rural, remote, or low-volume communities.

SSJ10-05 Magnetic Resonance Imaging Evaluation of Invasive Placentation: Accuracy and Impact on Delivery Management

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E351

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To assess accuracy and reproducibility of Magnetic Resonance Imaging (MRI) findings in the diagnosis of Invasive Placentation (IP) in high risk patients. To evaluate the impact of interventional radiological assistance (IRA) on delivery outcomes.

METHOD AND MATERIALS

Twenty-one patients (mean age 36.05 years) with risk factors for IP underwent 1.5T MR examination. Images were reviewed by two readers. Gold standard was histology in 11 and obstetrical diagnosis in 10 patients. Sensitivity and specificity of MRI findings were calculated and reproducibility was estimated with Cohen's K-test. Impact of eventual IRA was evaluated regarding multiple maternal-child factors during and after delivery.

RESULTS

IP was found in 13 patients (61.90%), placenta accreta/increta in 10 (47.62%) and percreta in 3 (14.29%). MRI had sensitivity of 100% and specificity of 87.5%. MRI findings with higher sensitivity were placental heterogeneity, uterine bulging, black intraplacental bands, myometrial interruption and thinning of the uterine-placental interface. Findings with higher specificity were uterine scarring, placental heterogeneity, myometrial interruption and tenting of the bladder. MRI inter-rater agreement was high (K=1). IRA was performed in 10 women among 13 with diagnosis of IP, with global positive impact on delivery's outcome. Factors with statistical significant difference ($p<0.05$) were: blood loss (1405 ml vs 3080 ml), days in surgical intensive care unit (1 vs 3), APGAR at first minute (6.11 vs 4) and overall days of hospitalization (12.00 vs 41.77).

CONCLUSION

MRI is an accurate and reproducible tool in prenatal diagnosis of IP and can be used to plan safe delivery in an appropriate setting with eventual IRA, that positively affects delivery's outcomes.

CLINICAL RELEVANCE/APPLICATION

MRI is extremely accurate in the diagnosis of invasive placentation and it has a strong indication in high risk patients allowing to plan delivery with eventual interventional radiological assistance.

SSJ10-06 The Ringed Placenta on Fetal MRI: 11 Cases Linked with Fetal Ventral Body Wall Defects

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E351

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Fetal MRI is increasingly used in high-risk pregnancies not just for diagnosis and treatment planning, but also for prognostication of neonatal outcomes. Ventral Body Wall Defects (VBWD) of variable manifestation are well-recognized on fetal MR imaging and have been described in the literature. In more severe cases, outcomes can be highly variable, and counseling in these cases can be extremely challenging. We present here a pattern of abnormal placental MRI signal not previously described, which we found to correlate with extremely high mortality in patients born with VBWD. Specifically, we identified abnormal T1 hyperintense signal in the placenta in a multi-ringed pattern in several cases of fetal VBWD which correlated with extremely high mortality. We have termed this finding, the "ringed placenta."

METHOD AND MATERIALS

A local database of prenatal imaging studies was used to retrospectively review prenatal cases with MR imaging which demonstrated the characteristic appearance of ringed placenta in patients with VBWD. Electronic medical records were also used to follow up on the outcome of the patients identified as having these same areas of signal abnormality.

RESULTS

The "ringed placenta" appearance was identified in 11 fetal MRI studies, with the neonates later confirmed at birth to have VBWD. On pathology, these placentae were variably described as containing massive perivillous hemorrhage, intervillous thrombosis, villous edema, and diffuse chorionic villitis. Out of the 11 identified cases, only one neonate survived beyond 3 months of life.

CONCLUSION

This work presents cases of VBWD in the fetus, demonstrating the presence of T1 hyperintense ringed patterns in the placenta, which correlate with subsequent high perinatal mortality. Given the pathologic findings, this MRI appearance may be secondary to global placental ischemia with reperfusion hemorrhage. In evaluating VBWD patients, accurate prognostic information can be critical for appropriate parental counseling, and it may also affect the approach to perinatal management. Further studies will be necessary to better evaluate the prognostic accuracy of this MR imaging sign.

CLINICAL RELEVANCE/APPLICATION

This novel sign may enable improved planning and more accurate counseling for parents, many of whom face very high levels of uncertainty during the pre-natal management of complex fetal anomalies.

SSJ11

Genitourinary (Imaging of Benign Gynecological Disease)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E353B

GU MR

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

Participants

Hilton M. Leao Filho, MD, Sao Paulo, Brazil (*Moderator*) Nothing to Disclose
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Sub-Events

SSJ11-01 Structured vs Narrative Reporting of Pelvic MRI for Fibroids: Impact on Treatment Planning

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E353B

Awards

Student Travel Stipend Award

Participants

Andrea Franconeri, MD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the usefulness of MRI reporting of uterine fibroids using a structured disease-specific template vs narrative reporting for planning fibroid treatment by gynecologists and interventional radiologists.

METHOD AND MATERIALS

This is a HIPAA-compliant, IRB-approved study with informed consent waived given its retrospective nature. In April 2016, a structured reporting template for fibroid MRI examinations was developed in collaboration between gynecologists, interventional radiologists and diagnostic MRI radiologists. Study population included 29 consecutive women who underwent myomectomy for uterine fibroids and a pelvic MRI prior to implementation of structured reporting; and 42 consecutive women with MRI for uterine fibroids after implementation of structured reporting. Subjective evaluation by gynecologists and radiologists and objective evaluation for the presence of 19 key features were performed to assess the clarity and usefulness of the reports for treatment planning. Statistical analysis was performed using the Student t test, Fisher exact test and Wilcoxon signed-rank test.

RESULTS

More key features were absent from the narrative reports 7.3 ± 2.5 (range 3-12) than from structured reports 1.2 ± 1.5 (range 1-7), ($p < 0.0001$). Compared to narrative reports, gynecologists and radiologists deemed structured reports both more helpful for surgical planning (gynecologists: 8.5 ± 1.2 vs. 5.7 ± 2.2 , ($p < 0.0001$); radiologists: 9.6 ± 0.6 vs. 6.0 ± 2.9 , ($p < 0.0001$)) and easier to understand (gynecologists: 8.9 ± 1.1 vs. 5.8 ± 1.9 , ($p < 0.0001$); radiologists: 9.4 ± 1.3 vs. 6.3 ± 1.8 , ($p < 0.0001$)).

CONCLUSION

Structured fibroid MRI reports miss less key features essential for treatment planning than narrative reports. Gynecologists and radiologists described structured reports to be more helpful for treatment planning and easier to understand.

CLINICAL RELEVANCE/APPLICATION

Structured reports for uterine fibroid MRI are more helpful, easier to understand and miss less key features essential for procedural planning than narrative reports.

SSJ11-02 Efficacy of Vaginal and Rectal Distension Using Gel in MRI for Deep Pelvic Endometriosis

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E353B

Participants

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PURPOSE

To study MR performance without and with per vaginal (PV) and per rectal (PR) gel distension for the detection of posterior compartment deep pelvic endometriosis (DPE).

METHOD AND MATERIALS

IRB approval and informed consent were obtained for this prospective study. Female patients presenting with clinically suspected DPE to a single centre underwent MRI to map their disease. Multiplanar T2 and axial T1W images were acquired without and with PV and PR gel. Each patient went on to laparoscopy. 8 expert readers from 6 countries, all blinded, recorded sites of disease on 2 datasets with a minimum of 10 days between the readings. Each dataset comprised a mixture of without and with gel studies. Findings were collated and compared with gold standard laparoscopic data. MR performance without and with PV/PR gel was evaluated by calculating sensitivity, specificity, positive and negative predictive values. Variability between readers was calculated using the Fleiss' kappa coefficient.

RESULTS

Posterior compartment disease was recorded in a total of 22 sites in 9 women (mean age 34.8 years) in whom complete imaging and surgical data were available. With 8 readers, this gave a total of 176 potential sites of disease to be detected across all reads. 107 of 176 locations were identified on MR without gel and 139 of 176 with gel distension. There was a significant improvement in sensitivity, PPV and NPV between MR images without and with PV/PR gel distension for all regions assessed ($p=0.006$, 0.029 and 0.002 respectively). There was no statistically significant difference in specificity between groups. Interobserver concordance was substantial with a Fleiss' kappa coefficient of 0.76 without and 0.74 with gel distension.

CONCLUSION

Vaginal and rectal distension with gel significantly improved the sensitivity of MR for the detection of DPE.

CLINICAL RELEVANCE/APPLICATION

The use of PV/PR distension in MRI for DPE remains controversial. This study, with 8 expert readers, showed a significant improvement in sensitivity, PPV and NPV following the administration of gel.

SSJ11-03 Accuracy of Non-Contrast CT in Characterizing Simple Cysts in Late Post-Menopausal Patients: Do We Really Need to Perform an Ultrasound in All Cases?

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E353B

Participants

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PURPOSE

Contrast enhanced CT (CECT) is accurate at characterizing simple appearing cysts with benign features relative to US. We sought to determine the accuracy of non-contrast CT (NCCT) in characterizing adnexal lesions found in late postmenopausal (>55 years) women and whether a probably benign adnexal cyst >1 cm on NCCT needs further US evaluation in all cases as is the case with current ACR guidelines.

METHOD AND MATERIALS

We performed an IRB approved HIPAA compliant retrospective review of 101 patients with 110 ovarian lesions found on NCCT with an associated CECT (reference standard) within 180 days (median: 7 days, 72% within 30 days). NCCT and CECT images were reviewed by different readers, blinded to the images from the other modality and patients' clinical information. Readers characterized each lesion by presence/absence of complex features (e.g., solid component, mural nodules and septae) and then classified lesions as simple cystic, complex cystic, solid-cystic or solid. Lesion classifications and characteristics were compared between modalities using Bhapkar's or the sign test. Cohen's kappa was used to assess agreement between modalities.

RESULTS

The average age was 68 years \pm 10 (SD). Of 110 lesions, 72 (65%) were simple cysts, 22 (20%) were complex cysts, 9 (8%) were

solid-cystic and 7 (6%) were solid on CECT compared with 49 (45%), 39 (35%), 13 (12%), and 9 (8%) for the same categories, respectively, on NCCT. There was overall moderate agreement in lesion classification (kappa: 0.56), though more cysts were simple-appearing on CECT than NCCT (65% vs. 45%, $p<0.001$). This was primarily due to the increased number of perceived mural nodules (1% vs. 13%, $p=0.01$) and septae (12% vs. 37%, $p<0.001$) seen on NCCT compared with CECT. Of 49 simple cysts by NCCT, 48 were found to be simple cysts on CECT (PPV = 98.0%, 95% CI: 87.8-99.9%). Of 61 non simple cystic lesions by NCCT, 37 were also found to be non-simple cystic lesions on CECT (NPV = 60.7%, 95% CI: 48.3-73.0%).

CONCLUSION

Our study confirms the high accuracy of non-contrast CT in characterization of simple cysts seen in late postmenopausal women. On the other hand, non-simple cystic lesions were not as accurately characterized.

CLINICAL RELEVANCE/APPLICATION

Non-contrast CT accurately characterizes simple cysts; so if incidentally detected, these may not need further imaging characterization. Non-simple cysts may still need further imaging workup.

SSJ11-04 DTI and Tractography Correlated With Symptoms and Site of Pelvic Endometriosis

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E353B

Participants

Valeria Vinci, MD, Rome, Italy (*Presenter*) Nothing to Disclose
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PURPOSE

The aim of the present study was to evaluate the sacral nerve roots aspects by the means of DTI tractography in women with endometriosis and to analyze the correlation between DTI abnormalities, the presence and intensity of different pain symptoms, and the endometriotic lesions found at surgery.

METHOD AND MATERIALS

In 2 years time, we enrolled 66 women affected by endometriosis and scheduled for surgery; they were asked for the presence of dysmenorrhea, deep dyspareunia and/or chronic pelvic pain (CPP), intensity of pain was recorded on a Visual Analog Scale (VAS) score. MRI was performed on 3T Magnet, DTI sequences was acquired and a 3D reconstruction of S1, S2 and S3 was achieved. FA was calculated for every root as described. Univariate analysis was performed collecting also data from the following laparoscopy.

RESULTS

DTI of sacral roots revealed a regular and homogeneous appearance in 17 (25.8%) patients, while 44 (66.7%) women showed abnormalities in microstructure reconstructions, consisting mainly of fiber irregularities and disorganization combined with the loss of the simple unidirectional course. In 5 (7.6%) women the reconstruction of the sacral roots was not possible. Pathological DTI was significantly associated with the severity of dysmenorrhea and CPP, but no association with dyspareunia ($P=0.398$) or dyschezia ($P=0.738$) was found. Furthermore, a higher duration of pain was significantly associated with a pathological DTI. Adhesions in Douglas Pouch resulted significantly associated with pathological DTI ($P=0.001$), as well as DIE ($P=0.001$) and tubo-ovarian adhesions.

CONCLUSION

Pathological DTI of the sacral nerves is associated to the presence of CPP, but also it is related to the type and the site of endometriosis being obliteration of the cul-de-sac, tubo-ovarian adhesions and DIE responsible of DTI abnormalities. This new noninvasive method may help both clinicians and surgeons to select a better and more personalized therapeutic approach or select those patients who might benefit from alternative treatments, such as presacral neurectomy, anaesthetic nerve infiltration, neurostimulation or different types of pain killers that target neuropathic pain

CLINICAL RELEVANCE/APPLICATION

DTI alterations may help to select an alternative therapeutic approach such as presacral neurectomy, anaesthetic nerve infiltration, neurostimulation or different types of pain killers that target neuropathic pain

SSJ11-05 Virtual Hysteroscopy in Daily Practice in 14200 Cases

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E353B

Participants

Carlos Capunay, MD, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
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PURPOSE

To illustrate the clinical findings of virtual hysteroscopy (VHS) by MDCT in daily practice and the differential diagnosis with

To illustrate the typical findings of virtual hysterosalpingography (VHSG) by MDCT in daily practice and the differential diagnosis with other pathologies in patients studied between 2006 and 2014

METHOD AND MATERIALS

We evaluated the V-HSG studies of 14200 patients derived from our institution. Studies were performed using 64, 128 and 256 multislice CT scanners. Scanning parameters were: On 64-row CT: slice thickness of 0.9 mm 120 kV and 100-250 mAs, with an average duration of each scan of 3.6 seconds. On 128 and 256-slice CT: slice thickness of 0.6 mm and a reconstruction interval of 3 mm, 80 kV and 100-150 mAs, with an average duration of each scan of 1.3 seconds. A dilution of low-osmolality iodinated contrast (10-20 ml) was instilled into the uterine cavity. Images were analyzed using multiplanar reconstructions, 3D and virtual endoscopy. The duration of the CT scan, the radiation exposure and the degree of discomfort of the patients were documented.

RESULTS

The scan time was 3.5 and 1.3 seconds using 64-slice or 128-256-slice CT scanners respectively. The mean radiation dose was 0.9 and 0.3 mSv using 64-slice or 128-256-slice CT scanners respectively for each scan. In the cervical region were identified parietal irregularities (22%), thickening of folds (8%), polyps (7%), diverticula (5%), stenosis (5%) and sinechiaes (1%). In the uterine cavity were visualized polyps (35%), submucosal myomas (7%) and adhesions (3%). In addition changes were observed in the wall of the uterus: myomas (15%), malformations (3.2%), adenomyosis (5%) and cesarean section (12%). Fallopian tubes showed hydrosalpinx in 5% cases; unilateral (3.4%) and bilateral (1.6%). Patients reported no or mild discomfort in 85% of the cases.

CONCLUSION

The VHSG allowed a proper assessment of the internal genital organs, providing useful diagnostic information on infertility and other gynecological disorders. The technique is painless, well tolerated by patients with low doses of radiation. These advantages place this modality as a valid alternative algorithm study in patients with infertility

CLINICAL RELEVANCE/APPLICATION

Virtual hysterosalpingography is an useful diagnostic tool to obtain information on infertility and other gynecological disorders.

SSJ11-06 Prospective Comparison of 3D FIESTA versus 2D SSFSE MRI in Evaluating Pelvic Floor Dysfunction Disease

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E353B

Participants

Yanbang Lian, Zhengzhou, China (*Presenter*) Nothing to Disclose
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PURPOSE

To compare fast imaging employing steady state acquisition (FIESTA) sequence with single shot fast spin echo (SSFSE) sequence in terms of acquisition time, image quality, artifacts, and lesion detection.

METHOD AND MATERIALS

Fifty-three patients (mean age, 49 years; range, 21-81 years) suspected pelvic floor dysfunction disease (PFDD) were enrolled in this study and underwent high resolution dynamic magnetic resonance defecography (MRD). The MR imaging protocol included static T2-weighted fast spin-echo sequence in three planes and a single sagittal dynamic sequence of FIESTA and SSFSE for rest, left and defecation phase. The acquisition time of dynamic sequence was calculated. The sagittal data sets of FIESTA were compared with SSFSE data sets with respect to image quality, artifacts, and lesion detection. Quantitative values of acquisition time and lesion detection and qualitative analyses of image quality and artifacts were analyzed by using a paired Student's t test and the Kappa test, respectively.

RESULTS

Mean acquisition time of FIESTA sequence (80-slice/53 seconds) was significantly shorter than that of SSFSE sequence (40-slice/57 seconds) ($p < 0.05$). More pelvic organ prolapse (39/53 VS. 22/53) and rectocele (21/53 VS. 11/53) were detected with FIESTA than SSFSE ($p < 0.05$). There was no significant difference between FIESTA and SSFSE in image quality and artifacts ($\kappa = 0.905$, $p > 0.05$). Readers preferred the FIESTA sequence for showing more details.

CONCLUSION

For time savings and the versatility of showing greater degree of lesions without compromise of image quality, the near real-time continuous imaging with FIESTA sequence should be included in MRD protocols to better evaluate pelvic floor dysfunction disease.

CLINICAL RELEVANCE/APPLICATION

We recommend that FIESTA sequence should be included in MRD protocols to better assess pelvic floor dysfunction disease.

SSJ12

Health Service, Policy and Research (Patient Centered Care)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S104B

HP

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

Participants

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Sub-Events

SSJ12-01 Implementing Direct Patient Result Delivery in Radiography

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S104B

Awards

Trainee Research Prize - Resident

Participants

David C. Mihal, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
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PURPOSE

A subset of radiography outpatients in a large pediatric academic medical center were uncertain and sometimes anxious about how to receive their results. Our aim was to develop a practical system to offer results to these patients directly from a radiologist on the same visit. Goals were to achieve a high degree of patient declared understanding of results and positive feedback of their face to face interaction with the radiologist.

METHOD AND MATERIALS

The service evolved through four phases. In phase 1 (408 days) technologists screened outpatients and included those nervous about, or simply requesting, their results. We excluded any non-outpatient or those who would otherwise get results the same day from another provider. Patients completed an anonymous feedback survey after result delivery. Technologists and radiologists completed weekly feedback surveys. Phase 2 (55 days) expanded inclusion to outpatients without scheduled follow up. Phase 3 (21 days) expanded inclusion to offer results to all radiography outpatients using a patient self-screening survey at check in. Phase 4 (21 days) simply removed the wait time notification (10-20 min) from the self-screening survey.

RESULTS

The phase 1 direct result delivery rate was 1 patient per month, possibly due to technologists not identifying all potential patients. Phase 2 direct results tripled to 3 per month. Phase 3 results again tripled to 9 per month, but notably 92% of screened patients opted to receive results through their primary physician. In phase 4, with the wait period notification removed, results were delivered at a rate of 30 per month. More than 97% of patients reported understanding the radiologist delivered results. Patient feedback comments were 92% positive, 3% neutral, and 5% left blank. More than 84% of radiologists agreed that they experienced a sense of satisfaction afterward.

CONCLUSION

Having radiologists discuss results with patients was feasible, positive for radiologists, and clearly valued by patients. The highest, but manageable response was achieved when patients screened themselves. Still, direct result delivery may fall short of increasing patient awareness of radiologists' role in their care due to limited demand.

CLINICAL RELEVANCE/APPLICATION

Implementation of a service delivering results from radiologist to patient is feasible even when utilizing patient self-screening methods, and is a strongly positive experience for patients and radiologists.

SSJ12-02 Point-of-Care Virtual Radiology Consultations in Primary Care: A New Model for Patient-Centered Care in Radiology

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S104B

Awards

Trainee Research Prize - Resident

Participants

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PURPOSE

The use of virtual visits for routine outpatient care delivery has been steadily increasing. Limited data are available on the role of such visits in radiology. The goal of this study is to assess the value of point-of-care virtual consultations in radiology, through the implementation of synchronous video-based virtual consultations whereby referring primary care physicians can consult with a radiologist virtually and review studies in real-time while seeing a patient.

METHOD AND MATERIALS

We conducted an IRB-approved feasibility study of video-based radiology consultations in an internal medicine primary care clinic at a quaternary academic medical center. The study included 3 primary care providers (PCP) and enrolled 40 patients. Inclusion criteria consisted of the following: age >18, English speaking, recent radiology exam at our institution, and patients indicating verbal consent. Patients completed a pre- and post-visit survey. PCPs completed a post-visit survey. Primary study endpoints included the effect on patient and provider satisfaction, effect on patient experience and understanding of medical condition, and impact on PCP's management decisions. Statistical significance was assessed using student's t-test and Fisher's exact test.

RESULTS

Both patients and primary care providers indicated high satisfaction with the virtual radiology consult experience on a Likert scale of 1 to 5 (92 and 96% respectively). 89% of the patients reported increased understanding of their disease and improved patient experience as a result of the radiologist virtual visits. PCPs indicated that the consult was helpful for their management decisions in 83% of the visits. Virtual visits increased patient interest in receiving their imaging results from radiologists; 56% indicated interest in the pre-visit survey versus 88% in the post-visit survey (p=0.03).

CONCLUSION

Initial experience with virtual radiology consults show high rates of patient and provider satisfaction and increasing demand for the availability of these visits.

CLINICAL RELEVANCE/APPLICATION

Virtual radiology consults have the potential to advance radiology's value in care delivery by providing more personalized radiology care and by promoting patient-centered practice models.

SSJ12-03 Incidental Findings in Whole-Body MR Imaging of a Population-based Cohort Study: Frequency, Management and Psychosocial Consequences

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S104B

Participants

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PURPOSE

Management of incidental findings (IF) in whole-body magnetic resonance (MR) imaging remains controversial but highly relevant. We aimed to assess the frequency, management and psychosocial consequences of IF reporting in a population-based cohort study.

METHOD AND MATERIALS

From a population-based sample, a set of 400 participants underwent 3T whole-body MR imaging using a comprehensive protocol, including cranial (FLAIR, T1, SWI TOF), thoracoabdominal (T1 DIXON, multi-echo) and cardiovascular sequences (cine imaging, T1 mapping, LGE). All images were reviewed by a board-certified radiologist for presence of relevant IF according to a recommended list of relevant and non-relevant IFs based on current literature. In case of deviation the finding was referred for interdisciplinary panel adjudication. A participants' survey was conducted prior and 6 months after the MR scan regarding personal expectations, psychosocial consequences and experiences with IF reporting.

RESULTS

A total of 116 IF were reported in 89 participants (22.3%), of which 27 cases were reviewed by the panel. Additionally, 22 cases (5.5%) were referred to the panel but classified as not relevant for reporting. Among the reported IF, "Unclear Liver Lesion" (n=13), "Silent Myocardial Infarction" (n=12) and "Complex Renal Cyst" (n=9) were most common. Pre-/post-scan survey data were available in 251 participants. More than half of the participants (57.4%) noted in the pre-scan survey that reporting IF in general would be "very important" for them, which decreased to 43.0% after the scan ($p < 0.001$); this decrease did not differ whether the participant had an IF reported or not ($p = 0.75$). A small portion (2.3%) reported that waiting for the IF reporting was "very burdening" or "burdening". Of participants with reported IF, 9.1% felt that the results were "very burdening" while in contrast 56.8% classified the results as "very helpful".

CONCLUSION

In this cohort, the prevalence of IF was high, and many findings were adjudicated by an interdisciplinary panel. For participants, reporting of potential IF was highly important and added only minor psychological burden.

CLINICAL RELEVANCE/APPLICATION

Assessment of IF in population-based imaging research is important to study participants but associated with substantial resources of the investigators. Thus, optimized, workflow-oriented tools such as structured reporting or deep learning algorithms may prove beneficial in this setting.

SSJ12-04 Radiological Counselling: A New Approach to Radiologist-Patient Relationship

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S104B

Participants

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PURPOSE

Patients are more and more interested in improvements within medicine, curious about alternative methods of treatment and more conscious about their health. This leads the patients to look often for medical specialists to get information about the best diagnostic procedure.

RESULTS

The service started in September 2015 and the patients involved were 215. The need of radiological counselling was greater for complex imaging modalities, such as magnetic resonance imaging (48%) and computed tomography (31%) than, for example, X-rays (14%). The survey on the first 50 patients showed complete satisfaction of the meeting with the radiologist, with a score of 4,5/5. The 60% of the cases were under 60 years-old, which highlights the increased concern, within the younger generation, about their health. The majority of the patients answered that they preferred to receive the radiological report by a meeting with the radiologist: 50% if there are normal findings and 80% if pathological.

CONCLUSION

The Radiological Counselling is a useful service and can improve the relationship between the patient and the radiologist, who gains a new clinical role. The results are satisfying and will help the management to improve this service and to raise the patient's trust in the institution. In particular, the intention is to monitor patients after a pathological diagnosis, during their radiological follow-up and to research in which sub-specialty the service is more needed (neuroradiology, breast radiology, oncologic imaging, musculoskeletal radiology, thoracic radiology).

METHODS

To meet our patients' needs, the "Radiological Counselling" was introduced, a service which allows patients to have a meeting with the radiologist. This is useful for patients to learn the different and best imaging modalities, to have an explanation of what is written in the radiological report and to have recommendation about the best diagnostic process. Every radiologist reserved 2-3 hour a week for this service and the appointments were taken by the administrative office. The patients usually met the doctor who signed the report. The service outcome has been investigated by a survey on the first 50 patients that used radiological counselling: after the meeting with the radiologist, they answered a questionnaire about their age and sex, their satisfaction as well as the preferred method of communication in normal or pathological findings. In particular, It was asked if they preferred to receive the report: 1) at the reception of the radiology department (which is the method currently in use), 2) by the general practitioner, 3) by a phone call from the radiologist 4) by a meeting with the radiologist or 5) by email or internet.

PDF UPLOAD

https://abstract.rsna.org/uploads/2017/17012739/17012739_aw31.pdf

SSJ12-05 Patient Expectations for Receiving Imaging Results: Implications for Patient Portal Embargo Period

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S104B

Participants

Sean A. Woolen, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
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PURPOSE

The electronic patient portal is used by patients to access their imaging results. The objective of this study is to determine patient expectations for receiving imaging results.

METHOD AND MATERIALS

A prospective HIPAA-compliant multicenter outpatient survey using questions administered by a trained interviewer. The survey was reviewed by patient advocates with experience in survey design and underwent patient precognitive testing for readability. Over a four month period, outpatients receiving imaging tests were asked to participate in a survey regarding patient expectations for receiving imaging results. Descriptive statistics were calculated.

RESULTS

The response (93% [202/218]) and completion (100% [202/202]) rates were excellent. Patient expected median imaging result turn around in different scenarios are the following: 3 days (IQR 5) after screening, 2 days (IQR 3) after CXR for chest pain, 1 day (IQR 2) after CXR for pneumonia, 2 days (IQR 2) after MRI/CT for back pain, 1 day (IQR 2) after MRI/CT for brain tumor, and 1 days (IQR 3) after CT for cancer treatment. If patients do not have their imaging results yet, they will call their provider to inquire about results by the following median days in different scenarios: 5 days (IQR 4) after screening, 2 days (IQR 4) after CXR for chest pain, 1 day (IQR 2.75) after CXR for pneumonia, 2.5 days (IQR 3) after MRI/CT for back pain, 1 day (IQR 3) after MRI/CT for brain tumor, and 2 days (IQR 3) after CT for cancer treatment. Waiting on imaging results causes a negative effect on patient state of mind in 20% [38/188] and emotional change in 45% [91/202] with the majority (85% [77/91]) of emotional distress being anxiety (minimal 28%, mild 45%, moderate 22%, severe 4%, extreme 1%).

CONCLUSION

Patients expect their imaging results by 3 days and will call outpatient clinics by 5 days.

CLINICAL RELEVANCE/APPLICATION

The results support delivering imaging results within 3-5 days. These data can be used to inform institutional policy regarding automated imaging result release.

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/> Ella A. Kazerooni, MD - 2014 Honored Educator

SSJ12-06 Radiologist Experiences with Direct Patient Interactions

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S104B

Participants

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PURPOSE

To evaluate radiologists' attitudes and experiences with direct patient contact and how interactions with patients affect the workflow.

METHOD AND MATERIALS

This prospective survey of staff and trainee radiologists (n=128) at tertiary academic institution was performed with approval of our institutional review board. A multiple choice questionnaire with optional free text comments was distributed via departmental email between June 2016 and July 2016. Participation in the survey was voluntary and anonymous and responses. Statistical analysis of categorical responses was performed with the chi-squared test with statistical significance defined as $p < 0.05$.

RESULTS

Response rate was 73.4%, (94/128), with 54.3% (51/94) of the respondents being staff radiologists and 45.7% (43/94) trainee radiologists. Majority of the respondents, 78.7% (74/94), found interactions with patients to be satisfying experiences. 51/94 (54.3%) of radiologists desired more opportunities for patient interaction. Similar percentage of staff and trainees desired more patient interaction (56.9% (29/51) vs. 51.2% (22/43), $p=0.58$). Staff radiologists who specialized in vascular and interventional radiology and breast imaging were significantly more likely to want more patient interaction compared to those who specialized in other areas (77.8% (14/18) vs 45.5% (15/33), $p=0.03$). Only 4.2% (4/94) of radiologists found patient interactions to be detrimental to normal workflow. Most interactions between radiologists and patients, 80.9% (76/94), took less than 15 minutes. Only 14/94 (14.9%) of radiologists indicated they had ever refused to communicate directly with a patient when the patient requested discussion with radiologist. Majority of radiologists 62/94 (66.0%) were comfortable discussing potentially distressing and ominous results directly with their patients.

CONCLUSION

A majority of radiologists are open for more opportunities for interactions with patients and find them satisfying experience. Meeting a patient takes usually takes less than 15 minutes and is not felt to significantly affect the workflow.

CLINICAL RELEVANCE/APPLICATION

There should be opportunities for more direct patient-radiologist contact in clinical practice, as these interactions are rarely detrimental to the radiologists' workflow, while majority of radiologists find these interactions to be a satisfying experience.

SSJ13

Informatics (3D Printing)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: N230B

IN

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

SSJ13-01 Low-Cost Fabrication of Interventional Radiologic Training Models using Fused Filament Fabrication and Silicone Molding

Tuesday, Nov. 28 3:00PM - 3:10PM Room: N230B

Participants

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PURPOSE

Procedural training is a vital element to become confident in interventional procedures yet training models are expensive, not universally available and not patient-specific. We demonstrate an easy, cost-effective and reproducible approach to create vascular and tissue models with a combination of 3d printed scaffolding and silicone molding.

METHOD AND MATERIALS

With the use of open source 3D-Modelling software the model of a generic stenosis was developed with defined connections for an angiography simulator. A negative form of the model was derived and printed on a consumer fused filament fabrication 3d printer. The form was then casted using a clear yet flexible silicone. After curing the form was scanned in a CT scanner and registered on the initial model to ensure production precision. A second model was developed to train venous access management for technologists and students using a CT scan of a forearm that was segmented for bone and soft tissue. Intravenous lines were used to simulate veins with a diameter of 4 and 2 mm as well as to ensure easy compatibility to iv-systems of the hospital. After curing the lines were removed and the proximal entry was connected to an infusion to provide simple gravity-based vascular flow.

RESULTS

Reproducibility of stenosis model to the original file was excellent. The model is to be used as a training modality for interventional radiology and vascular surgery courses and was received with great interest. Material properties of the chosen silicone are reported to be vascular like. The second model is being used in the education for technologists yet the material characteristics of the soft tissue need to be improved.

CONCLUSION

A combination of segmentation, modelling and 3d printed scaffolding together with silicone casting proves to be a great way to develop easy, cost-effective and reproducible models. This approach can be used to create generic training models for the education of technologists and interventional radiology residents as well as patient-specific models for training and planning before high-risk interventions.

CLINICAL RELEVANCE/APPLICATION

The use of 3d-printed scaffolding and silicone molding allows to create cost-effective models for procedural training that help technologists and residents to become more confident in interventional procedures.

SSJ13-02 Patient-Specific Orbital Implant Shaping Guide for Orbital Wall Fracture Repair Using 3D Printing

Tuesday, Nov. 28 3:10PM - 3:20PM Room: N230B

Participants

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CONCLUSION

The implant shaping guide using 3D printing can be used for shaping the surgical implant precisely in orbital wall fracture repair. This exact mapping of shape and surface of defect site into a surgical implant would let surgeons secure the defect margin more confidently, and promise shorter operation time and convenience as well.

Background

The commercialized orbital implant is usually used to reconstruct bone fracture region in patients with orbital wall fracture. In the existing surgical method, surgeons guess the bone fracture region visually during surgery and shape the planar orbital implant manually before inserting it into the fracture site. It is very hard to match the implant to the 3D shape and size of the defect by use of the conventional 2D cutting method. Any discordance would lead to postoperative complications such as enophthalmos and diplopia.

Evaluation

From CT images, the fracture site of volume of interest was segmented in Fig. 1-A. The implant surface was created by an expert so that the damaged part could be covered. (Fig. 1-B) The 3D model was generated from the segmented 2D mask and fitting of orbital bone and implant were checked, which was converted into a STL format in Fig. 2. Planar orbital implants were regenerated as the created surfaces, and the zig molder, press was generated and used for shaping of the implant. (Fig. 3) The guide was washed and sterilized with isopropanol or EO gas for clinical use after remove supporter, and transported to the operating room. For surgery, the surface of zig molder was coated with surgical film not to direct contact with molder and patient. During the operation, the Implant plate was compressed using a sterilized molding model, and inserted into the fracture site.

Discussion

Seven eyes of 6 patients underwent orbital wall reconstruction using 3-dimensional printing between November 2016 and December 2016. Follow-up time ranged from 3 to 4. There were 4 men and 2 women. There were no complications such as loss of vision, infection, displacement or exposure of the implant. There was no significant difference in the orbital volume between the undamaged orbit and reconstructed orbit (21.84 ± 1.67 vs 21.83 ± 1.72 cm³, $P = 0.89$).

SSJ13-03 Utilizing the Power of the EMR, RIS, and VNA for 3D Printing Lab

Tuesday, Nov. 28 3:20PM - 3:30PM Room: N230B

Participants

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CONCLUSION

Building a 3D workflow in an existing EMR has potential benefits to facilitate the 3D service delivery process. It allows 3D printing to rank amongst other modalities important for patient care by living where all other clinical care orders reside. It also allows 3D Lab staff to document the process through quick communication with clinicians. The easier use and availability of 3D printed models will ultimately provide better patient care.

Background

In recent years' 3D printing, has shown exponential growth in clinical medicine, research, and education (Carlos et al.). Imaging departments are at the center of 3D printing service delivery, efforts of establishing a 3D printing lab, and making it a unique contribution towards patient care (Kent Thielen et al.). Building a fully electronic medical record (EMR) integrated workflow to deliver 3D services offers unique advantages for clinicians.

Evaluation

We have successfully tested the electronic process by generating 3D orders and delivering the printed models such as of the heart, skull, face, and ear.

Discussion

To facilitate clinicians and 3D printing lab staff, we developed an automatic workflow in our EMR and radiology information system (RIS). Clinicians use our Cerner EMR to order 3D printing services by selecting the available 3D printing orders for each modality i.e. MR, CT, and US. The order also allows them to add their requirements by filling out relevant Order entry fields (OEFs). 3D printing orders populate the RIS worklist for 3D lab staff to start, complete, and document the service process. Consultation with ordering clinicians and radiologists is also vital in 3D printing process, so we developed a message template for the communication between lab staff and clinicians, which also has the capability to attach 3D model PDFs. 3D Lab staff upload the models to our Vendor Neutral Archive (VNA) before completing, storing the models in the patient's record.

SSJ13-04 A 'Super-resolution' Algorithm for Generating Optimal 3D Printed Models From Multiple Sub-Optimal Non-Isotropic Resolution Clinical Images

Tuesday, Nov. 28 3:30PM - 3:40PM Room: N230B

Participants

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CONCLUSION

A method has been developed to "super-resolve" anatomy imaged in multiple independent, lower resolution CT/MR data sets for more accurate 3D printing than possible using the underlying images individually

Background

Clinical protocols often do not acquire high resolution data (<1-1.5mm slice thickness) to successfully 3D print anatomy. When the need for 3D-printing is known ahead of imaging, protocols can be adjusted to obtain appropriate data. However, this is not always possible due to signal-to-noise ratio vs imaging time in MR, and radiation dose in CT. For example, for pelvis CT in a large teaching hospital where ALARA principles are applied, 3mm thick slices in all 3 planes (axial [ax], sagittal [sag] and coronal [cor]) are obtained, but reconstructing 1mm slices for printing yields images too noisy to segment. On some CT equipment, sag/cor reconstructions are produced directly from the sinogram, rather than reformatting of axial images. In those cases, image voxels reconstructed at each plane contain intrinsically different information. Similarly, MR images at different planes contain information from intrinsically different spins excited for each slice

Evaluation

We developed a method to combine data from independent multi-planar images into a single "super-resolution" 3D image set, using the highest resolution for each axis amongst the available image data sets, that can be more easily and accurately segmented. The method uses the voxel size and location of all low-resolution images (with or without registration as necessary) to produce a single higher-resolution voxel grid whose image intensities satisfy the lower-resolution images as mathematical constraints. The method was used on CT images of a pelvis with prior periacetabular osteotomy and fracture. Bone was automatically segmented from each ax/sag/cor 3mm images interpolated to 0.5mm, and from super-resolved images reconstructed using the new method at a 0.5 mm grid

Discussion

The method enabled accurately segmenting anatomy demonstrating a superior pubic ramus fracture and prior hardware that none of the individual (ax/sag/cor) clinical CT images allowed despite being interpolated to a higher resolution grid

SSJ13-05 Creation of Low-Cost Multi-colored Clear 3D Printed Models

Tuesday, Nov. 28 3:40PM - 3:50PM Room: N230B

Participants

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CONCLUSION

With minimal post-processing, it is possible to create low-cost, clear 3D printed models with colored components using consumer grade Stereolithography printers. These models are ideal for percutaneous and endovascular pre-procedure planning.

Background

While there has been rapid expansion of low-cost solutions for creation of opaque 3D printed models in Radiology, the creation of clear models with colored internal components has been limited. PolyJet printers offer the ability to create clear models with multi-color components, but printer costs are >\$150,000 and material costs are often prohibitive. Here, we present a technique to create low-cost clear models with colored components using a consumer-grade stereolithography printer at <5% of the cost of traditional techniques.

Evaluation

Clear visceral, bony and vascular 3D printed models with colored internal components are valuable for visualizing internal structures relative to more superficial anatomy. Examples include renal tumors and bony lesions. PolyJet printers are directly able to create multi-color models with clear components; however, the printers and their materials cost hundreds of thousands and hundreds of dollars respectively. Desktop stereolithography printers cost <\$5000 and allow creation of clear 3D printed models at low cost. However, these printers can only print with one material at a time. Our technique centers on creating models with internal structures modeled as hollow cavities. These cavities are then filled with paint. As an example, when creating clear renal models with colored components depicting the collecting system and tumor (figure), traditional polyjet techniques result in model costs of \$1000. Using our techniques, models cost an average of \$29.01 (SD: \$6.79, n = 5).

Discussion

Here, we present a technique for creating multi-color models using low cost SLA 3D printers with relatively easy post-processing. Our experiences show that creation of low-cost, high-quality clear models with colored components is feasible and can be done at a tiny fraction of the cost of traditional techniques. This results in the removal of a primary barrier for implementation of 3D printing in hospitals.

SSJ13-06 Characterization of 3D Printing Materials: Hounsfield Unit Energy Dependence and Comparison to Commercially-Available Tissue Equivalent Materials

Tuesday, Nov. 28 3:50PM - 4:00PM Room: N230B

Participants

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PURPOSE

To compare Hounsfield Units (HU) of commonly used 3D-printing materials (3DMs) to tissue-equivalent materials (TEMs) from commercially-available phantoms. Further, to examine the energy dependence of 3DMs and estimate visibility of 3D-printed implants or instruments in computed tomography (CT).

METHOD AND MATERIALS

A Stratasys Object 350 Connex3 printer produced 1"x 1"x 1" cubes of six common materials. Stratasys materials were chosen because it has the largest commercial install base in the world. Silicone used to fill 3D-printed molds was also characterized. TEMs from the American College of Radiology (ACR) Image Quality Phantom and the RMI 641A phantom were characterized for comparison. All materials were CT scanned at 80, 100, 120, and 140 kV on a Philips Ingenuity 128 and GE VCT 64. 3DM: 1. RGD-CW-004-DM (mix of VeroWhite+ & VeroCyan), 2. FLX9870-DM (mix of TangoBlack+ & VeroWhite+), 3. RGD835 (VeroWhite+), 4. RGD8525-DM (mix of TangoBlack+ & VeroWhite+), 5. RGD843 (VeroCyan), and 6. FLX980 (TangoBlack+). Silicone: Smooth-on platinum cure silicone rubber compound

RESULTS

All 3D-printed materials were between 40HU and 140HU and demonstrated a slightly increasing HU trend with tube voltage. ACR acrylic also demonstrated a slightly increasing HU trend with tube voltage. Four of the six 3DMs were equivalent to ACR acrylic. Material 6 (TangoBlack+) had an HU between water surrogates and ACR acrylic. Material 2, a mixture of TangoBlack+ and VeroWhite+, had an HU higher than TangoBlack+ alone demonstrating how mixtures could be used to produce low contrast structures if desired. Silicone had a strong non-linear decreasing dependence with tube voltage. Unfortunately, none of the 3DMs investigated were similar to water, fat, or bone. Scanner make/model did not significantly impact HU of the investigated materials ($p = 0.21$).

CONCLUSION

Materials typically used in 3D-printing have a slight energy dependence and their HU is between that of soft-tissue and muscle. 3DMs investigated here would be suitable to model organs and muscle in CT phantoms; however, printed implants or instruments using these 3DMs may not be visible in muscle or organs due to their similar HU and thus low contrast.

CLINICAL RELEVANCE/APPLICATION

The 3D-printed materials investigated here are suitable for organ and muscle modeling, but implants and instruments made from these materials could be invisible on CT scans due to the HU similarity to organ and muscle.

SSJ14

Molecular Imaging (Renal, Hepatic, Cardiovascular)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S504CD

MI

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

SSJ14-01 Multimodal Imaging of BAT Activity in Type I and Type II Diabetes Mouse Models Using 7T MRI and Intravital Microscopy

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S504CD

Participants

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PURPOSE

To determine the metabolic activity of brown adipose tissue (BAT) in type I and type II diabetes mouse models using superparamagnetic iron oxide nanoparticles (SPIO - for MRI) or quantum dots (QD - for intravital microscopy (IVM)) embedded into triglyceride-rich lipoproteins (TRL).

METHOD AND MATERIALS

C57BL/6J wild-type were either treated with Alloxan which is selectively toxic to pancreatic beta cells (100µl iv; Alloxan monohydrate, Abcam) to induce type I diabetes or received a 35% Lard-based high fat diet over 16 weeks to induce type II diabetes. BAT activity was stimulated by treatment with the β_3 receptor agonist CL316,243. All mice were starved for 4 hours before imaging. MRI at 7T ClinScan (Bruker) was performed before and 20 minutes after iv injection of TRL-SPIOs using a T2*w Multiecho-GRE sequence (TR/TEfirst 400/2ms, ETL 12, ES 1ms, FA 25°). In addition to the MRI set up, IVM analysis was performed for real time imaging of TRL-QD uptake into BAT. In order to quantify TRL clearance, the fate of radioactively labelled TRLs were analysed under the same experimental conditions.

RESULTS

While control mice showed a significant signal drop after CL treatment, no significant signal difference in BAT before and after the injection of TRL-SPIO was detectable neither for type I nor for type II diabetes mouse model. Analogy real time IVM analyses showed a clear reduction of TRL-QD in case of diabetes disease mouse models. MRI and IVM results were confirmed by quantitative metabolic studies using radioactive lipid tracers. In both setups diabetes type I and type II lead to a reduction of TRL uptake into BAT.

CONCLUSION

β_3 -receptor activation via CL with following acute insulin release lead to BAT activation, which can be visualised in vivo by MRI using TRL-SPIO. However, in case of diabetic disease, the uptake of TRL into BAT is diminished, indicating a loss of BAT activity in this case. Thus, MRI can visualize physiological lipid processing in the vascular endothelium of activated BAT.

CLINICAL RELEVANCE/APPLICATION

MRI in combination with nanoparticle-labelled lipoproteins can be used to noninvasively monitor the molecular pathway of insulin-dependent lipoprotein metabolism.

SSJ14-02 Evaluation of Early Renal Injury Development in Diabetic Rats by BOLD-MRI

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S504CD

Participants

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PURPOSE

To observe changes in renal oxygenation levels by BOLD-MRI, and sought to evaluate the usefulness of BOLD-MRI in development of early diabetic renal injury.

METHOD AND MATERIALS

80 male SD rats with left uninephrectomy were randomly divided into normal control (NC) group and diabetes mellitus (DMN) group. Streptozotocin (65 mg/kg) was intraperitoneally injected in DMN group, and the NC group given with saline. BOLD-MRI scans were performed for the two groups at different time points, NC group as baseline and DMN group at 3, 7, 14, 21, 28, 35, 42, 49, 56, 63 and 70 days following streptozotocin injection. Renal cortical and medullary $R2^*$ ($CR2^*$, $MR2^*$) signals were measured and $R2^*$ ratio of medulla and cortex (MCR) was calculated. Urinary protein excretion (UAE) and histopathological examination were evaluated at different time points.

RESULTS

$CR2^*$ and $MR2^*$ values of diabetic rats were significantly higher than control group rats at different time points after induction of diabetes ($P < 0.01$). Those $R2^*$ values raised gradually and reached the peak at day 35 ($CR2^* = 33.95 \pm 0.34$ s⁻¹, $MR2^* = 43.79 \pm 1.46$ s⁻¹), then dropped gradually until day 70 ($CR2^* = 33.17 \pm 0.69$ s⁻¹, $MR2^* = 41.61 \pm 0.95$ s⁻¹), but still significantly higher than the control group ($CR2^* = 28.41 \pm 0.56$ s⁻¹, $MR2^* = 31.77 \pm 0.87$ s⁻¹) ($P < 0.01$). MCR in DM group rose gradually from 1.12 to 1.32 at day 42, and then decreased to 1.25 at day 70. UAE of DMN group increased gradually, it was significantly higher than that of NC group since day 7 ($P < 0.01$). The GSI was higher in DMN group compared to NC. Mesangial volume density (Vv_{mes}) and the capillary surface density (Sv_{cap}) was increased in the DMN group when compared to NC.

CONCLUSION

BOLD-MRI can non-invasively evaluate the renal hypoxia in diabetes and detect diabetic renal injury earlier than UAE. The dynamic changes MCR like a downward parabola in our study diabetic would be adopted to reflect the dynamic changes from stage II to stage of diabetic renal injury proved by Mesangial proliferation and nodular sclerosis appearing pathologically.

CLINICAL RELEVANCE/APPLICATION

BOLD-MRI can non-invasively evaluate the renal injury early and dynamically

SSJ14-03 VLA-4 Targeted Liposomes for Noninvasive Visualization of Vulnerable Plaques in ApoE(-/-) Mice by MRI

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S504CD

Participants

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PURPOSE

Currently, there is no approved method for diagnosing cardiovascular complications of atherosclerosis which delineates the cellular and molecular components that predict plaque stability (1). Activated monocytes/macrophages and T-lymphocytes constitute about half the cellular makeup of vulnerable plaques and contribute to weakening and eventual rupture (2). We report herein, a nanoparticle targeted to VLA-4 (a surface receptor on leucocytes), that labels and enables noninvasive visualization of vulnerable plaques in ApoE(-/-) mice by MRI at 1 Tesla.

METHOD AND MATERIALS

A lipid mixture containing lipid-PEG-THI567 conjugate, DSPE-PEG-DOTA-Gd complex, and Rhodamine DHPE was subjected to a standard liposome formulation protocol to achieve targeted particles with size $\sim 170 \pm 10$ nm. A control untargeted formulation was also prepared. Flow cytometry was used to evaluate particle binding and receptor specificity in vitro, and leukocyte cell subset binding distribution in vivo. MR imaging in ApoE(-/-) mice (protocol approved by the IACUC, N=7 for controls, N=9 for the test group), was performed on a 1.0 Tesla MRI scanner. Images were acquired pre-, immediately after, and 72-96 hours post contrast injection. Following the last scan, animals were sacrificed, and the aortic arch, carotids and descending aorta were frozen for histology.

RESULTS

VLA-4 targeted particles bind activated monocytes and T-lymphocytes both in vitro and in vivo with picomolar binding constants. In delayed phase imaging, animals injected with the targeted liposomes showed enhanced regions in the aortic arch or the descending aorta, with 4-fold greater mean signal than the animals injected with the untargeted agent. Histochemical analysis of tissue sections from the treated animals showed co-localization of the targeted particles and immune cells within the plaques as shown in Figure 1.

CONCLUSION

Liposomal nanoparticles bearing a T1 contrast agent, targeted to monocytes/macrophages and T-lymphocytes allows for noninvasive visualization of vulnerable plaques in ApoE(-/-) mice by MRI at 1T.

CLINICAL RELEVANCE/APPLICATION

A sensitive, specific method to identify vulnerable plaques before they rupture and could dramatically change the therapeutic course for patients with atherosclerotic lesions.

SSJ14-04 Identification of Metabolic Regulation Mechanism Involved in Diabetes Comorbid Depression by Ex Vivo High Resolution 1H-NMR Spectroscopy

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S504CD

Participants

Wen Xu, Hangzhou, China (*Presenter*) Nothing to Disclose

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PURPOSE

To investigate the mechanism and find related biomarkers of diabetes comorbid depression, ¹H nuclear magnetic resonance (¹H NMR)-based metabolomics were applied to study the metabolic changes in the prefrontal cortex(PFC), hippocampus(HI) and hypothalamus(HY) of the comorbidity rats.

METHOD AND MATERIALS

Male wistar rats were divided into two groups: control group(group Con) and diabetes combined depression group(group DD). Rats of group DD were injected intraperitoneally with STZ, the control rats received sham injections of citrate buffer alone. Group DD were then exposed to chronic unpredictable mild stress(CUMS) for 28 days. All rats were submitted to the open-field and Morris water maze tests immediately after the CUMS procedure. After brain tissue collection, a part of tissue were used for measuring the expression of glial fibrillary acidic protein(GFAP), glutamine synthetase(GS), glutaminase(GLS), glutamate decarboxylase(GAD) in PFC, HI and HY by immunohistochemistry. The rest of tissue underwent NMRS to find out metabolic changes in these cerebral regions.

RESULTS

Group DD showed high blood glucose level (>33.3mol/L), declined body weight ($P<0.01$), and exhibited other typical signs of diabetes. In the open-field test, group DD showed reduced total traveling distance and locomotor activity ($P<0.05$). Throughout the probe trial of Morris water maze test, group DD performed less times of crossing the former platform area ($P<0.05$). The mean optical density(MOD) of GFAP and GLS in aforementioned regions of group DD were elevated, while declined MOD of GS in these regions and GAD in the PFC increased ($P<0.05$). The level of Lac increased in all three regions of group DD compared with group Con. Decreased Glu, Gln, NAA, Cre and Cho, but increased Tau were obtained in PFC and HI. Besides, declined levels of Asp and Gly were observed in PFC, decreased Ala but increased m-Ins were presented in HI. In HY, concentrations of GABA, NAA, Ala, Glu, Gln, Cho, Gly, Asp all decreased.

CONCLUSION

Alterations in energy metabolism and amino acid neurotransmitters metabolism might be associated with the pathogenesis of diabetes comorbid depression, and disordered Gln-Glu-GABA cycle plays a crucial role in neuron injury of the comorbidity.

CLINICAL RELEVANCE/APPLICATION

The overall findings may contribute to the understanding of the underlying mechanism and provide some potential targets for treatments to ameliorate the effects of the comorbidity.

SSJ14-05 Hyperpolarized [¹³C] Pyruvate Metabolism in Precision-Cut Mouse Liver Slices

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S504CD

Participants

Naama Lev-Cohain, MD, Jerusalem, Israel (*Presenter*) Nothing to Disclose

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Rachel Katz-Brull, PhD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

[¹³C]Pyruvate metabolites in a hyperpolarized state have been visualized in whole rodent liver in vivo and ex-vivo. However, this approach does not permit the necessary radiology-histopathology needed to adequately evaluate the technique as a marker of the relevant biologic process. Precision cut liver slices have the potential to breach this obstacle. We aimed to validate the use of precision cut liver slices for hyperpolarized metabolic investigation in a mouse model. Following validation of the slices viability by ³¹P NMR spectroscopy and detection of ATP signals, hyperpolarized [¹³C]pyruvate was administered to the slices and its metabolism was followed.

METHOD AND MATERIALS

Fresh normal livers were harvested from five mice. The livers were sliced with a microtome-tissue slicer to 500 μ m thickness slices and placed in an ice-cold recovery medium. The slices were then placed in an NMR spectrometer (5.8 T, RS2D, France) and perfused continuously with oxygenated growth media at 37 $^{\circ}$ C. ³¹P spectra were acquired to evaluate the presence of ATP. After

ATP production was seen, hyperpolarized [^{13}C]pyruvate was flushed into the NMR tube in the spectrometer, into the liver. Consecutive ^{13}C NMR spectra were acquired immediately after the injection. Spectral analysis was performed using MNova (Mestrelab Research, Santiago de Compostela, Spain).

RESULTS

The ^{31}P spectra collected from each liver showed the characteristic signals of ATP, confirming the viability of the tissues slices in the spectrometer. After each of the [^{13}C]pyruvate injections, both [^{13}C]lactate and [^{13}C]alanine signals were detected within 20 sec, for a duration of 1.5 min.

CONCLUSION

We were able to maintain and show the viability of precision-cut mouse liver slices in an NMR spectrometer as well as record hyperpolarized [^{13}C]pyruvate metabolism for the first time. This suggests that it can be used for ex-vivo evaluation of liver metabolism. This strategy is translational to the study of human liver metabolism ex-vivo as very small amounts of tissue are required. This approach is likely to lead to more accurate assessment of intracellular processes in a personalized manner.

CLINICAL RELEVANCE/APPLICATION

The validation of precision-cut mouse liver slices has great impact on the ability to increase evaluation accuracy and metabolites quantification. This new translational finding can improve evaluation of numerous biological processes in liver diseases.

Honored Educators

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

SSJ14-06 Quantitative Optoacoustic Imaging Detects Changes in Renal Ischemia: Potential New Horizons in Renal Transplant Imaging

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S504CD

Awards

Student Travel Stipend Award

Participants

Oshaani Abeyakoon, MBBS, FRCR, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
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Sarah Bohndiek, MSc, PhD, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Abstract Co-Author*) Research Grant, Hologic, Inc; Research Grant, General Electric Company; Research Grant, GlaxoSmithKline plc

PURPOSE

Optoacoustic imaging (OPUS), a novel technique based on measuring the differential absorption characteristics of oxy/deoxyhemoglobin in perfused tissues, has the potential to assess changes in tissue oxygenation during renal cortical ischemia. The aim of our proof of principle study was to explore the potential of optoacoustic imaging to detect quantitative changes in oxygen saturation in the renal cortex of revascularized porcine kidneys under ex-vivo normothermic perfusion conditions.

METHOD AND MATERIALS

Four porcine kidneys harvested by the animal licence holder on two separate occasions were evaluated. The harvested organs were perfused with a fully oxygenated (100%) warm red cell solution at a constant flow rate of 85 ml/min. An OxyLite probe was placed within the renal cortex under imaging guidance, distal to the external optoacoustic probe but within the same pyramid, approximately 1 cm apart (to avoid interference between the tip of the probe and the optoacoustic scanner). Real time measurements correlating the detected OPUS signal with the measurements from the OxyLite probe were made while clamping the renal artery intermittently until the kidney infarcted.

RESULTS

Kidneys 1 and 4 infarcted when connected to EVNP before results were obtained. Kidneys 2 and 3 showed a good temporal correlation between the indirect OPUS-derived oxygen saturation measurements and the OxyLite probe. The results are summarised in the figure uploaded.

CONCLUSION

Our preliminary results indicate that renal cortical ischemia can be assessed with a clinical optoacoustic system and OPUS measurements correlate with invasive OxyLite measurements in revascularised porcine kidneys under ex-vivo normothermic perfusion conditions. This first, but important step, opens the possibility of further evaluating the utility of this technique to assess transplant viability and develop it further as a method to detect renal ischemia.

CLINICAL RELEVANCE/APPLICATION

The ability to non-invasively quantify renal cortical ischemia is an important advance in treatment planning and assessing the viability of a transplant kidney.

SSJ15

Musculoskeletal (Muscle and Nerve)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E450B

MR MK

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

Participants

Darryl B. Sneag, MD, Plainview, NY (*Moderator*) Institutional research agreement, General Electric Company
Soterios Gyftopoulos, MD, MSc, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSJ15-01 Multi-Parametric MRI Characterization of Changes in Skeletal Muscles with Aging

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E450B

Participants

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PURPOSE

To evaluate age-related characteristics of thigh muscles by applying multi-parametric quantitative MRI and to investigate relationships between age and the parameters.

METHOD AND MATERIALS

Ninety-five healthy subjects (47 men, 48 women; median, 47 years; IQR, 39-58 years) with normal body mass index (18.5-24.9) were included for this prospective study. No subject had muscle disorder, diabetes, history of operation or trauma in the thigh region or was on medication. Age groups were as follows: 30-39 years (n=25), 40-49 years (n=25), 50-59 years (n=25), 60-69 years (n=20). Multi-parametric (intravoxel incoherent motion (IVIM) diffusion-weighted imaging (DWI), diffusion tensor imaging (DTI), multi-echo Dixon imaging, and dynamic contrast-enhanced (DCE)) MRI was acquired at 3.0 T. Parametric maps were evaluated by two radiologists independently in the following muscles: (1) anterior compartment: rectus femoris, vastus lateralis, medialis and intermedius; (2) medial: adductor longus and magnus; (3) posterior: biceps femoris, semitendinosus and semimembranosus. Significance of differences in multiple parameters in three thigh compartments between four age groups was determined by one-way analysis of variance (ANOVA) with post hoc Tuckey. Strength of relationships between multiple parameters and age was evaluated using Pearson correlation analysis. Interrater reliability was also assessed.

RESULTS

Significant differences between different age groups were appreciated for ADC, true diffusion (D), fractional anisotropy and Ve of anterior compartment muscles, as well as fat percentages of all three compartments (p<0.05). Moreover, fractional anisotropy and Ve in anterior compartment (r=0.428, 0.309, respectively) and fat percentages in all three compartments (r=0.481, 0.475, and 0.667, respectively) showed positive relationships to age (p<0.05). Interrater reliabilities were excellent (ICC, 0.786-0.992, p=0.000 for all).

CONCLUSION

Our study suggests that a number of MRI parameters are associated with age-related changes in thigh muscles. These parameters may reflect histologic and microstructural alterations in aging muscles.

CLINICAL RELEVANCE/APPLICATION

Multi-parametric MRI offers potential for non-invasive characterization of histologic changes in aging skeletal muscles. Our study provides a baseline data for further research on sarcopenia.

SSJ15-02 Fibrosing versus Non-Fibrosing Scleroderma-Related Myopathy: Role of Thigh Muscle MRI

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E450B

Participants

Shivani Ahlawat, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Filippo Del Grande, MD, MBA, Baltimore, MD (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bayer AG; Institutional research collaboration, Siemens AG;
Parvinder Sujlana, MD, Newport News, VA (*Abstract Co-Author*) Nothing to Disclose

Julie J. Paik, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Systemic sclerosis (SSc)-associated myopathy has variable clinical outcomes. SSc patients with fibrosing myopathy (FM) have a rapidly progressive course and higher mortality than those with non-fibrosing myopathy (NFM). The purpose of our study was to describe MRI features in patients with SSc that may be predictive of FM and therefore, patient outcome.

METHOD AND MATERIALS

Following IRB approval, patients with SSc myopathy were included who had undergone a rheumatologic evaluation, thigh MRI and muscle biopsy. MRI included T1-weighted, STIR and DWI with ADC mapping (b-values 0,800 s/mm²) of both thighs. Two musculoskeletal radiologists (in consensus), without knowledge of histopathological findings, evaluated 36 individual muscles in each patient for the presence of intramuscular edema, fascial edema, fatty replacement and atrophy on all sequences using a 4-point score (absence, mild, moderate, maximal). Each patient was categorized by histologic results, as having FM (endomysial/perimysial fibrosis) or NFM (necrosis/inflammation etc.), and comparison of the two groups was performed.

RESULTS

There were 11 patients with FM (mean age 47; 9 women/2 men) and 14 with NFM (mean age 51; 10 women/4 men). Comparing STIR muscle appearance in FM (n=356) and NFM (n=498), intramuscular edema (65%(232/356) vs 49%(245/498), p<0.0001) and fascial edema (22%(79/356) vs 17%(84/498), p=0.07), respectively, were more common in FM. DWI showed a greater difference in muscle signal in FM compared with NFM, at low b-value (54%(133/246) vs. 23% (64/280), p<0.0001) and high b-value (46% (113/246) vs. 23%(65/280), p<0.0001) images, respectively. Minimum, average and maximum ADC values were not different between the two groups. NFM had chronic changes more often than FM, with fatty replacement (45%(223/498) vs. 26%(92/356), p< 0.0001) and atrophy (52%(261/498) vs. 33%(118/356), p< 0.0001), respectively.

CONCLUSION

In patients with SSc-related myopathy, intramuscular and fascial edema (as identified by STIR and DWI) on thigh MRI are more common in FM than NFM, while markers of chronic muscle damage are more often associated with NFM, potentially related to the rapid and fatal course of FM.

CLINICAL RELEVANCE/APPLICATION

Thigh muscle MRI maybe serve as an adjunct tool to distinguish between fibrosing and non-fibrosing SSc related myopathy and as such serve as a biomarker for prognosis.

SSJ15-03 Pudendal Nerve Entrapment: Comparing Pudendal MRI with Surgical Findings, Lessons Learned

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E450B

Participants

Matthew L. Harwood, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose
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Michael Hibner, MD, PhD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the performance of pudendal MRI in patients with pudendal nerve entrapment (PNE) in comparison with transgluteal pudendal neurolysis, which is the gold standard for detection of PNE caused by scar, dilated vessels, or both.

METHOD AND MATERIALS

We performed a retrospective chart review to obtain basic patient information, operative report data, and presurgical pudendal MRI findings. All patients underwent a dedicated pudendal MRI with and without contrast performed on a 1.5T scanner. Surgical and MRI data were categorized by side (left, right, or bilateral), location [anatomically narrowed spaces, either Alcock's canal (AC) or the interligamentous space (ILS)], and surgical pathology (scar, dilated vessels, or both). Data underwent sensitivity analysis, and descriptive statistics were computed using R (www.r-project.org).

RESULTS

391 patients had dedicated pudendal MRIs between 8/2010 and 12/2016. We identified 67 patients who underwent transgluteal pudendal neurolysis after MRI. There were 55 women and 12 men, whose age ranged 24 to 77 years, mean age 51. 40 surgeries were on the left side; 21 were on right side; and 6 were bilateral. The surgeons saw 70 total scars (51 in ILS, 10 in AC, and 9 in both ILS and AC) and 16 dilated vessels (12 in ILS, 2 in AC, 2 in both ILS and AC). 64 (91%) of the scars and 13 (81%) of the dilated vessels were not discernable on MRI. Only 3 (4%) MRI findings of scar and only 2 (13%) MRI findings of dilated vessels matched findings seen at surgery exactly. Though not exactly quantified at the time of surgery, small scars (<= 2 mm thickness) and mildly dilated vessels (<= 3 mm diameter) predominated the findings at surgery.

CONCLUSION

Pelvic MRI with pudendal protocol has a low detection rate of small scars and mildly dilated vessels in the interligamentous space and in Alcock's canal. In spite of the limitations of current MRI technique, from our experience, clinicians should continue to use MRI to assess for unexpected causes of pudendal nerve entrapment.

CLINICAL RELEVANCE/APPLICATION

This study quantifies the detection rate of scars and dilated vessels to further clarify the role of pelvic MRI with pudendal protocol in patients with clinically determined pudendal nerve entrapment.

SSJ15-04 Will Pre-Operative Combined MRI and HRUS Redefine Brachial Plexus Imaging? A Comparative Study of Pre-Operative MRI versus HRUS in Assessing C5, C6 Viable Root-Stump Length, a Predictor of Intra-Plexal Nerve Grafting

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E450B

Awards

Student Travel Stipend Award

Participants

Jyoti Panwar, MD, FRCR, Toronto, ON (*Presenter*) Nothing to Disclose
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S. Devika, Vellore, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

MRI is the preferred imaging modality for the traumatic brachial plexus (BP) imaging. From a surgeon's perspective locating viable root stumps is important as they are a source of axons for intra-plexal grafting. Hence predicting its presence preoperatively is of high priority. We argue that the presence of a viable nerve root stump is better assessed pre-operatively with high resolution ultrasonography (HRUS) rather than MRI in patients undergoing BP surgery. This study was undertaken to compare the diagnostic accuracy of combining HRUS with MRI versus MRI alone in the preoperative assessment of viable nerve root stumps of the BP.

METHOD AND MATERIALS

After approval by the institutional review board 56 adult patients with unilateral BP injury who were planned for BP nerve surgery between July 2015 to April 2016 and consented for this prospective study were included. This cohort underwent pre-operative imaging using both MRI and HRUS and an analysis for the presence of viable nerve roots and its length if present were done using the above two modalities. Undisrupted plexuses were deemed as "continuous" while discontinuous plexuses with "viable" root stumps were termed as "present" and those without as "absent". A viable stump was one with preserved epineurium and fascicular architecture and devoid of pre-ganglionic injury. Stump lengths were measured using both imaging modalities and compared with intraoperative (IO) measurements for their concordance.

RESULTS

We observed a greater agreement between the HRUS and IO findings in categorizing BP root stumps (Kappa value 0.70) as compared to MRI and IO (Kappa value 0.42). Similarly, there was a higher correlation (intra-class correlation-ICC) of the stump length measured, between HRUS and IO (0.94) than that of MRI and IO (0.53).

CONCLUSION

Combining HRUS with MRI in the pre-operative assessment of patients with adult BP injury can predict better, the presence of viable nerve root stumps as well as accurately measure its length compared to MRI alone.

CLINICAL RELEVANCE/APPLICATION

Knowing the quality of the root stump pre-operatively will help the surgeon in choosing an appropriate nerve grafting procedure and have possible better clinical outcomes. Hence, all pre-operative BP imaging protocols should include HRUS imaging along with standard MRI sequences for a comprehensive radiological evaluation.

SSJ15-05 Parsonage-Turner Syndrome: Not a Brachial Plexitis

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E450B

Participants

Darryl B. Sneag, MD, Plainview, NY (*Presenter*) Institutional research agreement, General Electric Company
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PURPOSE

Parsonage-Turner syndrome (PTS) - commonly known as neuralgic amyotrophy and brachial neuritis - is described etiologically as a 'brachial plexitis,' implying diffuse plexus involvement, but recent electrodiagnostic research suggests otherwise. We sought to characterize lesion distribution in PTS using high-resolution MRI.

METHOD AND MATERIALS

We searched our institution's MRI database for patients with a clinical diagnosis of PTS. Two radiologists specializing in peripheral nerve MRI independently evaluated signal characteristics and morphology of the brachial plexus on high-resolution MRI, including terminal branches of the plexus, as well as peripheral nerves when imaged. A physiatrist with expertise in PTS reviewed all charts to confirm the diagnosis of PTS using history, exam, and electromyographic (EMG) findings of complete/near-complete motor loss.

RESULTS

24 patients (18 M, 6 F; age 41 ± 15 years) had ≥ 1 clinically involved nerves: suprascapular (15), long thoracic (7), axillary (5), radial (2), anterior interosseous (2), thoracodorsal (1), phrenic (1), musculocutaneous (1), and median nerve branch to pronator

teres (1). 75% of patients developed severe weakness following a prodrome of sudden-onset intense pain, while 25% had onset >12h following a surgical procedure. Mean time between symptom onset and initial EMG was 5.5 ± 4.6 months and 8 ± 6.7 months between onset and MRI. On MRI, the plexus proper appeared normal in 21/24 patients; in 3 others, T2-weighted signal hyperintensity was seen immediately proximal to the terminal branch take-off. Focal caliber decreases of terminal branches, suggesting intrinsic constrictions, were detected in 19/24. Hyperintensity and enlargement of involved peripheral nerves were present in all patients, except the phrenic nerve (too small to identify). MRI inter-reader agreement was nearly perfect (Cohen's kappa = 0.833).

CONCLUSION

MRI findings, corroborated by EMG, localize abnormalities to the plexus branches and peripheral nerves, suggesting PTS is a mononeuropathy multiplex rather than a diffuse brachial plexitis.

CLINICAL RELEVANCE/APPLICATION

'Brachial plexitis' is a misnomer that erroneously implies diffuse plexal involvement. Accurate disease terminology may improve diagnosis and management.

SSJ15-06 T1 and T2* MRI Mapping for Detection of Early Tendon Degeneration: A Phantom Study

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E450B

Participants

Andrea Roszkopf, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
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Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Michael A. Fischer, MD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To quantitatively assess early tendon degeneration using T1 and T2* mapping in healthy and chemically degenerated bovine flexor hallucis tendons

METHOD AND MATERIALS

Twelve cadaveric specimens underwent MRI at 3T before and after chemical tendon degeneration. Fibre cross-linking or protein denaturation resembling the first or the second step of tendon degeneration was chemically induced in a total of 10 tendons. A variable-echo-time sequence and variable-flip angle sequence was used for T2* mapping and T1 mapping respectively. Each scan (untreated and treated tendons) was repeated twice at different time points and T1 and T2* times were correlated with different grades of early tendon degeneration. Standard T1- and T2-weighted spin-echo (SE) sequences were acquired for visual assessment of tendon texture. Degree of tendon degeneration was verified by histopathological analysis.

RESULTS

The degree of tendon cross-linking and denaturation ranged from mild to strong. T1 times were reproducible, showing no difference between scan 1 and 2 for untreated and treated tendons (both, $P < 0.01$). The mean T1 and T2* times were significantly different between normal and degenerated tendons ($P < 0.01$) and correlated well with the degree of tendon degeneration ($R = 0.86$, $P < 0.05$). Standard T1 and T2 SE sequences showed no visual signal differences both in treated and untreated tendons.

CONCLUSION

T1 and T2* mapping has the potential to detect and quantify early tendon degeneration before changes in tendon structure become visible on standard MR sequences.

CLINICAL RELEVANCE/APPLICATION

Early tendon degeneration in symptomatic patients might be diagnosed much earlier as with routine MR sequences.

SSJ16

Musculoskeletal (Cartilage)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E451A

MK MR

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

Participants

Daniel B. Nissman, MD, MPH, Raleigh, NC (*Moderator*) Royalties, John Wiley & Sons, Inc; Royalties, Wolters Kluwer nv
Donna G. Blankenbaker, MD, Madison, WI (*Moderator*) Consultant, Reed Elsevier; Royalties, Reed Elsevier

Sub-Events

SSJ16-01 Evaluation of Knee Cartilage Composition using T2 Mapping Sequences at 3T in Patients with Early Osteoarthritis Treated with Intra-articular Platelet-Rich-Plasma (PRP) Injections

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E451A

Participants

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PURPOSE

To define the ability of T2 mapping sequences to evaluate the efficacy of PRP injections characterizing qualitatively and quantitatively knee cartilage composition in patients with early osteoarthritis

METHOD AND MATERIALS

40 patients (17 men, 23 women, mean age 35.8 years), with clinical suspicion of tibiofemoral and patellofemoral chondropathy were examined on a 3T MRI scanner. T1WI, T2WI, and PDWI sequences were used for morphological evaluation of cartilage lesions, using a modified WOMS score. T2 mapping sequences were used for the qualitative and quantitative analysis of cartilage by means of color-scale representation and ROI measurements of T2 relaxation time values. Patients were assigned to 2 groups: 20 patients (group A) were treated with intra-articular PRP injections (3 times, 3 weeks apart), 20 patients (group B, control) were submitted to conservative therapy. MRI follow-up was performed at 6 months

RESULTS

Before treatment the two study groups were homogeneous in terms of age, sex and BMI. The morphologic evaluation showed mean WOMS score of 8.4 (pre-treatment) and 6.6 (post-treatment) in Group A ($p < 0.0001$). In Group B mean WOMS scores were 8.6 (pre-treatment) and 7.9 (post-treatment) ($p = 1,323$). Mean T2 relaxation times values in Group A were 51.39 ms (pre-treatment) and 44.19 ms (post-treatment) ($p < 0.001$). In Group B, 51.86ms (pre-treatment) and 50.7ms (post-treatment) ($p = 0.274$)

CONCLUSION

Our imaging results confirm the clinical evidence of the efficacy of PRP injections for the treatment of knee osteoarthritis. Evaluation of cartilage T2 relaxation times provides additional quantitative information that may not be directly discernible from standard morphological sequences

CLINICAL RELEVANCE/APPLICATION

Cartilage repair is a challenging clinical issue. The efficacy of novel therapies aiming at tissue regeneration (such as PRP) is strictly dependent on early detection of cartilage pathology and a close monitoring of the treatment effects. Characterization of the cartilage matrix composition with T2 relaxation time measurements could potentially help in prevention of OA progression, allowing better monitoring of the disease and treatment-related changes in the cartilage matrix over time

SSJ16-02 Articular Cartilage Reliably Predicts Symptomatic Osteoarthritis Progression from T2 Maps Using Transport-Based Morphometry

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E451A

Awards

Trainee Research Prize - Medical Student

Participants

Shinjini Kundu, PhD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
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PURPOSE

Articular cartilage in the knee undergoes early biochemical changes in the development of osteoarthritis (OA). We determine whether texture change in articular cartilage as assessed by T2 maps is a reliable predictor of future symptomatic osteoarthritis.

METHOD AND MATERIALS

70 subjects (39 progressors, 31 controls) were chosen from the Osteoarthritis Initiative (OAI) database (age = 58.5 ± 9.2 , BMI = 27.2 ± 4.8). At baseline, subjects had no evidence of OA either clinically (Western Ontario and McMaster Universities Arthritis Index (WOMAC) <10) or radiographically (Kellgren-Lawrence score ≤ 2). On 3-year follow up, progressors were identified as subjects with >10 increase in WOMAC from baseline. Femoral cartilage was segmented from baseline T2 maps and co-registered. The transport-based morphometry (TBM) technique was applied to characterize T2 spatial variation within each subject individually and compared to a common template image. A penalized linear discriminant analysis classifier was constructed in the transport space and test accuracy in predicting symptomatic OA progression was determined using complete leave-two-out cross-validation. Characteristic patterns of injury were visualized through inverse TBM transformation.

RESULTS

TBM enables 86.2% test accuracy in predicting future symptomatic OA three years in advance of symptoms using T2 spatial variation of articular cartilage (sensitivity=86.6%, specificity=85.9%, Cohen's kappa = 0.72), significantly outperforming classification based on age and BMI alone. By defining signature patterns of injury in the femoral cartilage, we found that a central defect in the medial condyle and diffuse fissuring in the medial aspect of the lateral condyles were predictive of future OA.

CONCLUSION

The development of symptomatic OA can be reliably predicted based on the T2 map of knee articular cartilage using TBM, yielding the highest accuracy to date when compared to other predictive studies. In addition, TBM enables visualization of signature patterns of injury that are predictive of future OA for the first time.

CLINICAL RELEVANCE/APPLICATION

The early changes in T2 spatial variation revealed by TBM enhance our understanding of OA progression and yield markers that may be used prognostically and monitor success of disease-modifying therapies in the future.

SSJ16-03 Are Different Weight Loss Regimens in Obese and Overweight Individuals Associated With Different Degrees of Cartilage Degeneration Over 96 Months? Data from the Osteoarthritis Initiative

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E451A

Participants

Alexandra S. Gersing, MD, Munich, Germany (*Presenter*) Nothing to Disclose
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Michael C. Nevitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Thomas M. Link, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec Ltd; Research Grant, InSightec Ltd; Royalties, Springer Nature; Consultant, Springer Nature; Research Consultant, Pfizer Inc;

PURPOSE

To investigate MR-based cartilage biochemical degeneration and morphologic joint abnormalities over 96 months in overweight and obese subjects with stable weight and weight loss and to assess how these changes are affected by different weight loss regimens.

METHOD AND MATERIALS

Subjects with a BMI >25kg/m² from the Osteoarthritis Initiative (n=760; age 62.6 ± 9.0 y; 465 females) with risk factors for or radiographic mild to moderate osteoarthritis were included. Subjects losing weight (>5% of baseline BMI; N=380) were frequency matched to controls with stable weight (N=380) and categorized into groups regarding the weight loss method (diet and exercise, diet only, exercise only). 3T MRI of the right knee was performed at baseline, 48- and 96-months. T2 relaxation time changes of cartilage composition, including laminar and texture analysis as well as morphological knee abnormalities, assessed with Whole-Organ-Magnetic-Resonance-Imaging-Scores (WORMS) were analyzed using mixed random effects models to calculate associations between amount of weight loss and regimen.

RESULTS

Progression of cartilage WORMS was significantly lower in the weight loss group compared to controls ($P < 0.001$) over 96 months. Subjects with weight loss showed significantly less T2-value increase in the bone layer of all compartments ($P < 0.03$, for each) compared to the controls with stable weight, suggesting less cartilage degeneration over 96 months in the subjects with weight loss compared to their controls. Rates of increase in cartilage T2 averaged over all compartments were lowest in the diet and diet and exercise groups compared to the stable weight group ($P = 0.042$ and $P = 0.003$, respectively). Weight loss through exercise alone showed no significant difference in change of T2 over 96 months compared to subjects with stable weight ($P = 0.56$).

CONCLUSION

Results suggest that cartilage degeneration is slowed through weight loss in obese and overweight subjects over 96-months. This

protective effect was, however, only found in subjects losing weight through diet and combined exercise and diet programs.

CLINICAL RELEVANCE/APPLICATION

MR-based knee cartilage T2 measurements and semiquantitative grading allow monitoring of the protective effect of weight loss on joint health and are useful to determine which weight loss regimen is most beneficial in overweight and obese patients.

SSJ16-04 Type 2 Diabetes Patients show Accelerated Cartilage Matrix Degeneration Compared to Age, Gender and BMI-matched Diabetes Free Controls: Data from the Osteoarthritis Initiative

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E451A

Participants

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Thomas M. Link, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec Ltd; Research Grant, InSightec Ltd; Royalties, Springer Nature; Consultant, Springer Nature; Research Consultant, Pfizer Inc;

PURPOSE

The relationship between osteoarthritis (OA) and type 2 diabetes mellitus (T2DM) is poorly understood with both diseases showing common risk factors. The purpose of this study was therefore to longitudinally investigate over 24 months cartilage matrix changes measured with MR-based T2 relaxation time including texture measurements in patients with T2DM compared to diabetes-free controls.

METHOD AND MATERIALS

Patients were recruited from the Osteoarthritis Initiative. In total 196 subjects with T2DM were group-matched for age, sex, BMI and Kellgren-Lawrence score with 196 diabetes free controls. T2DM was ascertained either by self-report or by use of anti-diabetic medication. Knee cartilage semi-automatic segmentation was performed on 2D multi-slice multi-echo spin-echo sequences; Cartilage T2 maps were calculated using a mono-exponential decay model. Texture of cartilage T2 maps was obtained with grey level co-occurrence matrix analysis, calculating the spatial distribution of neighboring pixels within the cartilage for contrast, variance, and entropy. Conditional logistic regression analysis was used to compare cross-sectional and changes in T2 and texture parameters between both groups.

RESULTS

Averaged over all compartments, subjects with T2DM increased almost twice as fast as the control group in the global knee T2 values (mean T2 (ms) [95% CI]: 1.77 [1.51,2.03] and 0.98 [0.68,1.28], respectively ($p < 0.001$). The 24-month cross-sectional analysis showed significantly higher T2 values in subjects with diabetes in the global knee ($p = 0.009$), patella ($p = 0.01$), medial tibia ($p = 0.02$), and lateral tibia (0.006). Moreover, T2DM showed texture parameters consistent with increased cartilage matrix inhomogeneity at baseline for contrast, variance and entropy ($p < 0.05$) and after 24 months for contrast and variance ($p \leq 0.05$).

CONCLUSION

Subjects with T2DM showed a significantly faster increase in T2 values when compared to diabetic-free controls, and had also significantly higher T2 values in the cross-sectional analysis at 24 months, indicating an accelerated degeneration of the cartilage matrix. Furthermore, T2DM subjects showed more heterogeneous cartilage texture composition at both time points.

CLINICAL RELEVANCE/APPLICATION

Altered cartilage composition and collagen architecture in subjects with T2DM and accelerated cartilage matrix deterioration, suggest that T2DM is an important risk factor for OA.

SSJ16-05 MRI-Based Indicators of Patella Cartilage Volume Loss over 24-Month Interval: Initial Assessment Using Data from the FNIH OA Biomarkers Consortium

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E451A

Participants

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Shadpour Demehri, MD, Baltimore, MD (*Abstract Co-Author*) Research support, General Electric Company; Research Grant, Carestream Health, Inc; Consultant, Toshiba Corporation;

PURPOSE

To investigate whether key patellofemoral alignment indicators on 3T magnetic resonance imaging (MRI) are associated with baseline cartilage volume differences and 2-year progression of patella cartilage volume loss.

METHOD AND MATERIALS

One index knee from each of 600 subjects in the Osteoarthritis Biomarkers Consortium FNIH project were included. Four key patellofemoral alignment markers were assessed on baseline imaging including: tibial tuberosity-trochlear groove distance (TT-TG), Insall-Salvati (IS) ratio, trochlear groove depth (TGD) and presence or absence of superolateral Hoffa's fat pad edema. Patella cartilage volume was determined at baseline and 24-month follow up MRI using validated automated software. Cross-sectional analysis of baseline data was performed by comparing cartilage volumes for each alignment index, with abnormal values considered TT-TG greater than 15 mm, IS ratio greater than 1.4, TGD greater than 3 mm, and presence of fat pad edema. Multivariable logistic regression analysis was performed with odds-ratios determined for future cartilage volume loss, adjusted for age, gender, BMI and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

RESULTS

On baseline cross-sectional analysis, abnormal IS ratio and abnormal TGD were associated with lower baseline patella cartilage volume (IS ratio: 2445 mm³ vs 2664 mm³, p:0.028; TGD: 2697 mm³ vs 2369 mm³ p<0.001). Multivariate logistic regression analysis showed only presence of superolateral Hoffa's fat pad edema to be predictive of significant 2-year interval decrease in patellofemoral cartilage volume (OR: 1.82, p: 0.003).

CONCLUSION

Presence of superolateral Hoffa's fat pad edema is associated with 2-year progression of patella cartilage volume loss. Furthermore, subjects with abnormal IS ratio and TGD had lower baseline patella cartilage volumes, suggestive of cartilage loss prior to initiation of this study.

CLINICAL RELEVANCE/APPLICATION

Routine indicators of patellofemoral alignment on MRI could allow for prediction of future patellofemoral cartilage loss.

SSJ16-06 Comparison of T2 Relaxation Values in Subtalar Cartilage between Patients with Lateral Instability of the Ankle Joint and Healthy Volunteers

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E451A

Participants

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PURPOSE

To evaluate the difference between the T2 relaxation values of the subtalar cartilage in patients with lateral instability of the ankle joint and the values in healthy volunteers.

METHOD AND MATERIALS

Twenty-seven ankle magnetic resonance imaging (MRI) examinations of 26 patients who underwent lateral ankle ligament repair between January 2011 and November 2013 were included. The datasets of previously enrolled healthy volunteers, 13 ankle MRI examinations of 12 volunteers, were used as a control group. Two radiologists independently measured the T2 relaxation values of the cartilage in the posterior facet of the subtalar joint comprising of eight compartments as follows: central calcaneus anterior (CCA), central calcaneus posterior (CCP), central talus anterior (CTA), central talus posterior (CTP), lateral calcaneus anterior (LCA), lateral calcaneus posterior (LCP), lateral talus anterior (LTA), and lateral talus posterior (LTP). The T2 relaxation values of the patient group were compared with those of the control group using linear regression analysis. Interobserver agreement and intraobserver agreement for the measurement were calculated using the intraclass correlation coefficient (ICC).

RESULTS

Readers found significantly higher mean T2 relaxation values in all compartments except that in LTP compartment measured by reader 1. For reader 1, the CCA findings were 44.9 for patients and 40.5 for healthy volunteers (p=0.002); CCP, 46.0 and 40.8 (p=0.002); CTA, 50.1 and 46.0 (p=0.001); CTP, 52.8 and 46.3 (p<0.001); LCA, 43.7 and 39.1 (p=0.002); LCP, 45.1 and 38.8 (p<0.001); LTA, 50.8 and 47.5 (p=0.019); and LTP, 50.4 and 47.6 (p=0.085). For reader 2, the CCA findings were 45.5 for patients and 41.5 for healthy volunteers (p=0.005); CCP, 45.8 and 40.1 (p<0.001); CTA, 49.7 and 45.6 (p=0.009); CTP, 52.7 and 47.0 (p<0.001); LCA, 44.3 and 39.2 (p<0.001); LCP, 45.8 and 38.8 (p<0.001); LTA, 50.4 and 47.6 (p=0.040); and LTP, 52.9 and 48.0 (p=0.002). Interobserver agreement and intraobserver agreement were excellent for all measurements (ICC>0.75).

CONCLUSION

The T2 relaxation values of the subtalar cartilage were significantly higher in patients with lateral ankle instability compared with those of healthy volunteers.

CLINICAL RELEVANCE/APPLICATION

Quantitative T2 mapping in the subtalar joint is feasible and may have a role for diagnostic evaluation of cartilage degeneration in patients with lateral ankle instability.

SSJ17

Nuclear Medicine (Emerging Concepts and Comparative Technologies)

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

BQ CT NM

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

Participants

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Charles M. Intenzo, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ17-01 Quantitative and Visual Assessments toward Potential Sub-mSv or Ultrafast FDG-PET Using High-Sensitivity Time-Of-Flight (TOF) PET in PET/MRI

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S505AB

Participants

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Randall A. Hawkins, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Newer high-performance TOF PET systems have the capability to maintain diagnostic image quality even with low count density, while maintaining a high raw photon detection sensitivity that would allow for a reduction in injection dose or rapid data acquisition. To assess this, we performed quantitative and visual assessments of the PET images acquired using a highly-sensitive large field-of-view silicon photomultiplier (SiPM)-based TOF-PET integrated with 3T-MRI in comparison to PET images acquired on non-TOF PET/CT systems.

METHOD AND MATERIALS

Whole body FDG-PET/CT was acquired for fifteen patients followed by whole body PET/MRI. The PET list mode data from PET/MRI were reconstructed using full datasets (4 min/bed) and reduced datasets (2, 1, 0.5 and 0.25 min/bed). Qualitative assessment between PET(/CT) and PET(/MR) images were made. A Likert-type scale between 1 and 5, 1 for non-diagnostic, 3 equivalent to PET(/CT) and 5 superior quality, was used. Maximum and mean standardized uptake values (SUVmax and SUVmean) of normal tissues and lesions detected were measured and compared.

RESULTS

Mean visual assessment scores were 3.54 ± 0.32 , 3.62 ± 0.38 and 3.69 ± 0.35 for the brain and 3.05 ± 0.49 , 3.71 ± 0.45 and 4.14 ± 0.44 for the whole-body maximum intensity projections (MIPs) for 1, 2 and 4 min/bed PET(/MR) images, respectively. The SUVmean values for normal tissues were lower and statistically significant for images acquired at 4, 2, 1, 0.5 and 0.25-min/bed on the PET(/MR), with values of $-27 \pm 18\%$, $-26 \pm 18\%$, $-26 \pm 19\%$, $-25 \pm 19\%$ and $-25 \pm 18\%$ ($p < 0.05$) respectively. SUVmax and SUVpeak values of all lesions were higher and statistically significant ($p < 0.05$) for 4, 2, 1, 0.5 and 0.25 min/bed datasets.

CONCLUSION

High-sensitivity TOF-PET showed comparable but better visual image quality even at much reduced activity in comparison to lower-sensitivity non-TOF-PET. Our data translates to a 7 times reduction in either injection dose for the same time or total scan time for the same injected dose. This 'ultra-sensitivity' PET system provides a path to extremely low-dose FDG-PET studies (e.g. sub 1 mCi injection or sub-mSv effective dose) or studies as short as 1 min/bed (e.g., 6 minutes of total scan time) to cover whole-body without compromising diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

'Ultra-sensitive' TOF PET system can provide clinically acceptable FDG-PET studies for sub-mSv or short acquisition times (1 min/bed) to cover the whole-body.

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:

SSJ17-02 SiPM PET/CT vs Standard PET/CT: A Pilot Study Comparing Semi-Quantitative Measurements in Normal Tissues and Lesions

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S505AB

Participants

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PURPOSE

The aim of this pilot study is to determine if a new generation PET/CT scanner using silicon photomultipliers (SiPM), GE Discovery Molecular Insights - DMI PET/CT (GE Healthcare, Waukesha, WI), recently installed in our Department, provides equivalent results compared to the standard of care PET/CT scanners (GE Discovery 600 or GE Discovery 690) used in our clinic and to explore any possible differences in semi-quantitative measurements.

METHOD AND MATERIALS

We enrolled 50 patients who had a clinical indication for standard of care PET/CT. The local Institutional Review Board approved the protocol and written informed consent was obtained from each patient. All patients underwent a single injection dual imaging protocol including the standard of care PET/CT scan followed immediately by image acquisition using the DMI PET/CT scanner. We measured SUVmax and SUVmean of different background organs and up to 4 lesions per patient from data acquired using both scanners

RESULTS

DMI PET/CT scan did not miss any of the 107 lesions detected by standard PET/CT scanners and identified additional 37 areas of focal 18F-FDG uptake compatible with putative sites of disease. The results of equivalence tests, with an equivalence interval of $[-0.7, 0.7]$, performed on each of the normal tissues matched per patient showed an equivalence for all background tissues except for the cerebellum (P value < 0.01). The SUVmax measurements for all 107 lesions were 2.8 ± 2.8 higher on DMI PET/CT compared with standard of care PET/CT ($P < 0.0001$) and this difference was not related to time delay between two scans ($P < 0.0001$). Lesion:aortic arch ratios and lesion:liver ratios were 3.2 ± 2.6 and 1.9 ± 1.4 higher on DMI PET/CT compared with standard of care PET/CT ($P < 0.0001$).

CONCLUSION

The performance of SiPM PET/CT is at least comparable to that of standard PET/CT. While delayed imaging can lead to detection of additional lesions, our data suggests that in this series the lesions identified only on DMI PET/CT indicate superior performance of the scanner. Further evaluation needed to confirm our data. Differences in semi-quantitative measurements between standard PET/CT and SiPM PET/CT are important factors when adopting the new technology.

CLINICAL RELEVANCE/APPLICATION

DMI PET/CT new generation scanner allow to reduce the injected dose or the scan time without missing images quality, helping to diagnose and stage disease earlier and better guide treatment strategies.

SSJ17-03 Effect of Tumor Burden on Standard Uptake Values within the Brain, Blood, and Liver: Implication for Quantitative PET/CT Imaging

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S505AB

Participants

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PURPOSE

We have previously described the effect of patient specific factors, specifically plasma blood glucose, had on quantitative standardized uptake value (SUV) measurements within target organs/tissues of interest, particularly the relationship to brain cortical metabolism and liver parenchyma. During analysis of that patient population, there was suggestion that metabolic burden (total lesion glycolysis, TLG) either from tumor and/or heart can also be a confounding factor of FDG uptake within these reference

tissues.

METHOD AND MATERIALS

Previously published 436 FDG PET/CT studies performed for oncology staging from 229 patients (436 exams) at the Ann Arbor Veterans Administration Healthcare System were reviewed. An additional 107 exams from 50 patients were performed and TLG was obtained based on auto-segmentation of the tumor and/or the heart. The absolute and normalized uptake in target tissues for these studies were then compared to the entire group (previously published non censored data) as a function of TLG to determine if metabolic burden had an effect on uptake in reference tissue.

RESULTS

Metabolic tissue burden (tumor and/or heart) had a statistical significant effect on the uptake of FDG within reference tissue (blood, liver and brain) compared to the population average at similar plasma glucose. However, this effect was absent and or significantly mitigated when normalization to a reference tissue (blood) occurred.

CONCLUSION

The effects metabolic burden (tumor and or heart) upon brain SUV and various reference tissue can have a significant effect on absolute SUV measurements. This effect can be mitigated if normalization to a reference tissue occurs.

CLINICAL RELEVANCE/APPLICATION

Finding of this research could have implications in the implementation of PERCIST criteria in tumor imaging.

SSJ17-04 Whole Body Metabolic Tumor Volume is a Prognostic Marker for Overall Survival in Patients with Newly Diagnosed Stage 3B Non-Small Cell Lung Cancer Confirmed with External Validation

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S505AB

Participants

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PURPOSE

This study aimed to evaluate the prognostic value of quantitative FDG measurements, namely whole body Metabolic Tumor Volume (MTVwb), Total Lesion Glycolysis (TLGwb), and maximum Standardized Uptake Value (SUVmaxWB), on baseline FDG PET/CT in patients with newly diagnosed Stage 3B Non-Small Cell Lung Cancer (NSCLC).

METHOD AND MATERIALS

IRB approved retrospective study identified patients diagnosed with Stage 3B NSCLC (restaged according to 8th edition TNM classification) on baseline FDG PET/CT between Feb 2004 and Dec 2014. Exclusion criteria included a second primary cancer diagnosed from 5 years before to 2 months after this FDG PET/CT scan and any prior NSCLC treatment. MTVwb, TLGwb, and SUVmaxWB were calculated from the baseline PET/CT using Edge method with Mimvista software. The study included a training dataset from one medical center, and a validation dataset from an outside hospital. The primary endpoint was overall survival (OS). Cox regression models were used to test for an association between patient characteristics, quantitative FDG measurements and OS.

RESULTS

110 patients with clinical Stage 3B NSCLC met inclusion/exclusion criteria. 78.2% expired during follow-up. The median OS was 14 months. 1-year, 2-year, and 5-year OS was 56.5%, 34.6% and 13.9 %, respectively. The median follow-up among survivors was 26.0 months (inter-quartile range 13.6 to 57.2 months). Univariate analysis showed no significant difference in OS on the basis of age, gender, histology, ln(TLGwb), or ln(SUVMAXwb). However, increasing ln(MTVwb) was associated with worse OS (hazard ratio (HR) of 1.23). This association persisted on multivariate Cox regression analysis (HR of 1.28), when adjusted for age, gender, treatment and tumor histology. The second external dataset of 44 patients validated the significant correlation between MTVwb and survival. Specifically, a MTVwb cut-off point of 85.6 mL able to further stratify patient prognosis among patients with Stage 3B NSCLC, with increasing MTVwb predictive of significantly worse survival.

CONCLUSION

MTVwb is a prognostic marker for OS in patients with Stage 3B NSCLC, independent of age, gender, treatment, and tumor histology, with increasing MTVwb predictive of significantly worse OS.

CLINICAL RELEVANCE/APPLICATION

An MTVwb of 85.6 mL may be used as a threshold to further stratify Stage 3B NSCLC patients, with MTVwb \geq 85.6 mL on baseline PET/CT predictive of worse prognosis.

SSJ17-05 Who is Hot and Who is not? The Diagnostic Dilemma of Paraneoplastic Syndromes and Who to Image with FDG-PETCT

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

Awards

Student Travel Stipend Award

Participants

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PURPOSE

Paraneoplastic syndromes are a rare phenomenon that pose a diagnostic challenge and are sometimes the first clinically detectable evidence of occult disease. The dilemma occurs as many of the signs/symptoms associated with them can be features of conditions without an underlying malignancy. Given the higher radiation doses associated with a full body FDG-PETCT over conventional CT or non-ionising radiation imaging we wanted to evaluate its usefulness as a first line investigation for patients with suspected paraneoplastic syndromes. The challenge is 'who to PETCT?'.

METHOD AND MATERIALS

We conducted a retrospective review of patients who underwent FDG PETCT between 01/01/2009 and 31/01/2017, to investigate occult malignancy in suspected paraneoplastic syndrome. We collected information on age, sex, primary diagnosis, incidental pathology, other causative pathology, presence of antibodies and final diagnosis. Evaluation of cases where a positive neoplasm was identified was carried out to evaluate if other first line investigations were obtained, and if not, would alternative imaging have been suitable.

RESULTS

113 patients were identified as having PETCT. 3.5% (n=4) had a primary neoplasm identified. The commonest source of referral was from neurology n=73 (64%), followed by rheumatology (n= 38, 34%), and endocrinology (n=2, 2%). In our study, PETCT had a true positive = 4, true negative = 94, false positive = 14, false negative = 1. The PPV was 22%, NPV was 98%, sensitivity was 80% and the specificity was 87%. A review of the positive cases was carried out to identify if other imaging would have yielded the same result. The neoplasms identified were oropharyngeal, primary lung, pheochromocytoma and Hodgkins lymphoma. 75% of malignancy detected on PETCT was also detectable on conventional CT.

CONCLUSION

To our knowledge this is the largest retrospective analysis in the UK of PETCT in the investigation of patients with suspected paraneoplastic syndrome. PETCT has a high NPV and is therefore an excellent diagnostic test to exclude malignancy. The low positive yield for malignancy adds support to our current national imaging and neurology guidelines which advise against using PETCT as a first line investigation.

CLINICAL RELEVANCE/APPLICATION

Paraneoplastic syndromes are a diagnostic challenge. Radiation burden and resource management must be considered when deciding on the primary radiological investigation.

SSJ17-06 Synthesis, Quality Control and Bio-Distribution of PET Tracer (18F-FP-Chlorotoxin) and Preliminary Evaluate the Imaging Features of 18F-FP-Chlorotoxin in C6 Glioma Model

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

Participants

Jing Zhao JR, MD, PhD, Guang Zhou, China (*Presenter*) Nothing to Disclose
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PURPOSE

To synthesize, describe the bio-distribution of 18F-FP-Chlorotoxin and do quality control of this PET-tracer. Further, to preliminary evaluate its imaging feature in C6 glioma model.

METHOD AND MATERIALS

18F- was generated by medical cyclotron and 18F-NFB was synthesized through fluorination reaction, then, dissolved 18F-NFB and Chlorotoxin in Na₂HPO₄ or borate buffer. Quality control experiments of 18F-FP-Chlorotoxin were performed. 20 normal Kunming mice were randomly divided into four groups and each mouse was injected 18F-FP-Chlorotoxin (22-23 µCi) via the tail vein. They were sacrificed after injection in 10 min, 30 min, 60 min and 120 min, respectively. Blood and organs of each mouse were resected and weighed separately. 18F-FP-Chlorotoxin (60min, 90min, 120min) and 18F-FDG micro PET-CT (60min) was performed on the same rat with orthotopic C6 cell-based glioma (n=2) at different scan time points and their imaging features were analyzed.

RESULTS

¹⁸F-FP-Chlorotoxin was successfully made. The chemical purity of ¹⁸F-FP-Chlorotoxin was greater than 98% and the radiation purity was greater than 95%. The brain had a low and relatively stable uptake of ¹⁸F-FP-Chlorotoxin and, it was $0.37 \pm 0.10\%$ ID/g in 10 min which was slightly decreased to $0.28 \pm 0.06\%$ ID/g in 60min. Among all the organs, kidney showed the highest uptake. ¹⁸F-FP-Chlorotoxin and ¹⁸F-FDG micro PET-CT were successfully performed on the same rat with orthotopic C6 cell-bared glioma. Compared with ¹⁸F-FDG, a low uptake of ¹⁸F-FP-Chlorotoxin was detected in normal brain parenchyma while a higher level of ¹⁸F-FP-Chlorotoxin was found in the gliomas tissue. The glioma tumor/normal brain parenchyma in ¹⁸F-FP-Chlorotoxin was higher than the ratio in ¹⁸F-FDG. Further, the diagnostic performance of ¹⁸F-FP-Chlorotoxin in 90 min was better than it in 60 min.

CONCLUSION

The main quality control indexes of ¹⁸F-FP-Chlorotoxin had reached the positron radiopharmaceuticals quality requirements. Normal brain parenchyma has a low and stable uptake on ¹⁸F-FP-Chlorotoxin and, compared with ¹⁸F-FDG, ¹⁸F-FP-Chlorotoxin has a better performance in diagnosis of glioma.

CLINICAL RELEVANCE/APPLICATION

¹⁸F-FP-Chlorotoxin as a new PET-trace with a low and stable uptake in normal brain parenchyma and, compared with ¹⁸F-FDG, it has a better performance in diagnosis of glioma.

SSJ18

Neuroradiology/Head and Neck (State-of-the-Art Thyroid and Parathyroid Imaging)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: N226



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

Participants

Nancy J. Fischbein, MD, Stanford, CA (*Moderator*) Nothing to Disclose
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Sub-Events

SSJ18-01 Thyroid Nodule Assessment: Initial Experience with the New ACR TI-RADS Guidelines

Tuesday, Nov. 28 3:00PM - 3:10PM Room: N226

Participants

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PURPOSE

The new ACR TI-RADS guidelines were published on-line on March 31st 2017 <http://dx.doi.org/10.1016/j.jacr.2017.01.046>. Existing guidelines can be difficult to apply. The new risk stratification model was published with the aim of reducing the number of unnecessary thyroid biopsies. Our study aims to: 1. Determine the accuracy of the new guidelines 2. Look specifically at the biopsy rates and the number of malignancies that might be missed with the application of these new guidelines.

METHOD AND MATERIALS

The new guidelines were applied against a pre-existing electronic database of 200 pathologically confirmed cases. 200 cases had already been scored by 5 readers (4 using a newly developed on-line 'app') using an extended version of the 2015 ACR TI-RADS lexicon. The sonographic features scored included the ACR lexicon which had been extended to allow for the assessment against the pre-existing ATA, AAC/AME/ETA, BTA, Kim, Korean, ASRU and a number of the earlier versions of 'TI-RADS' scoring system. The readers included 3 faculty (> 10 years post fellowship training), a 4th year Resident and an intern (planning a career in Radiology) - all had been involved with thyroid US projects previously.

RESULTS

Using the summed scores of all readers the mean sensitivity for the new ACR TI-RADS was 57% (range, 40-93) while the specificity was 52% (range, 42-60). Initial experience from the readers that it was slow to use but with time productivity improved substantially. Average time with experience varied from 40 sec to 5 min. Less experienced users were more likely to use if available as a clinical decision support tool.

CONCLUSION

Initial experience with the new guidelines might suggest a lower specificity and consequently the expected reduction in biopsy numbers may not be achieved. A slightly lower sensitivity for biopsies is compensated for by combining the true positive biopsy rate and the follow-up rate of the 'false negatives'. The app may be more useful for less experienced operators.

CLINICAL RELEVANCE/APPLICATION

Further investigation is required to determine whether the new ACR guidelines constitute the correct balance of sensitivity and specificity to reduce the number of unnecessary thyroid biopsies while avoiding missing clinically significant cancers.

SSJ18-02 Preliminary Study on Spectral Parameters of Various Pathological Types of Malignant Tumors of Thyroid

Tuesday, Nov. 28 3:10PM - 3:20PM Room: N226

Participants

Lin Li, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To analyze the imaging manifestations and spectral parameters of various pathological types of malignant tumors of thyroid.

METHOD AND MATERIALS

67 cases of malignant tumors of thyroid were included in the retrospective study (44 papillary carcinomas, 2 follicular carcinomas, 9 medullary carcinomas, 7 anaplastic carcinomas and 5 primary thyroid lymphomas). The morphological manifestations and the spectral parameters were analyzed. All the patients underwent spectral CT scan with Discovery CT750HD scanner in GSI mode. The morphological manifestations of lesions were analyzed on the optimal monochromatic images. The iodine concentration (IC), water concentration (WC), normalized iodine concentration (NIC), spectral HU curve slope values (λ HU) were measured and analyzed by GSI Viewer. SPSS 19.0 software was used for statistical analysis of the data.

RESULTS

The morphological features of malignant tumors of thyroid were as follows: single lesion (57 cases, 85.1%), irregular shape (46 cases, 68.7%), indistinct margin (45 cases, 67.2%), heterogeneous density (48 cases, 71.6%) and detection of calcification (21 cases, 31.3%). There was no significant difference among various types of malignant tumors on WC ($P > 0.05$). The IC, NIC and λ HU values of papillary carcinoma, follicular carcinoma and medullary carcinoma were higher than that of anaplastic carcinoma and lymphoma ($P < 0.05$). The NIC of papillary carcinoma was lower than that of medullary carcinoma ($P > 0.05$). There were no significant differences on the parameters between each two groups remained ($P > 0.05$).

CONCLUSION

The morphological features and spectrum parameters are different in various pathological types of thyroid malignant tumors, and it is helpful for the diagnosis and differential diagnosis.

CLINICAL RELEVANCE/APPLICATION

Spectral CT imaging is helpful to differentiate various pathological types of thyroid malignant tumors.

SSJ18-03 Computer-aided Diagnosis System for Thyroid Nodules on Ultrasound: Initial Clinical Experience

Tuesday, Nov. 28 3:20PM - 3:30PM Room: N226

Participants

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Eun Ju Ha, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Miran Han, MD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yoon Joo Cho, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To prospectively evaluate the diagnostic performance of a computer-aided diagnosis (CAD) system (S-Detect for ThyroidTM) for thyroid US in the differential diagnosis of thyroid nodules and to determine interobserver agreement between the CAD system and experienced radiologist.

METHOD AND MATERIALS

This study was approved by the ethics committee of the institution, and all patients provided written informed consent. We consecutively enrolled patients with thyroid nodules with final diagnoses whether benign or malignant between June 2016 and July 2016. An experienced radiologist reviewed US characteristics of thyroid nodules, and a CAD system provided nodule diagnosis whether benign or malignant in a prospective design. We compared the diagnostic performance of experienced radiologist, CAD system, and CAD system assisted radiologist for detecting thyroid cancer and determined interobserver agreement between the CAD system and experienced radiologist.

RESULTS

A total of 117 thyroid nodules from 50 consecutive patients were included. The mean size of nodules was 1.5 ± 1.1 cm (range: 0.5-10.0 cm) and final diagnoses were 67 (57.3%) benign nodules and 50 (42.7%) malignant nodules. The CAD system showed similar sensitivity and specificity compared with the experienced radiologist (sensitivity: 80.0% versus 87.0%, $P = 0.754$; specificity: 88.1% versus 95.5%, $P = 0.180$). The diagnostic accuracy was not significantly different between the CAD and experienced radiologist (84.6% versus 90.6%, $P = 0.646$). The CAD system assisted radiologist reached the higher diagnostic sensitivity when compared to the radiologist without the CAD system (91.8% versus 87.0%, $P = 0.031$). The interobserver agreement between radiologist and CAD system were substantial agreement for a final diagnosis ($\kappa = 0.661$).

CONCLUSION

The diagnostic performance of CAD system for differentiating thyroid nodule was as good as that of the experienced radiologist with a substantial agreement. The CAD system assisted radiologist could achieve the highest diagnostic sensitivity for thyroid cancer.

CLINICAL RELEVANCE/APPLICATION

The CAD system could be used as a good decision-making supporter for the experienced radiologist with achieving the highest sensitivity up to 91.7% as well as for the beginner or non-thyroid radiologist with achieving comparable diagnostic performance with the experienced radiologist.

SSJ18-05 Can 4D-MRI Be an Alternative Modality for the Detection of Parathyroid Lesions in Primary Hyperparathyroidism?

Tuesday, Nov. 28 3:40PM - 3:50PM Room: N226

Participants

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PURPOSE

To compare ultrasonography (USG), Tc99 MIBI, 4D-CT & 4D-MRI in the detection & localisation of parathyroid lesion in patients with primary hyperparathyroidism (PHPT).

METHOD AND MATERIALS

In this prospective institutional ethics committee approved study, 39 patients with PHPT underwent USG, 4D-CT, 4D-MRI & Tc99 MIBI in the period, May 2016 - Feb 2017. Children & pregnant patients was excluded from study. 4D-CT was performed in 3 phases (NCCT, arterial & venous) on a 256 slice scanner & 4D-MRI was performed on a 1.5T scanner. Sixteen patients underwent surgery & only those were included for analysis. Surgical findings confirmed on histopathology & normalisation of parathormone (PTH) after excision of lesion were taken as the gold standard. The images were analysed for the presence & quadrant wise location of parathyroid lesions by two experienced radiologists & a nuclear medicine physician.

RESULTS

Of the 16 patients analysed, parathyroid hyperplasia was seen in 2 (12.5%), parathyroid adenoma in 12 (75%) & parathyroid carcinoma were found in 2 (12.5%) patients. In all patients, preoperative localisation was confirmed at surgery & this included ectopic lesions (mediastinum & parapharyngeal region) in two patients. PTH values returned to normal after surgery in all patients. 4D-CT, 4D-MRI showed 100% sensitivity whereas USG & MIBI showed 81.25% sensitivity each, for lesion detection & quadrant localisation. Two ectopic parathyroid adenomas were missed on USG & MIBI scan.

CONCLUSION

4D-CT & 4D-MRI had a high accuracy for parathyroid lesion detection & localisation in patients of PHPT whereas USG & MIBI showed moderate accuracy. 4D-MRI, being a modality without radiation exposure may provide a viable alternative for the localisation of parathyroid lesions.

CLINICAL RELEVANCE/APPLICATION

4D-CT & 4D-MRI have comparable high accuracy for detection & localization of parathyroid lesions in patients with PHPT. Due to better safety profile, the latter may become the modality of choice in the future

SSJ18-06 Parathyroid Adenoma Identification Using Spectral Dual Energy CT Texture Analysis

Tuesday, Nov. 28 3:50PM - 4:00PM Room: N226

Awards

Student Travel Stipend Award

Participants

James W. Alexander, MSc, Montreal, QC (*Presenter*) Nothing to Disclose

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PURPOSE

The purpose of this study was to (1) determine the accuracy of texture analysis performed on multi-energy or single energy (65 keV) virtual monochromatic images (VMIs) from dual energy CT (DECT) scans for parathyroid adenoma classification and (2) to compare accuracy using a single phase or multiple phases from the 4D-DECT scan.

METHOD AND MATERIALS

16 patients with pathologically proven parathyroid adenomas having a 3-phase 4D-DECT including a non-contrast (NC), arterial (CTA), and delayed phase (DEL) scan were included. Texture analysis was performed using a commercial software (TexRAD®) by manually delineating a region of interest around the largest diameter of the PA, thyroid, and a lymph node on VMIs ranging from 40 to 140 keV in 5 keV increments or VMIs at 65 keV alone. Random forests (RF) models were constructed using various histogram-based texture features for outcome prediction with internal cross-validation in addition to use of separate randomly selected training and validation sets. Sensitivity (Sens), specificity (Spec), positive predictive value (PPV), and negative predictive value (NPV) were determined for PA distinction from thyroid tissue or lymph nodes.

RESULTS

With RF models, the highest accuracy for PA prediction was achieved using a combination of NC-CTA-DEL phases with estimated Sens, Spec, PPV, and NPV of 100%. The CM-CTA and CTA-DEL combinations had similar accuracy with Sens, Spec, PPV, and NPV of 100%, 90%, 83%, and 100%, respectively. Multi-energy analysis was superior to analysis of 65 keV VMIs alone. For the latter, the highest accuracy achieved was Sens, Spec, PPV, and NPV of 60%, 100%, 100%, and 83%, respectively.

CONCLUSION

Multi-energy VMI texture analysis can correctly classify PAs with high accuracy at least similar to an expert radiologist, and is

superior to texture analysis of single energy image sets at 65 keV.

CLINICAL RELEVANCE/APPLICATION

DECT texture analysis has high accuracy for PA identification, improving diagnostic performance or potentially enabling a reduction in the number of phases acquired and patient radiation exposure.

SSJ19

Neuroradiology (Machine Learning and Deep Learning)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: N228

IN **NR**

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

FDA Discussions may include off-label uses.

Participants

Greg Zaharchuk, MD, PhD, Stanford, CA (*Moderator*) Research Grant, General Electric Company; Consultant, General Electric Company;
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Sub-Events

SSJ19-01 Improving Cerebral Blood Flow and Transit Time Measurement in Arterial Spin Label MRI with Deep Learning

Tuesday, Nov. 28 3:00PM - 3:10PM Room: N228

Participants

Enhao Gong, MS, Stanford, CA (*Presenter*) Research support, General Electric Company
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PURPOSE

The risk of under-estimating local CBF in cerebrovascular disease patients as well as the underlying low SNR of the arterial spin labeling(ASL) techniques calls for new approaches. Here we proposed and evaluated a Deep Learning method to boost image quality and improve cerebral blood flow(CBF) and arterial transit delay(ATD) estimation using multi-delay ASL.

METHOD AND MATERIALS

We developed a Deep Learning based method, a local Residual-Encoder-Decoder Convolutional Neural Network (CNN), to improve the ASL image quality. At 3T, we collected two multidelay ASL datasets in 7 normal subjects: (1) input images: low SNR/resolution (5.6mm resolution, 1 repetition, 4min); (2) gold-standard reference images: high SNR/resolution (3.8mm resolution, 3 repetitions, 24min). Label Duration(LD) was 2sec and 5 Post-Labeling-Delays(PLD) were used (0.7sec, 1.4sec, 2.1sec, 2.8sec, 3.5sec). We trained the network to reduce artifact/noise in the input ASL images by approximating the gold-standard reference images. The method takes in image patches from low-SNR/resolution ASL and the corresponding un-labeled proton-density-weighted data, forward-passes through the network and outputs improved image patches to approximate the high-resolution-high-SNR patches from the gold-standard reference ASL. Once trained, we applied the model to improve new ASL clinical scans which do not necessarily include gold-standard reference scans (n=5, patients with cerebrovascular and neoplastic disease). Application of the model is efficient, requiring only 1 sec per slice to apply.

RESULTS

To evaluate the proposed method, we compared the error metrics(normalized RMSE and PSNR) between the model outputs and the gold-standard reference. It showed the proposed method could reduce RMSE from 29.3% to 10.8% and increase PSNR by 4.3 dB on average. For data with pathology we compared the ASL images, CBF maps and ATD maps, demonstrating that the proposed method preserves the pathology while significantly improving the ASL image quality.

CONCLUSION

The proposed Deep Learning method significantly reduces(6 fold) the acquisition time required to obtain high-quality ASL imaging, improving CBF estimation and more detailed ATD maps in clinical patients.

CLINICAL RELEVANCE/APPLICATION

The proposed Deep learning method significantly improves ASL image quality, reduces scan time and increases SNR/resolution, potentially allowing it to be used in a wider variety of clinical settings.

SSJ19-02 Texture Analysis for Differentiating Glioblastoma Multiforme and Primary Cerebral Lymphoma: Benefits of Machine Learning Based on Multi-parametric MRI

Tuesday, Nov. 28 3:10PM - 3:20PM Room: N228

Participants

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PURPOSE

To determine whether a prediction model using machine learning based on multi-parametric magnetic resonance imaging (MRI) texture features can offer adequate diagnostic performance for differentiating glioblastoma multiforme (GBM) and primary cerebral lymphoma (PCL).

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. The requirement to obtain informed consent was waived. We included 70 patients who underwent contrast enhanced brain MRI at 3T with brain tumors diagnosed as GBM (n = 45) and PCL (n = 25). We measured minimum value, mean value, standard deviation and maximum value in apparent diffusion coefficient (ADC) and cerebral blood volume (rCBV), and eight types of histogram and texture parameters (skewness, kurtosis, homogeneity, energy, contrast, correlation, entropy, dissimilarity) for ADC, rCBV, T2 weighted images (T2WI), and contrast-enhanced T1WI (CE-T1WI). We developed a prediction model using a machine learning method (extreme gradient boosting) and calculated the area under the receiver operating characteristic (ROC) curve of this model via 10-fold cross validation. In addition, we compared the performance of machine learning with the judgments of two board certified radiologists.

RESULTS

Skewness in CE-T1WI had the strongest influence (GBM 0.237 ± 0.439 ; PCL -0.328 ± 0.679 , $p = 0.0006$), followed by standard deviation in rCBV (GBM 703.4 ± 337.0 ; PCL 382.9 ± 223.1 , $p < 0.0001$), mean ADC value (GBM 1.379 ± 0.403 ; PCL 1.114 ± 0.209 , $p = 0.0005$), kurtosis in CE-T1WI (GBM 2.612 ± 0.644 ; PCL 4.998 ± 1.796 , $p = 0.0009$), and skewness in rCBV (GBM 1.100 ± 0.663 ; PCL 1.799 ± 1.222 , $p = 0.0124$). Validation analysis showed that the AUC for the machine learning method and the two radiologists were 0.90, 0.84 and 0.79, respectively.

CONCLUSION

The performance of machine learning based on texture features in multi-parametric MRI was comparable to that of experienced radiologists in differentiating GBM and PCL.

CLINICAL RELEVANCE/APPLICATION

The current results suggest that machine learning based on texture features with multi-parametric MRI may provide a useful method for differentiating GBM and PCL.

SSJ19-03 Radiogenomics of Glioblastoma: Prediction of Molecular Subtype by Using Multiregional MR Imaging Features and Machine Learning Techniques

Tuesday, Nov. 28 3:20PM - 3:30PM Room: N228

Participants

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PURPOSE

To evaluate the association between multiregional radiomic features from MR imaging and molecular subtypes in patients with newly diagnosed glioblastoma.

METHOD AND MATERIALS

Preoperative MR imagings from 121 consecutive patients with newly diagnosed glioblastoma were retrospectively reviewed. 787 multiregional (contrast-enhancing regions and hyperintense regions at FLAIR images) radiomic features were extracted from on postcontrast T1-weighted, T2-weighted, FLAIR images, and ADC map. Molecular subtypes consisting of MGMT promoter methylation, IDH1 mutation, EGFR amplification and 1p/19q codeletion status were reviewed. The features that showed significant

difference (<0.05 by Wilcoxon test) or discriminative value (area under the receiver operating characteristics curve [AUROC] > 0.7) were selected on univariate test, and redundant features were removed. The strength of association between selected radiomic features and molecular subtypes was assessed via machine learning algorithms (stochastic gradient boosting machine, penalized logistic regression, and random forest). To prevent overestimation and overcome data imbalance, bootstrapping with 100 repetition and data subsampling were performed.

RESULTS

On univariate analyses, 11, 9, 6 and 15 radiomic features remained after removing redundant features to predict MGMT, IDH1, EGFR, and 1p/19q codeletion status, respectively. Applying machine learning to radiomic features yielded moderate performance (AUROC : 0.691-0.800) to predict MGMT status, and good to excellent performance to predict IDH1 mutation (AUROC : 0.868-0.971), EGFR amplification (AUROC : 0.729-0.874) and 1p/19q codeletion status (AUROC : 0.771-0.960). Nonetheless, in terms of accuracy, only a few machine learning models showed higher accuracy than prediction by chance, which was resulted from data imbalance.

CONCLUSION

The authors found associations between MR radiomic features and molecular subtypes, although some of them may not be significant considering the data imbalance and prediction by chance.

CLINICAL RELEVANCE/APPLICATION

Radiomic profiling may have association with molecular subtypes in glioblastoma, although some of them may not be significant considering the data imbalance and prediction by chance.

SSJ19-04 Machine Learning Prediction and Classification of Working Memory Performance Based on Brain Microstructure in Healthy Adults: A Diffusion Kurtosis Imaging Study

Tuesday, Nov. 28 3:30PM - 3:40PM Room: N228

Participants

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PURPOSE

The goal of this study is to predict working memory performance based on white matter (WM) microstructure in healthy adults by using machine learning approaches. White matter tract integrity (WMTI) metrics as well as diffusion tensor imaging (DTI) and diffusion kurtosis imaging (DKI) metrics were used to assess WM microstructure, and WAIS-IV letter-number sequencing (LNS) test was used to assess working memory.

METHOD AND MATERIALS

We studied 21 healthy individuals (34±9m 19-50 years old) using a 3T MR scanner (Skyra, Siemens). DKI was performed with 5 b-values (up to 2.5ms/μm² with up to 60 directions). WMTI (axonal water fraction (AWF), intra-axonal diffusivity, extra-axonal axial/radial diffusivities, extra-axonal tortuosity (a)), DTI (FA, MD, AD, RD) and DKI (MK, RK, AK) metrics were calculated. Tract-based spatial statistics (TBSS) was performed with age and gender as covariates to test for significant correlations between diffusion metrics and LNS z-scores. For each metric, regions-of-interest (ROIs) were selected if $p < 0.1$ after family-wise error (FWE) correction, and then were averaged as input features. The gradient boosted regression trees (GBRT) model was used to predict LNS and Logistic regression was used to classify individuals into arbitrary groups with LNS z-score above 1, below -1 and in between ±1. All data were randomly split into train (70%) and test (30%) sets.

RESULTS

Fig.1 shows ROIs for AWF, tortuosity a, FA, MK, and RK that were positively correlated with LNS. Using all 5 metrics as input features, we achieved a 95.4% accuracy in predicting LNS and a 79.6% accuracy in classifying individuals into two groups with LNS z-score above 1 and in between ±1 (Fig.2)

CONCLUSION

This study shows WM microstructural associations with working memory which can be predictable by using machine learning approaches. Our findings of higher AWF and tortuosity a with better performance on LNS go along with greater number of axons and greater myelination in these regions, causing efficient and faster information processes. Our results demonstrate the potential utility of diffusion metrics to serve as early biomarkers of working memory impairment.

CLINICAL RELEVANCE/APPLICATION

Our study elucidates the underlying relationship between white matter microstructure and working memory, and raises the potential utility of diffusion metrics to predict impairment of working memory.

SSJ19-05 Estimating the Age from Time of Flight MR Angiography Using Deep Learning

Tuesday, Nov. 28 3:40PM - 3:50PM Room: N228

Participants

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PURPOSE

Age-related changes involve the brain vasculatures as well as the brain itself. Previous studies suggested that time of flight MR angiography (TOF-MRA) could visualize morphological changes of aged intracranial arteries. Because atherosclerotic changes were similar with changes of aged brain arteries histopathologically and morphologically, findings of brain TOF-MRA could be used as a biomarker of aging and other age-related changes. However, previously suggested analysis using hand-crafted features were limited to formulate an integrated biomarker for various features. Moreover, developing quantitative indices for those features is very challenging. To overcome these limitations, we introduced deep learning to estimate the age-related changes from TOF-MRA, instead of developing domain-knowledge based analysis. In this study, we investigate the feasibility of deep learning as a tool to extract and quantify age-related change of brain vasculatures.

METHOD AND MATERIALS

A total 954 TOF-MRA images were collected from two public databases of healthy volunteer and our own database of participants without any neurological or neurovascular disease. A deep neural network based on Alexnets was trained using axial MIP images as input data and actual ages as labels to minimize mean absolute errors (MAE) using TensorFlow framework. Spatial normalization and data augmentation were performed before train. For training and validation purpose, 689 subjects (augmented to 22,737) and 93 subjects were used. Remaining 203 subjects were used as test set. To evaluate the model accuracy, correlation coefficients (r) and MAE were calculated.

RESULTS

A deep learning model was built to estimate subjects' age solely using TOF-MRA successfully. For validation set, high correlation coefficient ($r=.847$) with good MAE (6.774) was obtained. For test set, performance was slightly decreased ($r=.825$, MAE= 7.765), but results were acceptable. Using trained network, a subject's age can be estimated from TOF-MRA data within a second.

CONCLUSION

We demonstrated the potential of deep learning technology for the assessment of age from the brain MRA. Estimated age from TOF-MRA showed good concordant with subject's biologic age.

CLINICAL RELEVANCE/APPLICATION

Estimated age from TOF-MRA can be used as an imaging biomarker for the brain vasculature. For example, a subject with atherosclerosis might have higher estimate age from brain TOF-MRA than subject's biological age.

SSJ19-06 Convolutional Neural Network based Deep Learning to Diagnosis the Sinusitis with Paranasal Sinus X-Ray

Tuesday, Nov. 28 3:50PM - 4:00PM Room: N228

Participants

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PURPOSE

Sinusitis is diagnosed by the opacification of the sinuses and air/fluid level best seen in the maxillary sinus with the paranasal sinus (PNS) X-ray scan. It is hard to represent these features to discriminate sinusitis from normal cases. Deep learning is a branch of machine learning used in acquiring useful representation of features directly from data. The most important factors that determine the performance of deep learning is data quality and quantity. The objective of this study was to investigate the ability of deep learning to improve the diagnosis of sinusitis using the PNS X-ray image.

METHOD AND MATERIALS

A total of 496 patients, which included 248 normal and sinusitis subjects each, underwent PNS X-ray scan. All subjects were independently labeled twice by two radiologists. We used three input data type to investigate the efficiency classification tuning: 1) 248 images without patch and data augmentation, 2) 992 images with data augmentation that is rotated data, and 3) 992 images with extracted maxillary sinus patch and rotated data. We implemented on the data to differentiate between normal and sinusitis subjects with the AlexNet convolutional neural network (CNN) model for imaging classification. Finally, classification results were quantitatively assessed by accuracy.

RESULTS

We compared the results of our approaches to optimize classification model. The results of accuracy for training/test data set were 70.3 %/60.9 %, 75.6 %/59.6 %, and 75.6 %/59.6 %, , respectively. Fig.1 shows that representation for the learned hierarchical feature maps with PNS X-ray image. Original data: a (normal) and e (sinusitis), Patched data: b (normal) and f (sinusitis), Feature maps: .c (1st layer), g (2nd layer), d and h (normal and sinusitis in final fully connected layer, respectively). Arrow indicates the characteristic to evaluate the sinusitis in the maxillary sinus.

CONCLUSION

The diagnosis for sinusitis using deep learning with PNS X-ray depends on the quantity and quality of data. To improve the accuracy of sinusitis, it is necessary to run the pre-processing steps such as extracted patch and data augmentation. Deep learning with PNS X-ray can be used to classify between normal and sinusitis cases.

CLINICAL RELEVANCE/APPLICATION

Optimized deep learning study with PNS X-ray image can demonstrate to be used to classify normal and sinusitis cases indicating it as a practical method for early diagnosis.

SSJ20

Neuroradiology (Neurointerventional Radiology)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: N229



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

Participants

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Sub-Events

SSJ20-01 Prior IV tPA in Mechanical Thrombectomy for Acute Ischemic Stroke: Technical Details and Clinical Significance

Tuesday, Nov. 28 3:00PM - 3:10PM Room: N229

Participants

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PURPOSE

This study aimed to assess the impact of intravenous (IV) tPA treatment before mechanical thrombectomy in acute ischemic stroke patients.

METHOD AND MATERIALS

We studied patients prospectively included in SONIIA registry (2011-2015), a mandatory, externally audited registry that monitors the quality of reperfusion therapies in Catalonia. We included the total number of thrombectomy cases from all participant centers to simulate "real-world" clinical practice. Analysis and outcome parameters: any recanalization (TICI $\geq 2a$), complete recanalization (TICI $\geq 2b$), procedural time, symptomatic intracranial hemorrhage (SICH), neurological improvement (≥ 4 points decrease in the NIHSS score at 24 hours), independent functional outcome (mRS ≤ 2), mortality at three months.

RESULTS

Among the 1640 patients included, 48.1% received IV tPA. Mean age at treatment was 67.5 ± 13.5 , 54.4% male. Diabetes mellitus ($p=0.024$), atrial fibrillation ($p<0.001$), and ischemic cardiomyopathy ($p=0.018$) prevalence rates were higher in IV tPA patients. There were no other statistically significant differences in baseline characteristics between treatment groups. Median NIHSS score was 17 (12-21) on arrival and 9 (3-18) at 24 hours. The overall complete recanalization rate was 77.8%. The rate of complete recanalization was not different according to IV tPA administration: TICI $\geq 2b$: 79.8% IV tPA patients vs. 75.9% no IV tPA ($p=0.065$). However, patients who received IV tPA achieved higher any recanalization rate: TICI $\geq 2a$: 88.3% vs. 84.2% (RR, 1.0; 95% CI 1.0-1.1; $p=0.018$). IV tPA was associated with shorter procedural time: 82.4 ± 70.1 min vs. 93.3 ± 74.9 min ($p=0.002$). There were no differences in SICH: 3.0% vs. 3.2% ($p=0.064$). No differences were observed in early neurological improvement: 70.1% vs. 71.8% ($p=0.491$). IV tPA patients achieved higher functional independence: 43.9% vs. 53.3% (RR, 1.2; 95% CI 1.1-1.3; $p=0.046$), and less mortality: 21.4% vs. 14.7% IVT (RR, 0.7; 95% CI 0.6-0.8; $p=0.001$).

CONCLUSION

IV tPA before mechanical thrombectomy is associated with better recanalization rate, shorter procedural time, better functional independence, and less mortality. In addition, preceding IV tPA does not seem to influence in SICH development.

CLINICAL RELEVANCE/APPLICATION

Endovascular stroke therapy has revolutionized the management of patients with acute brain infarction. There is a lack of evidence-based data concerning the impact of including IV tPA before mechanical thrombectomy.

SSJ20-02 New Detector with Special High Definition (Hi-Def) Zoom Feature for Neuro Interventional Procedures

Tuesday, Nov. 28 3:10PM - 3:20PM Room: N229

Participants

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PURPOSE

Traditional Flat Panel Detectors (FPDs) have increasing difficulty in visualizing improved neuro interventional devices which have more complex finer structures. A new unique single package High Definition detector with a special Hi-Def zoom feature was developed. Initial subjective evaluations of Pipeline Embolization Device (PED) images acquired using the FPD and the Hi-Def zoom of this detector are presented.

METHOD AND MATERIALS

A PED was placed inside a neurovascular phantom with anatomically accurate 3D printed vessel structures embedded in a skull and having PMMA attenuating material. For image quality comparison, PED images were acquired with FPD and Hi-Def zoom in identical Fields-of-View. Ten Image sets each composed of one FPD and one Hi-Def zoom image acquired under the same x-ray exposure conditions were presented together to two blinded-neuro-interventionists who were asked to select the better image of the two and rate the selection as either Similar, Preferred or Much Preferred. Their annotations about the better images were also recorded.

RESULTS

For all the image sets generally, the Hi-Def zoom images were Much Preferred over FPD images by both the raters. Both the raters commented that the visualization of the stent structures in the Hi-Def zoom images were superior compared to those of the FPD and indicated that such imaging can be very helpful during interventions.

CONCLUSION

A new High Definition detector with high resolution Hi-Def zoom was developed and evaluated in simulated clinical settings by neurovascular interventionists. The Hi-Def zoom images were generally Much Preferred due to their superior image quality. Information regarding delicate movements and structural changes of the devices during deployment, navigation of the microwire through the stent, and stent to vessel wall apposition are critical to an intervention's success. The new high resolution imaging can improve real time visualization of such information and could potentially improve endovascular treatment outcomes.

CLINICAL RELEVANCE/APPLICATION

Superior real time imaging of devices during a neuroendovascular intervention treatment of diseases such as strokes and aneurysms is critical to its success and to ensure good treatment outcomes.

SSJ20-03 Intraoperative Thermal Imaging During Awake Craniotomy

Tuesday, Nov. 28 3:20PM - 3:30PM Room: N229

Participants

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PURPOSE

Gliomas represent a diverse and deadly class of brain tumors, for which aggressive surgical resection of the tumor is the best treatment. Resection is limited in a majority of patients by tumor invasion into critical functional regions, which are avoided in resection through direct cortical stimulation mapping during awake craniotomy.. However, this method has poor spatial resolution (~10 mm), limiting the extent of resection and therefore survival.

METHOD AND MATERIALS

Neural activation creates a downstream compensatory vasodilation, increasing local perfusion. Intraoperatively, this mechanism causes a focal increase in cortical temperature, which can be measured by infrared thermal imaging. This approach captures small temperature deviations (>0.03 °C) at high spatial and temporal resolution (~0.5 mm, 30 Hz). In this study, we examine cortical

temperature gradients during a behavioral task to construct a neural activation map for guidance of surgical resection.

RESULTS

Cortical temperature changes were measured in two patients undergoing routine direct cortical stimulation during glioma resection surgery. The first patient performed a lip pursing task, which created diffuse temperature elevation (+0.3 °C) throughout facial motor and sensory regions. The region of maximal temperature elevation (+0.5 °C) coincided with the area of positive direct cortical stimulation. A second patient performed a right hand clenching task, which created temperature elevation (+0.5 °C) in the left motor cortex in the areas of positive direct cortical stimulation. This thermal signature was not observed during left hand clenching, which produced an activation pattern similar to the cortical temperature pattern measured at patient baseline.

CONCLUSION

Intraoperative thermal imaging may delineate activated cortical regions during awake craniotomy, and appears grossly consistent with direct cortical stimulation. While further measurements are necessary to conclude efficacy across tasks and patients, the utility of thermal imaging as an intraoperative mapping tool is promising. Future work will parse networks and functional regions by examining the dynamics of small temperature fluctuations within gross activation.

CLINICAL RELEVANCE/APPLICATION

Infrared thermal imaging is a promising approach for intraoperative cortical mapping, permitting increased extents of resection which can prolong patient survival after glioma resection surgery.

SSJ20-04 Development of Patient-Specific CT/MR "Bio-mimicking" 3D-Printed Phantoms, with Application to Minimally-Invasive Image-Guided Thermal Ablation Planning and Simulation

Tuesday, Nov. 28 3:30PM - 3:40PM Room: N229

Participants

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PURPOSE

Image-guided percutaneous ablations in the head/neck, spine, chest, and abdomen have a steep learning curve and safety is a concern as new application sites such as the posterior spinal elements are explored. We developed a technique to 3D print "bio-mimicking" phantoms that replicate the patient-specific anatomy in both CT and MRI, and used it to simulate an image-guided cryoablation

METHOD AND MATERIALS

A model was designed from pre-procedure CT and MRI of a patient w/ L1 left lamina osteoblastoma. Cortical and cancellous bone and osteoblastoma were segmented from the CT. Cerebrospinal fluid, spinal nerves and foraminal fat were segmented from the T1- and T2-W MRI. Tissues segmented from each image set were combined in a single model using cancellous bone, aorta, and diaphragmatic crura as landmarks. The combined model was 3D-printed using a different mixture of 2 MRI-visible and 1 non-MRI-visible material for each tissue, and imaged identically to the patient (120 kVp CT, T1/2W FSE MRI). Signal intensity and contrast-to-noise ratio (CNR) of tissues in patient and model images were compared with ANOVA to determine if tissues separable in vivo were also separable with the printed model. Finally, CT-guided power drilling and subsequent MRI-monitored cryoablation was performed on the model identically to the patient procedure.

CONCLUSION

Bio-mimicking 3D-printed models can be produced that replicate patient anatomy in both CT and MRI. These models enable targeting and monitoring key anatomic structures during CT- and MRI-guided procedures such as thermal ablations.

CLINICAL RELEVANCE/APPLICATION

Patient-specific bio-mimicking 3D printed phantoms are now possible for simulating and hands-on teaching of CT/MR image-guided thermal ablations toward enhancing procedure safety and efficacy.

SSJ20-05 Clinical and Imaging Evaluation of Lumbar Disc Herniation after Different Oxygen-Ozone (O2-O3) Chemiodiscolysis Treatment Sessions: Which is the Best Treatment Protocol Management in Partially-Responder Patients?

Tuesday, Nov. 28 3:40PM - 3:50PM Room: N229

Participants

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PURPOSE

To compare the therapeutic outcome of different treatment sessions of oxygen-ozone (O2-O3) therapy in patients with lumbar disc herniation

METHOD AND MATERIALS

We retrospectively evaluated 432 patients (mean age 44.3 years, range 26-69), who underwent multiple treatment sessions of O2-O3 lumbar chemiodiscolysis in the period between January 2014 and January 2017. We excluded patients with multiple level pathology, patients with multiple causes of low back pain, patients who underwent surgery during the follow-up period. For each patient we evaluated the number of treatment sessions and the type of treatment performed. Treatment outcome was assessed using a modified MacNab method to assess the clinical response and performing MRI to evaluate the modifications of the disc herniation area

RESULTS

235 patients were treated with 2 sessions of intradiscal injection associated with periganglionic steroid injection (Group A); 197 patients received an intradiscal-perigangliar injection of O2-O3 and a second periganglionic injection with steroids (Group B). The mean time interval between each treatment was 32.6 days (range 15-62). Treatment was successful in terms of clinical outcome in 82.3% of patients of group A and 78.7% in group B. Statistical analysis showed no statistically significant difference between the two groups in terms of both clinical results and reduction of the disc herniation area ($p \leq 0.001$)

CONCLUSION

Multiple intradiscal ozone injections are not associated with a superior herniation volume reduction nor better clinical outcome compared to a single intradiscal O2-O3 injection followed by periradicular steroids

CLINICAL RELEVANCE/APPLICATION

According to the results of our follow-up, in partially or non-responder patients after a first O2-O3 intradiscal injection, a better cost-effective protocol should include a second periradicular steroid injection rather than additional intradiscal treatments

SSJ20-06 Efficacy and Safety of Ethanol Ablation for Branchial Cleft Cysts

Tuesday, Nov. 28 3:50PM - 4:00PM Room: N229

Participants

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Jung Hwan Baek, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Branchial cleft cyst (BCC) is a common congenital lesion of the neck. This study evaluated the efficacy and safety of ethanol ablation (EA) as an alternative treatment to surgery for BCC.

METHOD AND MATERIALS

Between September 2006 and October 2016, EA was performed in 22 patients who refused surgery for a second BCC. After the exclusion of two patients who were lost to follow-up, the data of 20 patients were retrospectively evaluated. All index masses were confirmed as benign before treatment. Ultrasound-guided aspiration of the cystic fluid was followed by injection of absolute ethanol (99%) into the lesion. The injected volume of ethanol was 50-80% of the volume of fluid aspirated. Therapeutic outcome, including volume reduction ratio (VRR), therapeutic success rate (VRR > 50% and/or no palpable mass), and complications, were evaluated.

RESULTS

The mean index volume of the cysts was 26.4 ± 15.7 mL (range: 3.8-49.9 mL). After ablation, the mean volume of the cysts decreased to 1.2 ± 1.1 mL (range: 0.0-3.5 mL). The mean VRR at last follow-up was $93.9 \pm 7.9\%$ (range: 75.5-100.0%, $P < 0.001$). Therapeutic success was achieved in all nodules (20/20; 100%), and the symptomatic ($P < 0.001$) and cosmetic ($P < 0.001$) scores had improved significantly by the last follow-up. In one patient, intracystic hemorrhage was developed during the aspiration; however, no major complications occurred in all patients.

CONCLUSION

EA is an effective and safe treatment for patients with BCC who refuse, or are ineligible for, surgery.

CLINICAL RELEVANCE/APPLICATION

1. This study evaluated the efficacy and safety of EA for the treatment of BCCs, based on the largest number of cases (drawn from two hospitals) reported thus far. 2. A mean volume reduction in the EA-treated BCCs of 93.0%, as well as improvements in clinical symptoms and cosmetic problems. There were no major complications or procedure-related deaths. 3. After a single session, 55.0% of the patients had incompletely resolved clinical problems but they responded well to additional EA, which was effective and safe and had a therapeutic success rate of 100.0%. These results support the use of EA as a first-line treatment for BCC.

SSJ21

Physics (Ultrasound)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S403A

PH US

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

FDA Discussions may include off-label uses.

Participants

Jaydev K. Dave, PhD, Philadelphia, PA (*Moderator*) Research Grant, Koninklijke Philips NV; Equipment support, Lantheus Medical Imaging, Inc; Equipment support, General Electric Company
Timothy J. Hall, PhD, Madison, WI (*Moderator*) Equipment support, Siemens AG; Technical support, Siemens AG

Sub-Events

SSJ21-01 How to Identify Optimum Incident Acoustic Output for Utilizing Subharmonic Amplitude from Ultrasound Contrast Microbubbles for Pressure Measurements: A Solution for Real-Time Clinical Applications

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S403A

Participants

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PURPOSE

At optimum incident acoustic output (IAO), subharmonic aided pressure estimation (SHAPE), based on subharmonic signals from microbubbles, is useful for estimating clinical pressures. However, real-time SHAPE application is impeded because the optimum IAO level varies on a case-by-case basis. Purpose of this work was to address this problem by identifying the optimum IAO for SHAPE in real-time.

METHOD AND MATERIALS

The SHAPE algorithm was developed to sequentially step through each available IAO level, extract the subharmonic amplitude, perform a spline fit (subharmonic amplitude vs. IAO), and identify the IAO level with maximum derivative as the optimum IAO. This algorithm was implemented using a customized interface on a SonixTablet scanner (BK Ultrasound, Peabody, MA) using C/C++ and Qt libraries (The Qt Company, Oslo, Norway). In vitro tests were conducted using a closed-loop flow system with activated Definity (Lantheus Medical Imaging, N Billerica, MA, USA; 0.1 mL) mixed in 750 mL isotonic diluent. A pressure catheter (Millar Inc., Houston, TX) provided ambient pressure values. A pulsed Doppler gate was placed within the lumen of the vessel in the flow system, then the SHAPE algorithm was initiated (fttransmit: 5.6 MHz; chirp down transmit pulse in pulse inversion mode). Catheter pressure and subharmonic data were acquired simultaneously at, below and above the optimum IAO level (10secs; n=3), then a linear correlation was performed between the subharmonic and catheter data using Matlab (MathWorks, Natick, MA, USA).

RESULTS

Correlation coefficient values between SHAPE and the pressure catheter data at, below and above the optimum IAO level were -0.73±0.1, -0.55±0.2, and -0.70±0.1, respectively, confirming best correlation occurring at the identified IAO level. At the optimum IAO, the sensitivity of the subharmonic signal to the ambient pressure was 13.5±1.0 mmHg/dB. Occasionally at relatively higher IAO levels (2.9 MPap-p), correlation coefficients as high as -0.9 were also noted, presumably due to bubble destruction.

CONCLUSION

Identification of optimum IAO (in real-time) for insonating microbubbles to be utilized for SHAPE has been demonstrated; this will pave the way for real-time clinical applications.

CLINICAL RELEVANCE/APPLICATION

Real-time implementation to determine optimum IAO for insonating microbubbles for SHAPE has been demonstrated and verified; this paves the way for real-time SHAPE applications.

SSJ21-02 Contrast-Enhanced Ultrasound Assisted Percutaneous Nephrostomy: A Technique to Increase Success Rate for Patients with Non-dilated Renal Collecting System

Participants

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CONCLUSION

CEUS assisted PCN in patients with nondilated renal collecting system is valuable with high technical success rate and acceptable complications.

Background

For percutaneous nephrostomy (PCN), lack of proper guidance system may lead to hazardous results, especial for these patients with nondilated renal collecting systems. The purpose of our study is to report our single-center experience of contrast-enhanced ultrasound (CEUS) assisted PCN for patients with nondilated renal collecting system.

Evaluation

From November 2011 to September 2015, 47 patients (mean age, 51.9±16.2 years; range, 11-80 years) with clinical necessity to urinary drainage, urinary diversion, or provision of access to the collecting system and with nondilated renal collecting system were performed 48 CEUS assisted PCNs. Ultrasound contrast agent was injected through the puncture needle and the drainage catheter to confirm successful PCN. The technical success rate was 100% (47/47, 95%CI: 93.8%, 100%) per patient and 100% (48/48, 95%CI: 94.0%, 100%) per kidney. For each kidney, the mean number of needle passes was 1.4 ± 0.5 (range, 1-3). The mean duration of the complete procedure was 18.9±4.8 min (range, 8-30 min). The mean dose of contrast-enhanced agent was 12.9 ± 3.2 ml (range, 8-25 ml). No major complication was observed. Only 4 patients (4/47, 8.5%, 95%CI: 2.37%, 20.4%) had minor complications, including perirenal hematoma last 9 days on ultrasound images in 1 and transient macroscopic hematuria last about 1-2 days in 3.

Discussion

Several modalities are considered to assist PCN in a nondilated collecting system. CEUS is known to have exclusive advantages including real-time scanning, no radiation, and easy operation, which is also recommended for intracavitary administration. Although PCN in the nondilated collecting system is a technical challenging, our results displayed that CEUS assisted PCN showed comparable success rate with conventional PCN placement in patients with dilated collecting systems.

SSJ21-03 Comparison of Computerized Analysis for Uniformity Assessment in Ultrasound QA

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S403A

Participants

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CONCLUSION

The MBCA method with the mean image shows good sensitivity for UA compared to UiQ, although this is a limited cohort of data available. We will enlarge our sample pool by acquiring cine loops routinely to facilitate this analysis for all probes.

Background

Performing uniformity assessment (UA) and detecting transducer defects of concern is an important component of Ultrasound QA testing. Although visual inspections of acquired phantom images are most frequently done, there is an increasing trend toward computerized analysis of cine files acquired during QC. It is important to understand performance differences between various computerized analysis methods for UA.

Evaluation

We developed a Matlab-based computerized analysis (MBCA) program for UA. It creates a mean image of frames in a cine loop acquired while a transducer is translated over a phantom. Element dropout defects are recognized as "shadows" emanating from the transducer surface. The code calculates a defect cutoff threshold (DCT) based on 3 standard deviations below the data's mean or 3 Median absolute deviations (MAD) below the data's median by utilizing only the ring-down portion of the phantom images. The detection performance was compared with that of a commercial program, UltraIQ (UiQ) that analyzes image data from a ROI having a 12 mm axial extent in the gray scale image. The comparisons were done for linear array transducers (LTA) and GE Logiq scanners evaluated during annual tests during the past year. Nine probes were judged defective, and three of these had recorded cine loops. Seven defects had been visually identified in this data set. Using the cutoff threshold described, the MBCA program applied to the mean image detected all 7 dropout areas (visually identified) from the 3 transducers with no false positive detection. On the other hand, the UiQ only detected four of the dropout areas with three false detections.

Discussion

Our MBCA currently works for LTAs but can be modified to analyze curvilinear arrays. The improved performance over UiQ can be related to a high signal to noise ratio in the ring-down part of the image and to the minimal spread of the defect shadow in this area.

SSJ21-04 Freehand 3D Ultrasound Construction via Preoperative MRI Co-Registration for Spine Needle Interventions

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S403A

Participants

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PURPOSE

Ultrasound (US)-guided spine needle interventions have limited clinical adoption due to confounding visualization of deep bony anatomy. Image registration between previously acquired MRI and real-time US could provide useful anatomical context to accurately guide needles toward target locations. Registration of MRI with an initially acquired, baseline 3D US image facilitates the mapping of anatomy in MRI to intraoperative US imaging space. This work proposes a method to register a 2D US image sequence to MRI and simultaneously construct a MRI-aligned, 3D US volume to be subsequently used for real-time navigation.

METHOD AND MATERIALS

Within the registration framework, US images were simulated from MRI using a US wave propagation model that incorporated reflection, refraction, and attenuation properties. Acoustic impedances were derived from T1-weighted MR values using a non-linear mapping function with relevant values for vertebra, CSF, fat, muscle, and intervertebral disc. Simulated US was compared with each actual US image using normalized cross-correlation metric and optimized using Powell's method to compute the best corresponding slice from MRI. Registered slices were interpolated in a volumetric grid to construct the 3D volume. Experiments were performed by acquiring axial slices of a lumbar puncture phantom using a 2D, linear, 128-element array probe at 5 cm depth. For comparison, 3D US image was constructed by optically tracking the calibrated 2D US probe.

RESULTS

The error between corresponding anatomical distances between US volumes constructed from the two methods (registration vs tracking) was found to be 1.3 ± 1.2 (mean \pm std) mm. Registration accuracy measured as the point-based distance between corresponding anatomical locations from MRI and US was 4.5 ± 5.9 (median \pm iqr) mm. Deformation due to applied US probe pressure contributed substantially to this error and it will be incorporated to the simulation model in ongoing work to improve accuracy.

CONCLUSION

Registration between actual and simulated US images could provide a useful method to yield MR-aligned 3D US volume for navigation in spine pain procedures.

CLINICAL RELEVANCE/APPLICATION

The proposed method could provide 3D US images registered to MRI to facilitate accurate needle targeting during spine needle interventions.

SSJ21-05 Can Speed of Sound Be Better Than Conventional Elastography for Breast Characterization?

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S403A

Participants

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PURPOSE

To compare a novel speed of sound (SoS) method and conventional elastography (strain ratio SR and shear wave velocity SWV) in breast with respect to tissue compression and differentiation.

METHOD AND MATERIALS

A healthy volunteer (42 yr) was repeatedly assessed with SoS and SWV at five different compression levels in order to identify non-linearity confounders. The examinations were performed in the cranio-caudal view and retromammillar segment for both non-diseased breasts. Also, five women with biopsy proven lesions (3 invasive ductal carcinoma IDC, 1 fibroadenoma FA, 1 cyst) were tested to identify differences between SoS, SR and SWV. Ultrasound examination was performed with a commercially available ultrasound system (SonixTouch, Ultrasonix, Richmond, Canada). B-mode imaging was used for lesion localization. Hand-held SoS images were generated for lesion characterization. A flat passive plexiglass reflector positioned opposite to a linear probe was used as a timing reference for the ultrasound signals transmitted through the lesions. Synthetic aperture data was acquired and average SoS values across the lesions were measured with an accuracy of $<0.7\%$. Elastography (SWS and SR) was performed with a GE Logiq E9 machine.

RESULTS

Breast compression was 60 to 25 mm. SWV correlates with breast compression ($R^2 > 0.5$) while SoS does not show a significant correlation ($R^2 < 0.2$). The average SoS value was 1465 m/s (SD 7 m/s) and the average SWS value 2.5 m/s (SD 0.2 m/s). The SoS increments in the lesions were [cyst = 0.9%, FA = 0.8%, IDC [2.7-3.0%], while for SWS [cyst = 2.5 m/s, FA = 5.4 m/s, IDC = 4.1-3.95%] and SR [cyst = 1.6, FA = 5.0, IDC 2.8]. While all lesions could be correctly classified with a single SoS threshold, both SE and SWS failed to differentiate FA from IDC.

CONCLUSION

Hand-held speed of sound showed less dependency on compression than SWS and a better differentiation in an exemplary population of benign and cancerous lesions. Further studies are needed to confirm its utility.

CLINICAL RELEVANCE/APPLICATION

A hand-held SoS add-on to conventional ultrasound system provides additional information (Bulk Modulus) to conventional elastography (Young Modulus) for multi-parametric tissue characterization. SoS may reduce operator dependency and outperform conventional elastography in selected clinical scenarios. This novel technique can be implemented on a standard ultrasound machine.

SSJ21-06 Acoustic Lens-Based Photoacoustic-Ultrasound System for Noninvasive Thyroid Imaging

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S403A

Participants

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CONCLUSION

A combined non-invasive PA and US imaging system, with functional and structural capability can be a potential alternate for FNAB.

Background

Among thyroid cancer screening techniques, ultrasound (US) is the most widely used modality followed by invasive fine needle aspiration biopsy (FNAB). Approximately 5% of FNAB results are inconclusive and are compromised by insufficient sampling. The US (being a structural imaging method) can depict thyroid cysts and nodules clearly but lacks the ability to differentiate between cancerous and benign nodules. We propose a hybrid multispectral photoacoustic (PA) and ultrasound imaging system for non-invasive. With the combined functional nature of PA imaging capturing physiologic changes and structural image from US image high specificity is expected. This estimate can be depicted as an image that can be used to detect, characterize, diagnose, and monitor suspect lesions in thyroid disease management.

Evaluation

The proposed PA probe consists of a light delivery system, acoustic lens and US transducers that enable real-time frontal plane imaging of the tissue. A fast Fourier-based image formation is considered for volume image formation. Axial and lateral resolution of the probe was evaluated to be 0.3 millimeters (mm) and 1.6 mm. Ex-vivo thyroid studies demonstrated high specificity greater than 96%. A circular scanning stage obtains images from multiple angles using the probe, which improves system signal to noise ratio and a fivefold improvement in lateral resolution. A polyvinylidene fluoride (PVDF) film used as a US source can provide impedance image of the tissue. Adding US imaging to PA will add value co-registering with functional information in locating the nodules.

Discussion

PA absorption image of deoxy and oxyhemoglobin shows a clear distinction between cancerous and benign. The ex-vivo studies suggest that thyroid disease classification accuracy was comparable to that of FNAB. Characterization of the proposed prototype in phantoms with human thyroid geometry are in progress. With multiple view of the target tissue a minimum detectable cancer region of 0.3 mm with high specificity is expected.

SSJ22

Physics (CT: Radiation Dose I)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S403B

CT PH SQ

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

Participants

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Sub-Events

SSJ22-01 Examining the Effects of Lung and Breast Dose CT Scans Using an Organ-Based Tube Current Modulation

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S403B

Participants

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PURPOSE

The purpose of this work was to use Monte Carlo simulation techniques to examine the effects of chest CT scans performed with an organ-based tube current modulation (OBM) scheme on lung and breast doses.

METHOD AND MATERIALS

Image and raw projection data were collected for twenty-three patients (14 males, 9 females) undergoing CT chest examinations under IRB approval. These scans actually used a combination of organ based and attenuation-based modulation (XCARE + CAREdose4D, Siemens Healthineers, Forchheim, Germany). From the image data, voxelized models of chest anatomy were generated for use in a previously validated Monte Carlo (MC) simulation code; lung and glandular breast tissues were segmented from patient image data and specifically identified for the simulation. Estimates of lung and breast dose were obtained using an MDCT source model with the tube current modulation values extracted from the raw projection data. These contain precise information about the tube current values as a function of angle and table location. Lung and breast doses were tallied and normalized by scan-specific 32cm CTDIvol values based upon the average tube current across the entire scan length. Water equivalent (Dw) was used as the size metric and was calculated at the center of the scan volume for each patient. These normalized doses were then compared with previously developed estimates of breast and organ dose based on attenuation based modulation only (CAREdose4D).

RESULTS

For normalized lung dose, six patients experienced dose reduction to the lungs, while ten patients experienced an increase to breast dose, with greatest reduction being 50% and greatest increase being 114% relative to CAREdose4D chest protocol. For normalized breast dose, four patients experienced dose reduction to the breast while five patients experienced an increase to breast dose, with greatest reduction being 40% and greatest increase being 55% relative to CAREdose4D chest protocol.

CONCLUSION

The combination of organ based and attenuation based modulation may, at times, increase both lung dose and breast dose in some patients. This may be dependent on the location of the glandular breast tissue relative among other factors.

CLINICAL RELEVANCE/APPLICATION

Organ and attenuation based tube current modulation does reduce breast dose, but some patients may receive substantial dose reduction from attenuation based modulation alone.

SSJ22-02 Radiation Dose Reduction in Thin-Slice Chest CT at a Micro-Dose (mD) Level by Means of 3D Deep Neural Network Convolution (NNC)

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S403B

Participants

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Water equivalent diameters (WED) ranged from 17.4 to 34.2 cm for the females and 14.4 to 24.5 cm for the males. CTDIvol (32 cm phantom) values ranged from 1.37 to 6.0 mGy for females and 1.25 to 2.85 for males. Monte Carlo estimated lung doses ranged from 1.03 to 4.11 mGy for females and 0.91 to 1.88 mGy for males; female breast doses ranged from 0.77 to 6.67 mGy. There is a

relationship between lung dose and WED that also indicates some difference between males ($R^2 = .77$) and females ($R^2 = 0.53$). Breast dose also appears to have a relationship to WED (R^2 value 0.7)

CONCLUSION

This work demonstrates the ability to estimate breast and lung doses from a lung cancer screening CT exam using tube current modulation (TCM). The relationship between lung dose and patient size appears to be slightly different between males and females and warrants further investigation.

CLINICAL RELEVANCE/APPLICATION

This work describes investigations to estimate lung and breast dose from lung cancer screening CT exams that use tube current modulation.

SSJ22-04 Comparison of Four SSDE Calculation Approaches in Thoracoabdominal CT

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S403B

Participants

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PURPOSE

To evaluate SSDE (Size Specific Dose Estimate) calculations relative to a method recommended in the AAPM Report 220 using thoracoabdominal CT examinations.

METHOD AND MATERIALS

SSDE values of 112 adult thoracoabdominal exams (50 male, 62 female, BMI-range 15.8 to 39.9 kg/m²) from three CT scanners (Siemens Somatom Definition AS+, Flash and Edge) were evaluated using four calculation methods. First, the study's reference was calculated from reconstructed axial images according to the AAPM Report 220. A dedicated reconstruction with non-overlapping slices and a 500 mm field of view was used. Slice by slice, the water-equivalent diameter (WED) was calculated excluding the patient table, the CTDI_{vol} was extracted and the SSDE was determined. The average over all slices was used as the reference SSDE. Secondly, the WED of only one slice at the center of the scan region was calculated and the SSDE was obtained using the mean CTDI_{vol}. The third and fourth SSDE results were extracted from two commercial dose monitoring software tools (Radimetrics, Bayer HealthCare and teamplay Dose, Siemens Healthineers). The results from the dose monitoring software tools were obtained from the localizer radiographs.

RESULTS

Compared to the reference method, on average the SSDE values from the central slice method were 4% lower and the SSDE values from Radimetrics were 5% lower (1% higher) before (after) optimization of the scan region to phantom mapping in the software. The SSDE values from teamplay were 9% lower (1% higher) on average compared to the reference method before (after) optimization of scan region.

CONCLUSION

AAPM Report 220 proposes that an SSDE calculation method is compliant with a reference method if the root mean square deviation is less than 10 % relative to the reference. According to this criterion, the central slice method and the optimized teamplay and Radimetrics methods agree with the reference method.

CLINICAL RELEVANCE/APPLICATION

As standardized SSDE calculations are not yet readily available from CT scanners, comparisons of available options are needed to choose appropriate methods for accurate patient dose estimates.

SSJ22-05 Equipment Selection: Comparison of Four Different Dose Monitoring Commercial Systems - How the Choice of Different Calculation Methods Could Affect the SSDE in CT Scans of Different Body Areas

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S403B

Participants

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PURPOSE

The dose from a CT scan depends on both patient size and scanner radiation output. Size-specific dose estimate (SSDE) is calculated applying a correction factor based on patient's size to the CTDI value. The purpose of the study was to evaluate SSDE calculation accuracy of four different commercial Radiation Dose Index Monitoring (RDIM) software.

METHOD AND MATERIALS

Two sets of CT acquisitions (GE Discovery HD750), with and without Automatic Tube Current Modulation (ATCM), were performed on an anthropomorphic phantom positioned at the center of the scanning Field-of-View (FOV). Acquisitions were repeated after increasing or decreasing table height by 5 cm. Each set consisted of 6 acquisitions of different scanning length: chest (C), abdomen (A), neck (N), chest+abdomen (C+A), neck+chest (N+C), head+neck+chest+abdomen (H+N+C+A). A user-developed code (Matlab, Matworks) was applied to calculate Size Specific Dose Estimate (SSDE) from Water Equivalent Diameter (WED) or Effective Diameter (eff), using the image at the center of the scanning region (SSDE_c) or the average on all the axial images (SSDE_m). Calculated values were compared with those registered by four commercial Radiation Dose Index Monitoring System: Radimetrics, DoseWatch, NexoDose and RDM.

RESULTS

The difference between SSDE_m,WED vs SSDE_m,eff and SSDE_c,WED vs SSDE_c,eff were within 5 % on all the scans (RMS=3.17%, max=5.1%). The difference between SSDE_m,WED vs SSDE_c,WED and SSDE_m,eff vs SSDE_c,eff were within 7 % on scan C, A and C+A (RMS=5.6%, max=9.2%) and increased on scan H+N+C+A, N and N+C (RMS=17.5%, max=31.2%) due to the diameter variation within the scanning length. The maximum difference between SSDE registered on the RDM software was lower in C, A and C+A (RMS=15.2%, max=29.4%) and became relevant on scan H+N+C+A, N and N+C A (RMS=37.4%, max=51.7%).

CONCLUSION

Different methods of SSDE calculation are implemented by different RDM vendor. Relevant differences were found when the scanning region comprehend anatomy with a high variation of patient attenuation (eg neck+shoulder). When comparing result from different evaluation software, the user should be aware of the calculation methods implemented and their limitation.

CLINICAL RELEVANCE/APPLICATION

Differences in SSDE arising from different calculation methods implemented on commercial dose monitoring systems should be carefully considered when comparing data in a multi-institutional framework.

SSJ22-06 Comparison of Clinical and Phantom Image Quality for Low Contrast Liver Lesions in a Prospective Multicenter CT scanner Dose Optimization Program

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S403B

Participants

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PURPOSE

To compare diagnostic performance for low contrast liver lesions on patient and phantom images, in a prospective multicenter CT scanner dose optimization program.

METHOD AND MATERIALS

A CT scanner protocol harmonization process based on clinical indication and BMI (<25 / >25), followed by a 12% stepwise dose reduction program, was implemented in a multicenter medical imaging group (5 units, Philips Healthcare, NL). During the optimization phase, 3035 abdomen CT examinations were prospectively assessed by experienced radiologists with a "positive/negative" diagnostic image quality electronic voting tool and 33 patients who underwent a CT examination for liver tumor or cancer staging before and after optimization were graded for image quality using European image quality guidelines. In parallel, phantom (QRM™ 401 abdomen, Germany) acquisition with 2.5 (size M) and 5cm (size L) fat ring was also performed before and after dose reduction using the liver tumor follow-up protocol. A channelized hotelling model observer was used to assess the lesion detectability using the ROC paradigm with the area under the ROC curve (AUC) as figure of merit.

RESULTS

Median patient CTDI_{vol} value decreased from 6.8 to 5.2mGy (-24%, p<0.005) and from 10.8 to 8.5mGy (-22%, p<0.005) respectively for BMI<25 and >25. For phantom images, mean CTDI_{vol} value decreased from 8.8 to 6.3mGy (-28%) for M-sized and from 15.9 to 11.8mGy (-26%) for L-sized phantom. No negative vote for diagnostic image quality was registered and preliminary results on 33 paired patients showed no loss of image quality according to European image guidelines. Image quality phantom analysis showed a constant low contrast lesion detectability, even after a 26% dose reduction. However, an additional 12% dose reduction started impairing the detectability of 5mm lesions.

CONCLUSION

Combining clinical diagnostic image quality and phantom based analysis enable dose reduction according to the ALARA principle without impairing low contrast liver lesion detectability.

CLINICAL RELEVANCE/APPLICATION

Combining clinical image quality evaluation and phantom analysis for image quality optimization preserves diagnostic confidence and sets a low-level threshold enabling no loss of detectability of low contrast liver lesions.

SSJ23

Physics (Nuclear Medicine)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S404AB

NM **PH**

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

SSJ23-01 MR-Assisted PET Reconstruction in the Presence of Respiratory Motion: A Phantom Study

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S404AB

Participants

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PURPOSE

The simultaneous PET/MR provides an unprecedented opportunity for motion correction. We aimed at developing an integrated MR-assisted PET motion correction method which would allow accurate PET quantification in the presence of respiratory motion. This makes it possible to detect small lesions, which would otherwise become undetectable given the blurring caused by motion. In this study, we also evaluated the performance of the proposed method using a deformable motion phantom with known ground truth.

METHOD AND MATERIALS

For tracking respiratory motion, we developed a self-navigated free breathing MR motion correction method that provides robust and fully-automated respiratory motion detection. Four spheres with FDG activity were placed in a deformable motion phantom to mimic FDG avid lesions. The diameters of the spheres were 4.5 mm, 6.75 mm, 7.5 mm and 9 mm, respectively. List mode PET data and MR motion correction data were acquired simultaneously in the presence and absence of motion. Respiratory motion was first detected using the self-navigated free breathing MR method. This MR derived motion was then used to rebin the simultaneously acquired list mode PET data. Motion-corrected and uncorrected PET images were reconstructed using the same motion-corrupted data. On the other hand, the static (no-motion) PET/MR scan was used as the ground truth for PET activity.

RESULTS

In reference to the static PET, the relative FDG activity measured in the motion uncorrected PET images were 55% (D=4.5 mm, motion range = 9.8 mm), 61% (D=6.75 mm, motion range = 10.7 mm), 75% (D=7.5 mm, motion range = 7.1 mm) and 69% (D=9 mm, motion range = 9.2 mm) for the four spheres. In contrast, the measured activity became, respectively, 95%, 99%, 96% and 96% after applying the MR assisted PET motion correction.

CONCLUSION

Depending on the size and the magnitude of motion, motion-compromised PET images can show up to 45% reduction in FDG activity. Our MR-assisted PET motion correction can recover the activity back to 95%-99% of that measured using the static data set.

CLINICAL RELEVANCE/APPLICATION

High noise and respiratory motion makes it difficult to detect small lesions in PET images. MR-assisted motion correction makes it possible to delineate lesions with significantly higher accuracy.

SSJ23-02 Faster PET Imaging: Evaluation and Optimization of PET Acquisition Overlap on both Solid State Digital PET and PMT PET in FDG and NaF PET/CT

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S404AB

Participants

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PURPOSE

To improve patient comfort and clinical volume throughput by accelerating PET imaging using optimized PET acquisition overlaps going beyond current accepted boundaries in FDG and NaF TOF PET on both solid state digital photon counting PET (dPET) and conventional PMT PET (cPET).

METHOD AND MATERIALS

An ongoing pre-clinical (beagles) and clinical trial was initiated to investigate the feasibility of minimizing and optimizing PET acquisition overlap in axial on cPET (Gemini TF 64) and dPET (Vereos TF). Four groups of wholebody PET/CT are included: A. preclinical FDG PET (~2.8mCi), B. preclinical NaF PET (~2.8mCi), C. clinical FDG PET (~13mCi) and D. clinical research NaF PET (~3mCi). Intra-individual PET imaging was acquired on both systems under investigational overlaps of 27%, 20%, 12% and 0% besides system defaults (Gemini: 53%; Vereos: 39%). Uniformity phantoms were performed for validation. PET image quality (IQ) and SUV assessment were blinded reviewed by multiple readers.

RESULTS

4 beagles (2 FDG and 2 NaF) and 4 human subjects (2 FDG and 2 NaF) were imaged. dPET images consistently showed better IQ with enhanced contrast and more uniform background than cPET under various overlaps. FDG PET exams showed no impact on visual grades with overlaps of 27%+ for cPET and 20%+ for dPET, compared to PET using default overlaps. NaF PET exams revealed better acceptable range than FDG PET with 20%+ for cPET, and 12%+ for dPET (surprisingly, nice NaF dPET images obtained even without overlap). Reducing overlap to 27% for cPET and to 20% for dPET from default saved ~40% acq time. No significant SUV variances were found between PET using minimized overlaps and default PET for cerebellum, lung, heart, aorta, liver, fat, muscle, bone marrow, thighs and target lesions ($p > 0.05$), except kidneys and bladder.

CONCLUSION

The study demonstrated through combined pre-clinical, phantom and clinical exams the feasibility of reducing PET overlaps on both solid state PET and PMT PET scanners to accelerate PET imaging for ~40% from current levels without degradation of image quality. Advantages of solid state PET being capable of enabling faster PET using less PET overlaps than PMT PET was obtained.

CLINICAL RELEVANCE/APPLICATION

Faster PET imaging has substantial benefits to patient comfort and clinical volume throughput and the study examined such by optimizing PET acquisition overlaps in FDG and NaF PET on both solid state PET and PMT PET systems.

SSJ23-03 Ultra High Spatial and Energy Resolution PET Detector

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S404AB

Participants

Mokhtar Chmeissani, Bellaterra, Spain (*Presenter*) Nothing to Disclose
Machiel Kolstein, PhD, Bellaterra, Spain (*Abstract Co-Author*) Nothing to Disclose
Jose Gabriel Macias, MENG, Bellaterra, Spain (*Abstract Co-Author*) Nothing to Disclose
Carles Puigdemogles, MENG, Bellaterra, Spain (*Abstract Co-Author*) Nothing to Disclose
Jorge Garcia, MENG, Bellaterra, Spain (*Abstract Co-Author*) Nothing to Disclose
Xavier Prats, BEng, Bellaterra, Spain (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Current Positron Emission Tomography (PET) scanners have a limited image resolution which is due both to the intrinsic limits set by PET physics and the design and the material used in state-of-the-art PET scanners. We present a novel 3D gamma sensor, based on pixelated CdTe, to reduce significantly the limitations coming from spatial and energy resolution.

METHOD AND MATERIALS

Each detector module has 4000 voxels (independent channels). Each voxel consists of 1mm x 1mm x 2mm of CdTe bonded to a dedicate pixel channel. The detector module is made of a stack of 10 layers. Each layer has 4 sensors glued to a flex printed circuit board (PCB). The sensor itself is a hybrid pixel CdTe detector, of size 10 mm x 10 mm x 2 mm, bonded to a dedicated pixel ASIC. The pixel ASIC is thinned down to 200um and the flex PCB is 255 um thick. Effectively, each layer has a thickness of 2mm of active material (CdTe), and 0.35mm of passive material. Each detector module has an amount of CdTe equal to 20 mm x 20 mm x 20 mm. A total of 18 of such detector modules will form a PET ring with an inner radius of 6.5 cm and an axial FOV of 2.6 cm. The full ring has 72000 independent channels. Each ASIC (of 100 channels) has one TDC with a time resolution of 1 nano-second. Each channel has its own pre-amp, shaper, discriminator, and 11 bit ADC. Each triggered voxel sends its digitized energy signal plus a time stamp. Currently, 11 out of the 18 detector modules have been assembled and tested using a Na22 source with a bias voltage of 250V/mm.

RESULTS

Overall 90% of the channels are operational. The other 10% have defects due to electronics or detector leakage current. With these working conditions, the energy resolution obtained for PET events is 2.4% at FWHM. The energy resolution for Compton events, reconstructed from two different sensors, is 3.4% at FWHM.

CONCLUSION

With a full PET ring and operating the CdTe at 500V/mm, we expect to achieve the intrinsic spatial resolution set by physics

with a full PET ring and operating the CUTE at 3000/min, we expect to achieve the intrinsic spatial resolution set by physics, thanks to the excellent 3D detector granularity and with a negligible scattered fraction (4%) thanks to the excellent energy resolution. This translates into a possible detection of cancer lesions as small as 2mm in diameter.

CLINICAL RELEVANCE/APPLICATION

This novel PET make it possible to detector cancer lesion as small as 2mm in diameter with TNR 4:1

SSJ23-04 Evaluation of CZT Gamma Cameras for Whole-Body SPECT and Small FOV Imaging

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S404AB

Participants

James W. Hugg, PhD, Saxonburg, PA (*Presenter*) Sr. Vice President, Kromek Group plc
Brian W. Harris, PhD, Saxonburg, PA (*Abstract Co-Author*) Employee, Kromek Group plc
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CONCLUSION

Continual improvements in CZT detector arrays for molecular imaging, coupled with optimal collimator and image reconstruction, result in minimized dose and exam time. With CZT cost and performance improving, more clinical applications are expected.

Background

The semiconductor CdZnTe (CZT) direct-conversion gamma photon detector has been used in several molecular imaging applications, including small-animal and whole-body human SPECT, cardiac SPECT, and molecular breast imaging (MBI). We designed a modular gamma detector (4.4 cm square with 2 mm pixel pitch) and tiled it in two array sizes: a small FOV camera (8.8 cm square, 44 x 44 pixels) and a whole-body SPECT camera (39.6 cm x 52.8 cm, 198 x 264 pixels) that we mounted on a refurbished SPECT gantry for demonstration. We evaluated the performance of these gamma cameras.

Evaluation

Integration of pixelated CZT detectors with advanced ASICs and readout electronics improves system performance. We measured energy resolution of 3.0% FWHM at 140 keV, intrinsic flood field uniformity of $\pm 0.8\%$ integral and $\pm 0.4\%$ differential, system spatial resolution at 10 cm with an LEHR collimator of 6.8 mm and 7.5 mm without and with scatter, and intrinsic detector count rate performance of 1.4 M cps at 20% loss and 6.1M cps maximum observed. These metrics are significantly better than scintillator SPECT systems.

Discussion

Very good energy resolution enables better scatter rejection and image contrast, further enhanced by excellent uniformity. Smaller pixels improve partial-volume dilution and quantitation. Spatial resolution is improved, even with hexagonal-hole collimators, but registered square-hole collimators provide significantly better resolution and a boost of about 30% in sensitivity which can lower dose and/or exam time. The non-paralyzable CZT cameras count at much higher count rates, enabling new first-pass and pharmacokinetic studies. Advances in detectors, collimators, and image reconstruction have significantly improved efficiency of CZT-based molecular imaging systems and the cost of CZT detectors has steadily declined.

SSJ23-05 TV-Constrained Image Reconstruction from List-Mode TOF-PET Data

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S404AB

Participants

Zheng Zhang, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
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Jinghan Ye, San Jose, CA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Amy Perkins, Philadelphia, PA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Chi-Hua Tung, Cleveland, OH (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Chien-Min Kao, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Walgreens Boots Alliance, Inc
Emil Y. Sidky, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Xiaochuan Pan, PhD, Chicago, IL (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV ; Research Grant, Toshiba Medical Systems Corporation; Research Grant, Varian Medical Systems, Inc

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PURPOSE

We investigate an innovative image reconstruction for advanced digital time-of-flight (TOF) positron-emission tomography (PET) and demonstrate its potential for improving image quality in digital TOF PET, in terms of enhanced spatial resolution, signal-to-noise ratio, and axial coverage.

METHOD AND MATERIALS

We employ a digital SiMP TOF PET clinical scanner to collect list-mode TOF-PET data from the Jaszczak and IEC phantoms. The Jaszczak phantom contains six types of cylindrical-shaped cold rods of diameters 4.8, 6.4, 7.9, 9.5, 11.1, and 12.7 mm, whereas the IEC phantom includes 6 spheres of 10, 13, 17, 22, 28, and 37 mm diameter. The activity in the four smallest spheres is 4 times of the background, and the other two spheres have zero concentration. We developed an iterative algorithm based on Chambolle-Pock framework to reconstruct images. Images reconstructed by use of the standard ordered-subset-expectation-maximization (OSEM) algorithm are used as references. Reconstructions are evaluated visually and quantitatively. In particular, the IEC-phantom reconstructions are assessed following the instruction in NEMA NU 2-2012.

RESULTS

TOF-PET images reconstructed with the proposed algorithm exhibit appreciably lower background noise and enhanced contrast relative to that of the reference images. In particular, the reconstructions are with much improved image quality especially in regions near the axial edges where the reference images are observed to have significant artifacts. For the Jaszczak phantom, the smallest revealed cold rods reconstructed by the proposed algorithm are of 7.9mm diameter, whereas those are of 12.7 mm in the reference image. This underscores a considerable improvement on the spatial resolution in reconstructed images. For the IEC phantom, the reconstructions with the proposed algorithm reveal 7%~20% increased contrast for hot spheres, 4%~6% increased contrast for cold spheres, and 27%~46% decreased noise for background over that of the references.

CONCLUSION

The novel algorithm proposed can yield reconstructions from TOF-PET data with considerably improved spatial and contrast resolution and signal-to-noise ratio over the standard algorithms in TOF-PET imaging.

CLINICAL RELEVANCE/APPLICATION

The PET-image quality may be improved by use of advanced algorithms. The algorithm-enabled quality improvement may be of clinical implication for enhanced lesion detectability at low count statistics.

SSJ23-06 Deep Learning Enables at Least 100-fold Dose Reduction for PET Imaging

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S404AB

Awards

Student Travel Stipend Award

Participants

Enhao Gong, MS, Stanford, CA (*Presenter*) Research support, General Electric Company

Jia Guo, PhD, Stanford, CA (*Abstract Co-Author*) Research support, General Electric Company

Junshen Xu, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

John Pauly, Stanford, CA (*Abstract Co-Author*) Research support, General Electric Company

Greg Zaharchuk, MD, PhD, Stanford, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Consultant, General Electric Company;

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PURPOSE

Lowering injected dose in PET can reduce the risk to patients, lower imaging costs and potentially improve imaging efficiency. In addition, it may help imaging logistics when fast-decaying tracers are used. However, lowered dose adversely affects PET image quality. Previous methods typically use complicated and slow iterative reconstruction, yet still cannot yield satisfactory results at significantly low dose.

METHOD AND MATERIALS

We developed a deep network(convolutional encoder-decoder residual network) to recover PET images acquired at ultra-low-dose. This network conducts patch-to-patch regression tasks, taking a noisy low-dose PET image patch as input and outputting a high-quality patch to approximate the corresponding patch in full-dose PET. The final reconstruction is generated by concatenating and averaging overlapping patches. Using bypass connections and patch-based training, we reduced the regression task complexity and achieved robust training performance. To avoid over-fitting, we trained the network with data augmentations(~ 10000 patches $\times 2$ flips $\times 4$ rotations). Brain PET-MR datasets(GE Signa 3T) were collected from 7 patients with recurrent glioblastoma(65 ± 6 yrs, 4 males), who received 10mCi FDG. We used the full-dose reconstruction(3D-OSEM, 2 iterations and 28 subsets) as gold-standard. For input, we created low-dose images by removing counts from the listmode data, reconstructing with various dose-reduction factors(DRF). We tested on DRFs up to 200-fold, showing we can achieve satisfactory results at least with 100-fold (1% of original counts).

RESULTS

To show the method can generalize on different data/subjects, we trained the model on subsets of slices from 3 patients and evaluated on all slices which were not used for training from all 7 patients. The proposed method reduces over 50% Root-Mean-Square-Error(RMSE) and gains 7dB in Peak-Signal-Noise-Ratio(PSNR) compared with the conventional method and achieves similar Contrast-Noise-Ratio(CNR) as the gold-standard.

CONCLUSION

Using a deep learning algorithm, we can reconstruct ultra-low-dose (at least 100 fold) PET images and achieve comparable image quality as the full-dose images.

CLINICAL RELEVANCE/APPLICATION

This method could dramatically reduce the radiation dose in PET imaging: a 100-fold-low-dose reduces the effective radiation in PET imaging to a similar level as a NYC-LA flight.

SSJ24

Radiation Oncology (Gastrointestinal)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S104A

GI RO OI

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

Participants

Tobias R. Chapman, MD, MS, Seattle, WA (*Moderator*) Nothing to Disclose
Tarita O. Thomas, MD, PhD, Chicago, IL (*Moderator*) Nothing to Disclose

Sub-Events

SSJ24-01 Baseline Hepatobiliary Iminodiacetic Acid (HIDA) Scans May Predict Toxicity after Stereotactic Body Radiation Therapy (SBRT)

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S104A

Awards

Student Travel Stipend Award

Participants

David Long, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
Mark Tann, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
James O. Galle, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Yukie Furukawa, RT, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Feng-Ming Kong, MD, PhD, Augusta, GA (*Abstract Co-Author*) Research Grant, Varian Medical Systems, Inc Speaker, Varian Medical System, Inc Travel support, Varian Medical System, Inc
Susannah Ellsworth, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cirrhotic patients (pts) may have regional variations in liver function (LF) that cannot be quantified by clinical scores based on serum liver function testing (LFT). Hepatobiliary iminodiacetic acid (SPECT-HIDA) scans map regional variations in LF. We aim to correlate HIDA with standard LFT and to evaluate its ability to predict toxicity.

METHOD AND MATERIALS

The study included pts with hepatocellular carcinoma who had a baseline SPECT-HIDA between 12/1/2012-2/28/2017. LFTs were collected at baseline, 3, and 6 months after treatment. Child-Turcotte-Pugh (CTP) and modified end-stage liver disease (MELD) scores were calculated. Pearson correlation was used to correlate HIDA and LFT. Toxicity was defined as an increase in MELD > median at 3 and 6 months (>2-point change). Stereotactic Body Radiation Therapy (SBRT) pts were analyzed separately to evaluate whether functional residual capacity (FRC HIDA; calculated as % counts receiving <15Gy * global HIDA score) predicted toxicity.

RESULTS

32 pts met inclusion criteria (SBRT=17, liver directed therapy=5, surgery=4, no therapy=6). Global HIDA correlated with CTP ($r=-0.662$, $p<0.001$) and MELD ($r=-0.690$, $p<0.001$) scores. Mean global HIDA was higher in CTPA than CTPB pts (3.6 vs 1.8 %/min/body surface area (BSA); $p<0.001$). Mean HIDA for pts with MELD ≤ 9 was higher than those with MELD ≥ 10 (3.7 vs 2.0 %/min/BSA; $p=0.001$). There was no difference in mean baseline HIDA between pts without and those with toxicity. SBRT pts without toxicity at 3 months had a higher mean global HIDA than those with toxicity (3.6 vs 2.2 %/min/BSA, $p=0.025$). Mean FRC HIDA in pts without toxicity at 3 months was higher than those with toxicity (2.8 vs 1.8 %/min/BSA, $p=0.022$). Similar trends were observed at 6 months. Of note, 8/17 SBRT pts had peritumoral defects in regional LF on baseline HIDA.

CONCLUSION

Global HIDA correlated with standard cirrhosis scoring systems. In SBRT pts, lower baseline global HIDA and FRC HIDA were associated with toxicity. If validated by a larger sample size, FRC HIDA and mapping regional variations in LF may help guide personalized SBRT.

CLINICAL RELEVANCE/APPLICATION

Global HIDA value correlates with standard cirrhosis scoring systems. If validated by a larger sample size, FRC HIDA and mapping regional LF may predict toxicity and guide personalized SBRT.

SSJ24-02 The Clinical Outcome of Stereotactic Ablative Radiotherapy for Advanced Hepatocellular Carcinoma: A Multicenter Retrospective Study

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S104A

Participants

Chin Beng Ho, Taipei, Taiwan (*Presenter*) Nothing to Disclose
Hsin-Lun Lee, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose

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Jo-Ting Tsai, New Taipei City, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Ying-Chun Lin, Taichung, Taiwan (*Abstract Co-Author*) Nothing to Disclose
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Shang-Wen Chen, Taichung, Taiwan (*Abstract Co-Author*) Nothing to Disclose
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Jeng-Fong Chiou, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose

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ABSTRACT

Purpose/Objective(s): To investigate the clinical outcome in patients with advanced hepatocellular carcinoma (HCC) treated with stereotactic ablative radiotherapy (SABR). **Materials/Methods:** Between July 2006 and June 2016, we retrospectively reviewed medical records of patients with advanced HCC treated by SABR at two medical centers. The patient eligibility criteria are as follows: (1) histologically or radiologically confirmed HCC according to AASLD (American Association for Study of Liver Diseases) criteria; (2) Karnofsky performance score ≥ 2 ; (3) Child-Pugh score of 5-7; and (4) Normal liver volume more than 700 mL. The treatment response was evaluated by follow-up imaging study according to RECIST (V1.1) criteria and treatment-related toxicities were scored by CTCAE (V4.03). **Results:** A total of 32 patients with a median Child-Pugh score of 5 (range: 5-7) were enrolled. Ten (31%) patients had tumor vascular thrombosis. The mean tumor size and mean GTV volume were 4.1 cm (range: 2.1-6.0 cm) and 22.0 mL (range: 4.5-54.3 mL), respectively. The dose scheme of SABR ranged from 24-54 Gy in 3-6 fractions (median: 45 Gy in 5 fractions). With a median follow-up duration of 13 months, the overall best treatment response rate was 46% and the median time to progression was 12 months. The 1-year local control and 1-year overall survival rate were 93% and 74%, respectively. No treatment-related toxicities above grade 2 were observed. **Conclusion:** SABR provides good local control and tolerable toxicity for selected patients with advanced HCC. Future prospective study is warranted to clarify the optimal patient selection, SABR dose scheme and combination of systemic drugs.

SSJ24-03 Robotic Stereotactic Body Radiation Therapy (SBRT) for Liver Metastases at a Non-Academic, Community-Based Hospital

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S104A

Participants

Emily Anstadt, West Hartford, CT (*Presenter*) Nothing to Disclose
Richard C. Shumway, MD, Hartford, CT (*Abstract Co-Author*) Nothing to Disclose
Joseph M. Colasanto, MD, Torrington, CT (*Abstract Co-Author*) Nothing to Disclose
David Grew, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Stereotactic body radiation therapy (SBRT) has been shown to be a safe and effective option for treatment of liver metastases in both retrospective and phase I/II prospective studies. However, existing data are mostly reported by academic centers. There have been reports that advanced radiotherapy techniques for some types of cancers performed at community-based hospitals result in inferior outcomes. Our goal was to assess the implementation of this technology by studying efficacy and toxicity of SBRT on liver metastases at a non-academic, community-based hospital through retrospective database analysis. **Materials/Methods:** We performed an IRB approved patient registry study at a non-academic, community-based hospital. Patients had a median age of 65, KPS of at least 70 (median 90) and primary tumor controlled. All patients underwent fiducial marker placement under CT-guidance 1-2 weeks prior to planning scans. GTV was delineated using contrast enhanced CT scans, as well as fusion with PET and/or MRI scans. GTV was expanded by 5 mm to create the PTV. Treatment was delivered by image guided stereotactic robotic radiosurgery with respiratory motion tracking. Lesions were treated with 3 consecutive fractions to a median total dose of 54Gy. Overall survival, progression-free survival and local failure-free survival were estimated using Kaplan-Meier method. To investigate the relationship between tumor volume and local control, we dichotomized our data set at the mean. Log-rank statistic was used to compare local control based on gross tumor volume. **Results:** Between 2006 and 2016, 42 consecutively treated patients with 81 metastatic liver lesions were treated with SBRT. Median follow up was 25 months. Primary tumor sites were colon (18), lung (7), breast (3), uterine (3), renal (2), pancreas (2), and others (7). Synchronous extrahepatic disease was present in 15% of the treated lesions at the time of SBRT and 46% had prior local treatment for liver metastases. Median number of lesions treated at one time was 1 (range 1-4). Lesions had a median maximum diameter of 2.5 cm (range 0.5 cm - 9.5 cm), and a mean volume of 53 cc (0.5 cc - 363.0 cc). Kaplan-Meier estimated 1 and 2 year overall survival was 72% and 62%. Estimated 1 and 2 year progression free survival was 32% and 23%. Estimated 1 and 2 year local control was 86% and 80%. 2 year local control was worse for lesions >50 cc compared to lesions ≤ 50 cc (62% vs 84%, $p=0.04$). Toxicity occurred in 26% of treatment courses and included grade 1 ($n=12$) (fatigue, diarrhea, nausea, skin irritation and pneumonitis) and grade 2 toxicity ($n=3$) (chest wall pain and vomiting with mildly elevated transaminase levels). **Conclusion:** These results are comparable to available published data regarding the safety and efficacy of liver metastasis SBRT on clinical trials at academic institutions. Our findings demonstrate the successful implementation of a liver metastasis SBRT program in a community hospital setting.

SSJ24-04 Assessment of Radiographic Changes after Radiotherapy for Hepatocellular Carcinoma

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S104A

Participants

Onyinye D. Balogun, MD, New York, NY (*Presenter*) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Hepatocellular carcinoma (HCC) is the most frequent primary liver tumor in adults and it is the fifth most common cancer in the world. Radiotherapy is increasingly being used to treat hepatocellular malignancies. However, there are no standard imaging protocols for evaluation of tumors treated with radiotherapy. Our study reports the radiological changes noted on MRI and/or CT scan in hepatocellular cancer patients after undergoing radiation therapy to a primary tumor. **Materials/Methods:** CT scans and MRIs of hepatocellular cancer patients who underwent stereotactic or hypofractionated radiotherapy between 2011 and 2016 at a single institution were evaluated prior to and after radiotherapy. Eligible patients had to have at least one imaging study after radiotherapy. Variables including lesion volume, arterial enhancement with or without portal venous washout, and presence of

a pseudocapsule were evaluated. Results: Fifteen patients with radiologic studies after radiotherapy were treated between 2011 and 2016. Primary tumor size ranged from 1.2 to 16 cm. Radiotherapy was delivered in 1-15 fractions (mean 7.2 fractions). Treatment doses ranged from 800 to 5805 cGy (mean 3794 cGy). Per institutional practice, initial follow-up imaging was usually performed at approximately 1 month after treatment. CT and MRI were utilized in 7 and 8 patients, respectively, for initial follow-up evaluation. Over 70% of tumors maintained characteristics of pseudocapsule presence and arterial enhancement with portal venous washout at initial imaging and were classified as stable according to modified RECIST assessment for hepatocellular carcinoma. Of note, three patients exhibited tumor decrease within two weeks of treatment completion. Radiographic assessment is ongoing and additional endpoints will be reported. Conclusion: The findings of this study will add to the existing limited literature regarding characteristic radiation-induced changes in primary liver tumors and surrounding liver parenchyma. Together, these studies can provide a framework for the standardized assessment of tumor response after radiotherapy.

SSJ24-05 Sequencing of Chemotherapy and Radiation Therapy in the Treatment of Extrahepatic Cholangiocarcinoma and Gallbladder Carcinoma

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S104A

Awards

Trainee Research Prize - Medical Student

Participants

Jonathan Van Wickle, Milwaukee, WI (*Presenter*) Nothing to Disclose

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ABSTRACT

Purpose/Objective(s): Primary malignancies of the Gallbladder and Extrahepatic biliary system (EHC-Gal) are rare. There are advantages to pre-operative chemoradiation (chemo-RT) in malignancies such as pancreatic adenocarcinoma. The objective of this study was to explore the benefit, if any, of neoadjuvant chemo-RT in patients with EHC-Gal malignancies who are not candidates for transplant, using the National Cancer Database (NCDB). We hypothesized that the use of neoadjuvant chemo-RT may improve outcomes. **Materials/Methods:** The NCDB was queried for patients with EHC-Gal between the years of 2006-2012. Patients without metastatic disease at the time of diagnosis, who underwent surgical resection, and received either pre-operative or post-operative chemo-RT, with radiation therapy doses between 40 Gy and 70 Gy, were included. Patients with ampulla of Vater involvement, those treated with stereotactic body radiation therapy (SBRT) or liver transplant were excluded. Baseline covariates were compared between treatment groups. Overall survival (OS) by treatment group was plotted using Kaplan-Meier methods. Univariate and multivariate Cox proportional hazards regression, incorporating inverse probability of treatment weighting (IPTW) to account for selection bias, were used to model time from diagnosis to death. The twang R package was used to calculate propensity scores and the average treatment effect of the treated (ATT) weights; the weighted estimate represents the treatment effect on the treated population. **Results:** Among the 561 patients meeting inclusion criteria, 34 (6%) received pre-operative chemo-RT. Among the entire cohort of 561 patients with EHC-Gal, the median age was 64 years, 47% were male, and 81% were Caucasian. Overall, 29%, 49% and 22% were clinical stage I, II, and III, respectively. Patients treated with pre-operative chemo-RT were more likely to be younger, have fewer medical comorbidities, have earlier clinical stage disease, and be treated at academic centers. Following surgical resection, patients treated with pre-operative chemo-RT had significantly higher rates of node negativity (65% vs. 34%, p Conclusion: Among a contemporary NCDB cohort of 561 patients with EHC-Gal, few patients received preoperative chemo-RT. Compared to patients treated with post-operative chemo-RT, patients treated with pre-operative chemo-RT had lower rates of positive margins and node positivity. This did not translate into a statistically significant difference in OS. This may be related to a dominant pattern of distant failure and short median survival in EHC-Gal. Further investigation into pre-operative therapy in EHC-Gal is warranted.

SSJ24-06 Does Radical Resection Obviate the Benefit of Adjuvant RT in Gallbladder Cancer?

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S104A

Participants

Joseph Marascio, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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ABSTRACT

Purpose/Objective(s): Gallbladder cancer (GC) is a rare aggressive malignancy for which optimal adjuvant treatment is not well studied. Studies showing benefit to adjuvant CRT have typically included advanced T stage or node positive patients and have largely been single institution retrospective reviews or analyses of historical databases. Often in these reviews, simple cholecystectomy was the chief technique, but more recently this has been replaced by radical resection. The purpose of this study is to compare the impact of adjuvant RT in simple vs radical resection. **Materials/Methods:** The Surveillance, Epidemiology and End Results (SEER) database was used to identify patients diagnosed with GC between 2004 and 2013 who underwent simple or radical cholecystectomy. Patients were classified according to AJCC 6th edition and included if stage IIA, IIB or III. Patients with metastatic disease and those surviving fewer than 3 months were excluded. Overall survival (OS) was then calculated for patients who received adjuvant RT or no RT with respect to simple or radical resection. **Results:** For patients undergoing radical resection, 266 patients who met the above criteria were identified. 121 received adjuvant RT and 145 did not. In the adjuvant RT group the median age was 61 and staging was as follows: IIA 28.9%, IIB 65.3%, and III 5.8%. For those not receiving RT the median age was 67 and staging was as follows: IIA 41.4%, IIB 44.8%, and III 13.8%. In the adjuvant RT group the median survival was 23.4 months, 1 year OS was 87.4% (95 CI 79.6 – 92.3%) and 3 year OS was 35.3% (95 CI 25.7 – 44.9%). In those not receiving RT the median survival was 11.9 months, 1 year OS was 49.5% (95 CI 40.8 – 57.7%), and 3 year OS was 23.8% (95 CI 16.6 – 31.8%). For patients undergoing simple resection, 866 patients who met the above criteria were identified. 289 received adjuvant RT and 577 did not. In the adjuvant RT group the median age was 65 and staging was as follows: IIA 34.6%, IIB 62.3%, and III 2.8%. For those not receiving RT the median age was 72 and staging was as follows: IIA 52.5%, IIB 44%, and III 3.5%. In the adjuvant RT group the median survival was 21.1 months, 1 year OS was 75.8% (95 CI 70.3 – 80.5%) and 3 year OS was 31.3% (95 CI 25.4 – 37.3%) For those not receiving RT the median survival was 12.8 months, 1 year OS was 52.5% (95 CI 48.3 – 56.6%) and 3 year OS was 21.1% (95 CI 17.6 – 24.8%). **Conclusion:** In the simple resection group a significant OS benefit is seen in those

receiving adjuvant RT at 1 and 3 years. Similarly, this benefit is seen in the radical group at 1 year, however significance is lost at 3 years. These findings reflect a benefit to adjuvant RT shown in prior studies for simple resection, but also support an improved OS in those undergoing radical resection. A weakness in this review is the lack of chemotherapy data as adjuvant RT may be a surrogate for adjuvant chemotherapy. Similarly, patients of greater performance status may be more likely to be selected for adjuvant treatments.

SSJ25

Vascular Interventional (Aortic Intervention and Vasculitis)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E352

IR **VA**

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

SSJ25-01 Dual Contrast Agent Based Spectral Photon-Counting Computed Tomography for Detection of Endoleaks Following EVAR: A Phantom Study

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E352

Participants

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PURPOSE

After endovascular aortic repair (EVAR) discrimination of leaking contrast media and calcifications of similar attenuation within the aneurysm sac is challenging and often requires multiple CT acquisitions. Dual contrast agent based spectral photon-counting CT (SPCCT) may provide reliable detection of endoleaks with a single CT acquisition.

METHOD AND MATERIALS

To experimentally evaluate the potential of SPCCT, an aortic phantom was in-house designed and produced. A centrally located stent lined compartment was filled with water as well as with iodine and gadolinium mimicking contrast-enhanced blood within the aortic lumen. To represent the endoleak, the adjacent compartments contained either one of the contrast agents or calcium chloride to mimic calcifications. After data acquisition with a small field-of-view spectral photon-counting computed tomography prototype scanner with multi-energy bins, material decomposition was performed to generate iodine, gadolinium and calcium maps.

RESULTS

In a conventional CT slice, Hounsfield Units of the different compartments were similar ranging from about 145 HU up to 170 HU. Material specific maps clearly differentiate the distributions within the compartments filled with iodine, gadolinium or calcium.

CONCLUSION

A single dual contrast agent based spectral photon-counting CT scan may replace conventional CT scans in native, arterial and delayed phase to detect endoleaks of different flow rates without interference from existing calcifications after endovascular aortic repair. It is a unique feature of the dual contrast spectral photon-counting CT scan to capture different endoleak dynamics in a single scan. Additionally, a significant reduction of radiation exposure is enabled.

CLINICAL RELEVANCE/APPLICATION

Dual contrast SPCCT with material decomposition offers extended endoleak diagnostics by a single acquisition.

SSJ25-02 Long-Term Result of Thoracic Endovascular Aortic Repair for Retrograde Type A Aortic Dissection

Participants

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PURPOSE

To report the long-term result of thoracic endovascular aortic repair (TEVAR) for retrograde type A aortic dissection with the entry tear in the descending aorta.

METHOD AND MATERIALS

Medical records of thirty-one patients who underwent TEVAR for the treatment of retrograde type A aortic dissection at four institutions were retrospectively reviewed.

RESULTS

There were 30 men and one women. The mean age was 64 ± 11 years old. The entry tear was located in the descending thoracic aorta in all patients. The false lumen of the ascending thoracic aorta was patent in 12 patients (40%), while it was thrombosed in the remaining 19 patients (60%). The false lumen of the descending thoracic aorta was patent in 17(55%) patients and most of it was thrombosed in the other 14 patients (45%). TEVAR was performed in acute phase in 24 patients (77%) and in subacute phase in 7 patients (23%). Only one patient died of aortic rupture within 30 days (3%). Early aorta-related adverse events were observed in 7 patients (23%) (type Ia endoleak: 3, type II endoleak: 1, intimal injury: 1, saccular aneurysm formation in the descending aorta: 1, patent false lumen in the ascending aorta: 1) and additional interventions including surgical conversion and additional placement of stent grafts were required in four of them. The mean follow-up period was 97 ± 68 months. Although no aorta-related death was observed, five patients died during follow-up (suicide: 1, trauma: 1, pancreatic cancer: 1, pneumonia: 1, hepatocellular carcinoma: 1). Overall survival rate at 1, 5, and 10 years was 97%, 93%, and 80%, respectively. Late aorta-related adverse events were observed in 7 (27%) patients (intimal injury: 3, newly-developed type A aortic dissection: 3, dissecting abdominal aortic aneurysm: 2, left arm ischemia: 1). Aorta-related event free rate at 1, 5, and 10 years was 61%, 56%, and 56%, respectively.

CONCLUSION

TEVAR for retrograde type A aortic dissection seems promising in terms of survival rate. However, taking into consideration that aorta-related adverse event develops at a non-negligible rate, we should be careful in selecting patients.

CLINICAL RELEVANCE/APPLICATION

TEVAR is an effective treatment option for retrograde type A aortic dissection with entry tear in the descending thoracic aorta.

SSJ25-03 To Assess the Role of FDG PET/CT in Evaluating the Large Vessel Vasculitis and Disease Activity

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E352

Participants

Sikandar M. Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

PURPOSE

To assess the value of PET-CT in the evaluating the disease activity in large vessel vasculitis .

METHOD AND MATERIALS

29 PET/CT scans were performed in 28 pts with large vessel vasculitis (giant cell arteritis, Takayasu arteritis or idiopathic aortitis). PET-CT was done after injecting FDG contrast with and without iv contrast. Vascular uptake was graded using a 4-point scale (0=no uptake, 1=less than liver, 2=similar to liver, 3=higher than liver). Grade 0-1 was negative, 2 was moderately positive and 3 was markedly positive. PET/CT was correlated with clinical indices including ITAS (Indian Takayasu Activity Score) and Kerr/National Institute of Health (Kerr/NIH), serum acute-phase reactants (ESR, C-reactive protein [CRP]) levels as well as interleukin-6 (IL-6) and the soluble IL-6 receptor (sIL-6R).

RESULTS

43% of 29 PET-CT were negative, 31% were moderately positive, and 26% were markedly positive. Further correlation was done with ESR and CRP levels. Significantly higher ESR values were observed in patients with markedly positive PET/CT (49.4 ± 36.5 mm/1st h) compared with moderately positive (27 ± 21 mm/1st h, $p = 0.0001$) and inactive scans (22.7 ± 15.9 mm/1st h, $p = 0.0001$). CRP levels were 0.8 ± 1.0 mg/dL in pts with inactive scans, 1.3 ± 2.2 mg/dL in pts with moderately positive ($p = 0.001$) and 3.0 ± 3.6 in patients with markedly positive scans ($p = 0.0001$). Higher levels of IL-6 resulted in patients with markedly positive scans (10.0 ± 8.9 pg/ml) compared to those with inactive scans (8.1 ± 18.5 pg/ml, $p = 0.013$). We found no association between sIL-6R levels and vascular FDG uptake. There was a significant association between vascular FDG uptake and both ITAS and Kerr/NIH scores.

CONCLUSION

Our evaluation showed significant amount of FDG sensitivity in relation to the metabolic uptake along the vessel walls. In the clinical scenario it was helpful in evaluating borderline cases of Vasculitis where no modality shows significant sensitivity in diagnosing

CLINICAL RELEVANCE/APPLICATION

FDG PET-CT is now proven and established modality for evaluating the large cell vasculitis.

SSJ25-04 Predictors for Blood Pressure Response after Unilateral and Bilateral Stents Placement of Atherosclerotic Renal Artery Stenosis

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E352

Participants

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PURPOSE

To explore the difference of BP response between the unilateral and bilateral stenting, and the potential predictors for BP response.

METHOD AND MATERIALS

Retrospectively collected ARAS patients who underwent PTRAS and pre-stenting renal artery (RA) ultrasonography (US) exams in 5 years at a single institution. Patients with accessory RA and contralateral RA occlusion were excluded. Baseline characteristics, including age, gender, pre-procedure BP, eGFR, and differences of bilateral US parameters (kidney length, PSV, RAR, and RI) were collected. Pre-stenting BPs and anti-hypertension medication were recorded, and were followed up at 1, 3, 6, 12 and 18 months. The BP response was classified into benefit (cure/improvement) or failure based on the guideline (2003), and the occurrence of BP benefit (study endpoint) and the time from stenting to BP benefit (month) were recorded.

RESULTS

Totally 101 ARAS patients underwent stenting were identified. After removing 14 cases with accessory RA, 9 cases with contralateral RA occlusion, 12 cases without qualified data, leaving a cohort of 66 patients, including 43 (age 74.72±10.51 years, male/female 18:25) with unilateral RA stenting, and 23 (Age 69.96±13.34 years, male/female 13:10) with bilateral RA stenting. 74.4% (32/43) of unilateral stenting and 82.6% (19/23) of bilateral stenting were found BP benefit within 6 months after stenting. As in Figure 1, Log rank analysis showed no difference of BP benefit between the two groups (P=0.199). Univariate Cox analysis revealed only the bilateral PSV difference was the predictor for the BP benefit.

CONCLUSION

This study demonstrated, patients underwent unilateral and bilateral stents had similar BP response. The cure/improvement of hypertension most commonly occurred within 6 months after stenting, and higher difference of pre-stenting bilateral PSVs may be its predictor.

CLINICAL RELEVANCE/APPLICATION

The blood pressure (BP) response to unilateral and bilateral percutaneous transluminal renal angioplasty with stent placement (PTRAS) of atherosclerotic renal artery stenosis (ARAS) has not been compared.

SSJ25-05 Experimental Rabbit Study to Evaluate the Effect of Botulinum Toxin Type A Injection Into the Perirenal Arterial Space to Treat Hypertension

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E352

Participants

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PURPOSE

To develop effective renal sympathetic denervation for antihypertensive therapy, we percutaneously injected the perirenal arterial space of rabbits with botulinum toxin A (BTA).

METHOD AND MATERIALS

Our study was approved by the ethical animal laboratory committee and followed the Animal Care Guidelines of our institution. Six Japanese white rabbits (JW) and 6 Watanabe heritable hyperlipidemic rabbits (WHHL), an arterial sclerosis rabbit model, were randomly divided into two groups. Group 1 (JW, WHHL; n=3 each) was injected with 0.32 ml saline and group 2 (JW, WHHL; n=3 each) with 0.32 ml (8 units) of BTA. All injections were percutaneous and into the perivascular space surrounding the bilateral renal arteries using an ultrasound device. Before and one week- and 1-, 2-, 3-, and 4 months thereafter, their systolic blood pressure (SBP) and heart rate (HR) were measured in the right femoral artery. Significant differences (p<0.05) were determined with

Student's t-test.

RESULTS

No rabbits lost appetite or died due to the procedures. At one month post-injection, the SBP of botox-treated animals fell by 23.66 ± 14.77 mmHg; in JW rabbits the difference from the baseline was not- while in WHHL rabbits it was significant ($p < 0.08$ vs $p < 0.05$). At 2 to 4 months post-injection, the SBP decrease between the two groups was not significantly different. There was no significant difference in the HR of both groups during 4 month.

CONCLUSION

While the percutaneous injection of BTA into the perivascular space around the bilateral renal arteries of rabbits may elicit an SBP decrease, its effectiveness duration, dose, and injection site require further study. Additional in vivo studies are needed to determine the antihypertensive effect of BTA percutaneously injected around the perirenal arterial space.

CLINICAL RELEVANCE/APPLICATION

This procedure may result in better antihypertensive therapy and facilitate new interventional radiology procedures.

SSJ25-06 Imaging Abdominal Large Vessel Vasculitis: The Diagnostic Value of T1 3D mVISTA Black Blood MRI

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E352

Awards

Student Travel Stipend Award

Participants

Stefan Maurus, MD, Munich, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the diagnostic performance of a T1-3D black blood TSE (turbo-spin echo) sequence in patients with abdominal large vessel vasculitis (aLVV).

METHOD AND MATERIALS

20 patients diagnosed with aLVV according to the reference standard and 17 controls were enrolled in this single center study and subjected to 3.0 T imaging. The protocol included a pre and post gadoteric acid, free-breathing, peripheral pulse-unit triggered T1 3D modified Volumetric Isotropic TSE Acquisition (T1-mVISTA) sequence and a segmented T1 3D turbo-field-echo sequence (T1-eTHRIVE). Two independent blinded readers evaluated the aorta and its main branches on a per-segment basis for concentric wall thickening (CWT) and concentric contrast enhancement (CCE) as signs of inflammation as well as image quality (IQ), flow artefact intensity (FAI) and diagnostic confidence level (DCL), using 4-point Likert scales. Scoring results were compared between the T1-mVISTA and the T1-eTHRIVE sequence using accuracy parameters and inter-reader agreement. Additionally the mean aortic wall thickness (MAWT) was determined on post contrast T1-mVISTA images and compared between aLVV-patients and controls.

RESULTS

IQ was diagnostic in all 37 examinations. Scan time of the mVISTA sequence was 4:10 min at an average heart rate of 80 bpm. In 91.5% of 282 evaluated vessel segments IQ was rated good to excellent with absent or only minor flow artefacts in 85.4%. Inter-observer reproducibility and DCL for CCE and CWT was excellent (0.92/0.93; $P < 0.001$; $3.54 \pm 0.52 / 3.50 \pm 0.63$). Comparing the T1-mVISTA to the T1-eTHRIVE Sequence showed high correlation for the diagnostic signs of aLVV with a kappa of 0.740 for CCE and 0.702 for CWT ($P < 0.001$). Using T1-eTHRIVE as reference standard resulted in a sensitivity of 87.8%, a specificity of 83.3% and an accuracy of 85.2% of T1-mVISTA with a positive and negative predictive value of 79.6% and 90.2%. There was a significant difference in MAWT of the suprarenal and infernal aorta between aLVV-patients and controls ($3.60 \pm 0.65 / 3.04 \pm 0.85$ mm vs. $2.32 \pm 0.44 / 2.18 \pm 0.44$ mm; $P < 0.001$).

CONCLUSION

Imaging of aLVV with navigated T1-mVISTA black blood MRI is feasible, allows the detection of inflamed vessel segments and provides high IQ as well as high resolution, combined with a relatively short scan time.

CLINICAL RELEVANCE/APPLICATION

T1 3D mVISTA black blood MRI could become a valuable imaging tool for the diagnosis and follow-up of patients with aLVV.

SSJ26

Vascular Interventional (Gastrointestinal/Genitourinary)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S402AB

GI GU IR VA

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

SSJ26-01 Image Guided Cholecystostomy Tube Placement: Short and Long Term Outcomes of Transhepatic versus Transperitoneal Placement

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S402AB

Participants

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PURPOSE

Image guided percutaneous cholecystostomy (PC) may be performed transhepatic (TH) or transperitoneal (TP). The TH approach is traditionally preferred and recommended when possible. We compared the short and long term outcomes of PC related to route of catheter placement.

METHOD AND MATERIALS

IRB approved, HIPAA compliant retrospective review of imaged guided PC was performed from 2004-2016. Search of the hospital RIS was performed using keywords including "percutaneous cholecystostomy" "gallbladder drain" and "cholecystostomy tube" and relevant procedural terminology (CPT) codes. All search results were manually reviewed to identify the cohort of 373 patients who underwent initial episode of PC placement. Radiology reports and images were reviewed to determine method and route of PC. Chart review was performed to determine clinical outcomes. Imaging studies following PC placement were reviewed when necessary to determine catheter course or complications. Differences were examined using a generalized linear model assuming a binary distribution and logit function with SAS/GLIMMIX.

RESULTS

Of the 373 patients, PC placement was performed using US in 229, US access with fluoroscopy in 129, CT in 14, fluoroscopy in 1. Trocar technique was used in 183 and seldinger in 190. 218 PC were placed TH and 153 were TP. The most common PC catheter sizes were 8 French (83), 8.5 French (151), 10 French (124), and 12 Fr (13). There was no significant difference observed between the TH and TP approach for bleeding (1.54% vs 0.91%, $p=0.25$), pain (2.16% vs 1.68%, $p=0.85$) or premature catheter dislodgement (3.15% vs. 2.61%, $p=0.90$). Odds of drain exchange were not different between TH (32%) and TP (24%), $p=0.23$. Odds of subsequent drain replacement were not different between TH (8%) and TP (10%), $p=0.73$. Median length of stay was 7 days for both TH and TP ($p=0.96$). Survival was not different (TH 1.8 years, TP 2.8 years; $p=0.12$).

CONCLUSION

Transperitoneal PC was not associated with increased incidence of bleeding, pain or premature catheter dislodgement. There was no significant difference between TP and TH placement for needing subsequent drain exchange, median hospital stay or survival.

CLINICAL RELEVANCE/APPLICATION

Placement of percutaneous cholecystostomy can be safely performed transhepatically or transperitoneally with similar short and long term outcomes. Choice of route should be based on the patient's anatomy.

SSJ26-02 Predictors of Clinical Outcomes of Self-Expandable Metal Stent Use to Palliate Malignant Esophagorespiratory Fistulas in 105 Patients

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S402AB

Participants

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PURPOSE

to identify the predictors associated with clinical outcomes (initial and late clinical failure) and patient survival after self-expandable metal stent placement for malignant esophagorespiratory fistulas in 105 consecutive patients.

METHOD AND MATERIALS

All included patients were reviewed using logistic and Cox regression analysis.

RESULTS

Technical success was achieved in all patients. The initial clinical success rate was 78.1% (82/105; 95% confidence interval [CI], 69.3%-84.9%), and clinical success was maintained until the end of the follow-up in 47.6% (50/105; 95% CI, 38.3%-57.1%) of patients. The major complication rate was 26.7% (28/105; 95% CI, 19.1%-35.8%). A stricture length of 5-10 cm (odds ratio [OR] 0.335; 95% CI, 0.122-0.889) and stenting only in the airway (OR, 12.445; 95% CI, 1.086-284.863) were independent predictors of initial clinical failure, and stricture at the upper esophagus (OR, 3.722; 95% CI, 1.276-11.544) was an independent predictor of late clinical failure. The independent predictors of survival were fistulas opening to the pleura (hazard ratio [HR], 3.313; 95% CI, 1.142-9.605) and initial clinical failure (HR, 2.510; 95% CI, 1.490-4.228).

CONCLUSION

Self-expandable metal stent placement is safe and effective for treating malignant esophagorespiratory fistulas.

CLINICAL RELEVANCE/APPLICATION

A stricture length of 5-10 cm, stenting only in the airway, and the stricture at the upper esophagus are independent predictors of treatment failure, whereas a fistulas opening to the pleura and initial clinical failures are independent predictors of shorter survival.

SSJ26-04 Recurrent Benign Urethral Strictures Treated with Covered Retrievable Self-Expandable Metallic Stents: Long-term Outcomes over an 18-year Period

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S402AB

Participants

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PURPOSE

To assess the long-term outcomes of covered retrievable self-expandable metallic stent (REMS) placement for recurrent benign urethral stricture and to compare the outcomes of three types of covered REMS.

METHOD AND MATERIALS

November 1998 to December 2016, 114 REMSs were placed in 54 men. These included 26 polyurethane (PU)-covered REMSs in 13 patients (Group A), 47 internally polytetrafluoroethylene (PTFE)-covered REMSs in 21 patients (Group B), and 41 externally PTFE-covered REMSs in 20 patients (Group C). The outcomes were analyzed and compared between the groups.

RESULTS

Overall clinical success was achieved in 14 (24%) of the 54 patients at the 5-year follow-up (Group A, 12%; Group B, 19%; Group C, 40%). The overall complication rate was 60.5%, and complication rates were significantly different between the groups ($p = 0.004$). The median maintained patency period was 108 months. In multivariate analysis, stent indwelling time was the only significant factor associated with maintained patency.

CONCLUSION

The long-term outcome of covered REMSs has not achieved the desired success rate for the standard treatment of recurrent bulbar urethral stricture. However, externally PTFE-covered REMS showed a better long-term outcome than the other studied types.

CLINICAL RELEVANCE/APPLICATION

Externally PTFE-covered REMS has low complication rate and long stent patency. Externally PTFE-covered REMS showed no tissue ingrowth and low stent migration rate. Longer stent indwelling time contributes to a high clinical success rate. Long-term outcome of covered REMSs has not achieved the desired success rate.

SSJ26-05 EW-7197-Eluting Nanofiber-covered Self-expandable Metallic Stent to Prevent Granulation Tissue

Formation in a Canine Urethral Model

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S402AB

Participants

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PURPOSE

To evaluate an EW-7197-eluting nanofiber-covered stent (NFCS) for suppressing granulation tissue formation after stent placement in a canine urethral model.

METHOD AND MATERIALS

All experiments were approved by the committee of animal research. A total of 12 NFCSs were placed in the proximal and distal urethras of six dogs. Dogs were divided into two groups with 3 dogs each. The control stent (CS) group received NFCSs and the drug stent (DS) group received EW-7197 (1000 µg)-eluting NFCSs. All dogs were sacrificed 8 weeks after stent placement. Histologic findings of the stented urethra were compared using the Mann-Whitney U test.

RESULTS

Stent placement was technically successful in all dogs without procedure-related complications. On urethrographic analysis, the mean luminal diameter was significantly larger in the DS group than in the CS group at 4 and 8 weeks after stent placement (all $p < 0.001$). On histological examination, mean thicknesses of the papillary projection, thickness of submucosal fibrosis, number of epithelial layers, and degree of collagen deposition were significantly lower in the DS group than in the CS group (all $p < 0.001$), whereas the mean degree of inflammatory cell infiltration was not significantly different ($p > 0.05$). The in vitro release study demonstrated that approximately 80% of the drug was eluted from the stents within 1 day after which the elution rate slowed and reached a plateau after 10 days.

CONCLUSION

The EW-7197-eluting NFCS is effective and safe for suppressing granulation tissue formation after stent placement in a canine urethral model.

CLINICAL RELEVANCE/APPLICATION

The direct and local therapy with EW-7197 via a covered stent is effective and safe for suppressing granulation tissue formation after stent placement in a canine urethral model.

SSJ26-06 Outcomes of Percutaneous Cholecystostomy Tube Placement in 419 Patients: A Single Institute Experience

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S402AB

Participants

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PURPOSE

To determine proportion of patients who undergo definitive treatment of acute cholecystitis (AC), either surgical cholecystectomy or percutaneous cholecystolithotomy, following percutaneous cholecystostomy (PC).

METHOD AND MATERIALS

Retrospective study was performed with institutional review board approval, and the requirement to obtain informed consent was waived. 419 patients that underwent PC at our institution between July 2010 and September 2016 were included. Patients who underwent PC for indication other than AC were excluded from analysis. Primary outcome was definitive treatment of AC following PC, including cholecystectomy or percutaneous cholecystolithotomy. Secondary outcomes include removal of drainage catheter without further management or death with catheter in place.

RESULTS

During the study period, 377 of 419 patients underwent PC for treatment of AC (mean age, 64.5 years; range 18-100 years). Diagnosis of AC was made via sonography (51%), computed tomography (29%), or hepatobiliary scan (20%). Technical success rate of PC at our institution was 100% with few complications (major 2.4%, minor 1.6%). Following PC, 118 patients (31%) underwent definitive treatment with cholecystectomy. Sixty-one patients (16%) underwent definitive treatment with percutaneous cholecystolithotomy with removal of catheters. Seventy-four patients (20%) had their catheters removed upon resolution of cholecystitis without undergoing surgery or stone removal. Definitive treatment differed between calculous and acalculous cholecystitis groups with the former undergoing further intervention more frequently, while the acalculous group were more likely to have their drain removed without further treatment ($p < 0.001$). Fifty patients (13%) died with catheters in place due to other comorbidities. Five patients (1%) still had their catheters in place at the end of the study period.

CONCLUSION

About half of patients with AC that had PC underwent subsequent treatment with surgery or percutaneous cholecystolithotomy. Percutaneous cholecystostomy remains a viable option for treatment of AC with low complication rate, and can be used as bridge to definitive therapy or as sole treatment for alleviation of symptoms associated with AC.

CLINICAL RELEVANCE/APPLICATION

PC can be used for early management of AC when plan for definitive treatment is unclear. The procedure is safe, has low complication rate, and prevents progression to sepsis in patients with AC.

MSAS34

Better Together: Improving Outcomes with Family Centered Care Practices (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, Nov. 28 3:30PM - 5:00PM Room: S105AB

PR

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

Participants

Catherine Gunn, RT, Halifax, NS (*Moderator*) Nothing to Disclose
JoAnn Balderos-Mason, PhD, RT, South Holland, IL (*Moderator*) Nothing to Disclose

Sub-Events

MSAS34A Parent Partnerships in the NICU

Participants

Catherine Gunn, RT, Halifax, NS (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role that both parents and imaging technologists have in the NICU environment. 2) Apply the concepts of patient and family centered care in the neonatal intensive care unit. 3) Increase understanding of how patient and family centered care practices contribute to improved outcomes.

ABSTRACT

The neonatal intensive care unit is a stressful environment for both parents and imaging technologists. Patient and family centered care concepts place emphasis on mutually beneficial partnerships between patients, families and health care professionals. Working in partnership with patients and parents by sharing information and allowing them to participate in the decision making process reduces uncertainty and fear, which are predominant factors in distress. This results in an increase in quality and safety, as well as increased satisfaction for both the family and the health care team. Using common imaging exams and interventions as examples, the importance of family involvement from the perspectives of both the technologist and the parent will be explored.

MSAS34B Coping Strategies in a Patient Centered Care Environment

Participants

JoAnn Balderos-Mason, PhD, RT, South Holland, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

joann.balderos.mason@gmail.com

LEARNING OBJECTIVES

1) Participants will acquire knowledge about Patient-Centered Care (PCC) in radiology. 2) The definition of PCC will be discussed. 3) Statistical information about PCC in the hospital environment will be discussed. 4) Effective patient care strategies will be reviewed that can be utilized in a PCC environment. 5) The benefits of practicing PCC will be discussed. 6) Gain knowledge about PCC models that are useful in the healthcare environment. 7) The participants will be able to recognize and appreciate their role in taking care of patients in a patient centered care environment. 8) The participants will learn how to handle some of the emotional, social, and psychological issues of the patient in 60 seconds so that the examination can be completed successfully. 9) The participants will learn about the importance of demonstrating kindness, courtesy and respect with the patients in medical imaging.

ABSTRACT

In Medical Imaging departments, the Imaging Technologist has about 60 seconds to gain the trust and respect of the patient. Respect and trust are essential elements in complacency. In order to complete some of the complicated imaging examinations that are performed in medical imaging, complacency on the part of the patient is the key element in completing a diagnostic examination. Respect and trust leads the patient to believe that the Imaging Technologist is competent to perform their imaging examination. Imaging Technologist must display confidence in performing the examinations. Confidence can be demonstrated by taking pride in our work product and display good work ethic with the patient. The purpose of this presentation is to present some coping strategies in a patient centered care environment. Strategies such as education, exercise, breathing and prayer will be discussed.

MSAS34C Coping Strategies for Imaging Technologists

Participants

Elvira V. Lang, MD, Brookline, MA (*Presenter*) Founder and President, Hypnalgescics, LLC;

LEARNING OBJECTIVES

1) Gain better understanding for patient stressors in the radiology department. 2) Access research on the connection between staff resilience, patient outcomes, and operational performance. 3) Consider rapport strategies to diffuse tension. 4) Learn at least one technique for immediate use in practice.

ABSTRACT

The moods of patients and staff are closely interrelated. Imaging technologists are often at the forefront of the medical encounter when uncertainty of diagnosis represents a special stressor for the patient. At a time when a patient is at most need of human support staff is increasingly hurried to produce faster and more efficient throughput. Fortunately it is possible to help patients help themselves quickly to call upon their own coping strategies and thereby experience greater job satisfaction for the Imaging Technologists. After all a happy patient = a happy technologist and vice versa. The basis for the techniques we now call Comfort Talk was laid in interventional radiology and breast imaging. They consist of rapid rapport, guidance of the patient in self-hypnotic relaxation, and reframing of distressing thoughts. In these areas, they reduced pain, anxiety, drug use, complications, and procedure time by avoiding unhelpful behaviors. In recent large-scale clinical trials in MRI, staff training in Comfort Talk resulted in reductions of noncompletions, no-shows, disruptive motion, need for extra time, and need for oral drugs while improving patient satisfaction. Some of the techniques can be executed with just a few sentences or applied by script. Pointers will be given to the audience for immediate use in their own practices.

Active Handout:Elvira Valentina Lang

http://abstract.rsna.org/uploads/2017/17000239/Active_MSAS34C.pdf

MSCC34

Case-based Review of Nuclear Medicine: PET/CT Workshop-Immune Response and Lung Cancer on PET/CT (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 28 3:30PM - 5:00PM Room: S406A

BQ CH CT NM

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 1.75

Participants

Katherine A. Zukotynski, MD, Hamilton, ON (*Director*) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Moderator*) Nothing to Disclose

Sub-Events

MSCC34A Lung Cancer

Participants

David M. Naeger, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

david.naeger@ucsf.edu

LEARNING OBJECTIVES

1) Describe the classic PET/CT appearance of various types of lung cancer. 2) Compare the imaging features that are similar between different types of lung cancer.

ABSTRACT

The classic PET/CT appearance of various types of lung cancers will be reviewed. Similarities and differences between different types of lung cancer will be presented in an effort to help attendees interpret thoracic imaging with more confidence and be more helpful in interdisciplinary settings.

MSCC34B Immune Response/Melanoma

Participants

Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rathan.subramaniam@utsouthwestern.edu

LEARNING OBJECTIVES

1) To review the basics of immune modulation therapies. 2) To review the immune therapy response methods using PET/CT. 3) To review complications of immune modulation therapies.

MSES34

Essentials of Breast Imaging

Tuesday, Nov. 28 3:30PM - 5:00PM Room: S100AB

BR

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

Sub-Events

MSES34A Multimodality High-Risk Screening

Participants

Ulrich Bick, MD, Berlin, Germany (*Presenter*) License agreement, Hologic, Inc; Royalties, Hologic, Inc

For information about this presentation, contact:

Ulrich.Bick@charite.de

LEARNING OBJECTIVES

1) Appreciate the differences in screening strategies between normal and high-risk patients. 2) Understand the strengths and weaknesses of the different breast imaging modalities for screening. 3) Describe differences in the frequency and imaging presentation of breast cancers found in patients with or without BRCA1/2 mutation.

ABSTRACT

In high-risk women such as BRCA1 or BRCA2 mutation carriers, breast cancer not only occurs much more frequently, but also at a considerably younger age than in the general population. Contrast-enhanced breast MRI with its high sensitivity independent of breast density is therefore the cornerstone of any high-risk screening program involving young premenopausal women. Depending on the age and risk constellation of the individual patient, this can be supplemented by mammography and/or tailored second-look ultrasound. By combining all three imaging modalities as necessary, the highest sensitivity and specificity can be achieved. This course will review the strengths and weaknesses of the different breast imaging modalities in the high-risk screening setting and point out differences in breast cancer frequency and morphology depending on the underlying genetic abnormality.

MSES34B Imaging of the Axilla

Participants

Fleur Kilburn-Toppin, MBBChir, MA, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appreciate the clinical role of staging of the axilla using ultrasound. 2) Describe imaging features of normal and abnormal axillary lymph nodes and criteria for ultrasound guided biopsy. 3) Understand the need for discriminating between minimal versus advanced nodal disease.

ABSTRACT

Evaluation of regional lymph node status is important for staging, treatment planning and prognosis in breast cancer patients. Pre-operative axillary ultrasound and biopsy are routinely used to detect nodal metastases, allowing the patient to proceed directly to axillary lymph node dissection. However following recent clinical trials and with improvement in systemic and radiation therapies, the role of staging sonography has been questioned. In this course the current role of axillary staging with ultrasound will be reviewed, with an emphasis on technique to improve axillary lymph node detection. The future of nodal staging and role of the radiologist in the advent of evolving surgical management of the axilla will be considered..

MSES34C An Organized Approach to Interpreting Screening Mammography Exams

Participants

Edward A. Sickles, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe approaches to image interpretation that may increase the cancer detection rate. 2) Describe approaches to image interpretation that may reduce the rate of false positives. 3) Describe approaches to image interpretation that may improve the accuracy of screening mammography.

ABSTRACT

Screening mammography interpretation is challenging principally when imaging findings are at or near the threshold for recall. Clearly abnormal or clearly normal examinations pose little difficulty in interpretation. This course presents several approaches to image interpretation that assist the radiologist in deciding when to recall and when not to recall for challenging cases. Illustrative case material supports and reinforces the teaching provided.

MSES34D Essentials of Image Guided Breast Biopsy

Participants

Christopher E. Comstock, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the various methods and techniques used for image-guided biopsy of the breast, including mammography, Ultrasound and MRI guided biopsy. 2) Apply a lesion based approach to improve accuracy and efficiency of image guided breast biopsies. 3) Understand imaging-histologic concordance and appropriate management of high-risk lesions found on image-guided biopsy.

ABSTRACT

Percutaneous biopsy using imaging guidance has been demonstrated to be a safe, accurate, less deforming, less invasive, and less expensive alternative to surgical biopsy and is the preferred method for sampling nonpalpable breast lesions. This lecture will review the techniques for performing biopsies using stereotactic, ultrasound, and MRI guidance as well potential pitfalls in both performing these procedures as well as management of the pathology obtained from percutaneous biopsy.

RC401

Pulmonary Vascular Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: N227B

CH CT MR VA

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

FDA Discussions may include off-label uses.

For information about this presentation, contact:

jerasmus@mdanderson.org

Sub-Events

RC401A Imaging of Acute Pulmonary Embolism

Participants

Ioannis Vlahos, MRCP, FRCR, London, United Kingdom (*Presenter*) Research Consultant, Siemens AG; Research Consultant, General Electric Company;

For information about this presentation, contact:

johnny.vlahos@stgeorges.nhs.uk

LEARNING OBJECTIVES

1) Overview current imaging strategies and key facts in acute pulmonary embolism imaging. 2) Provide an update on current issues and challenges in acute pulmonary embolism imaging.

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/> Ioannis Vlahos, MRCP, FRCR - 2015 Honored Educator

RC401B Imaging of Chronic Pulmonary Embolism and Pulmonary Hypertension

Participants

Carole J. Dennie, MD, Ottawa, ON (*Presenter*) Speaker, Bayer AG; Spouse, Consultant, Abbott Laboratories

For information about this presentation, contact:

cdennie@toh.ca

LEARNING OBJECTIVES

1) To outline the role of CT and MR imaging in the diagnostic work-up and management of patients with suspected chronic pulmonary embolism and pulmonary hypertension (PH). 2) To list the CT and MRI features of PH. 3) To illustrate diseases that cause PH and have typical imaging findings.

Active Handout: Carole Jeanne Dennie

http://abstract.rsna.org/uploads/2017/17000299/Active_RC401B.pdf

RC401C Imaging of Pulmonary Arteriovenous Malformations

Participants

Kristopher W. Cummings, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Cummings.Kristopher@mayo.edu

LEARNING OBJECTIVES

1) Explain the role MDCT plays in the evaluation of suspected hereditary hemorrhagic telangiectasia. 2) List the most important information provided by MDCT for management of pulmonary arteriovenous malformations.

RC401D Pulmonary MRA: Practical Applications

Participants

Christopher J. Francois, MD, Madison, WI (*Presenter*) Departmental research support, General Electric Company;

For information about this presentation, contact:

cfrancois@umwhealth.org

LEARNING OBJECTIVES

1) Identify roles for magnetic resonance angiography (MRA) in imaging patients with pulmonary artery disease, particularly on the use of MRA in pulmonary embolism. 2) Describe techniques and protocols for robust, clinical pulmonary MRA. 3) Summarize the evidence supporting the use of pulmonary MRA for pulmonary embolism.

ABSTRACT

1. Pulmonary MRA is appropriate for imaging patients suspected of having pulmonary embolism who have contra-indications to CTA, particularly those in whom avoiding iodinated contrast (due to allergy or decreased renal function) or minimizing radiation exposure (younger patients) would be beneficial. 2. Current, commercially available MRA sequences that take advantage of newer parallel imaging techniques help ensure consistent pulmonary MRA in a clinical setting. 3. Following multi-center studies (using older MRA techniques and protocols) in the last decade that indicated that pulmonary MRA may not be accurate enough for routine clinical use, more recent studies suggest that pulmonary MRA is effective in identifying clinically significant pulmonary embolism.

Active Handout: Christopher Jean-Pierre Francois

[http://abstract.rsna.org/uploads/2017/17000303/Active RC401D.pdf](http://abstract.rsna.org/uploads/2017/17000303/Active_RC401D.pdf)

RC402

What's New from the Radiology Residency Review Committee

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E260

ED

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 0

Participants

Felicia Davis, Chicago, IL (*Presenter*) Nothing to Disclose

James C. Anderson, MD, Portland, OR (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To provide updates from the Review Committee for Diagnostic Radiology. 2) To provide updates from ACGME. 3) To provide updates on ACGME's Next Accreditation System.

RC403

Coronary CTA and Calcium Scoring

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E353B

CA CT

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

FDA Discussions may include off-label uses.

Participants

Phillip M. Young, MD, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

RC403A FFR CT - A Sine Qua Non? Critical Review of the Evidence

Participants

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

For information about this presentation, contact:

ewilliamson@mayo.edu

LEARNING OBJECTIVES

1. Discuss the current evidence for using CT-based fractional flow reserve 2. Describe a potential role for FFR_{CT} in clinical practice

RC403B Interpreting and Reporting Cardiac CT - CAD-Rads

Participants

Christopher Maroules, MD, Portsmouth, VA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

christopher.maroules@gmail.com

LEARNING OBJECTIVES

1. To review the Coronary Artery Disease Reporting and Data System (CAD-RADS) lexicon for coronary CT angiography and its potential to improve quality in cardiac imaging. 2. To understand proper coding of CAD-RADS assessment categories and modifiers using sample coronary CT angiography cases.

RC403C Added Value of Myocardial Perfusion Imaging in Cardiac CT

Participants

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

LEARNING OBJECTIVES

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

RC403D Cardiac CT in Acute Chest Pain: Critical Review of the Evidence

Participants

Marc Dewey, MD, Berlin, Germany (*Presenter*) Research Grant, General Electric Company; Research Grant, Bracco Group; Research Grant, Guerbet SA; Research Grant, Toshiba Medical Systems Corporation; Speakers Bureau, Toshiba Medical Systems Corporation; Speakers Bureau, Guerbet SA; Speakers Bureau, Bayer AG; Consultant, Guerbet SA; Author, Springer Science+Business Media Deutschland GmbH; Editor, Springer Science+Business Media Deutschland GmbH; Institutional research agreement, Siemens AG; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Toshiba Medical Systems Corporation; ; ; ; ; ; ;

For information about this presentation, contact:

dewey@charite.de

LEARNING OBJECTIVES

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

ABSTRACT

Several clinical trials and smaller studies looked at the advantages and disadvantages of using CT in patients with acute chest pain.

This practical talk about the pivotal facts from these clinical studies will provide the information required for informed decision making with referring physicians.

RC404

Ligamentous Injuries of the Knee: Mechanistic Approach with Emphasis on MR Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E450A

MR MK

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

Participants

Donald L. Resnick, MD, Del Mar, CA (*Director*) Nothing to Disclose
Donald L. Resnick, MD, Del Mar, CA (*Presenter*) Nothing to Disclose
Tetyana A. Gorbachova, MD, Huntingdon VY, PA (*Presenter*) Nothing to Disclose
Robert D. Boutin, MD, Davis, CA (*Presenter*) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

GorbachT@einstein.edu

LEARNING OBJECTIVES

1) To delineate the MR imaging features typical of a variety of ligamentous injuries of the knee. 2) To illustrate how MR imaging findings, including those related to abnormalities in the subchondral bone of the femur, tibia, and/or patella, provide critical clues to the specific mechanism involved in these ligamentous injuries. 3) To define the characteristic MR imaging features associated with translational, angular, and rotational mechanisms that lead to injury of the anterior and posterior cruciate ligaments and the medial and lateral supporting structures of the knee.

ABSTRACT

This course will emphasize a mechanistic approach to ligamentous injuries of the knee, emphasizing MR imaging. Individual speakers will use this approach in their discussions of such injuries with attention focused on the anterior cruciate and posterior cruciate ligaments and the medial and lateral supporting structures. The importance of the distribution and pattern of bone injury, especially that in the subchondral region of the femur, tibia, and/or patella, will be illustrated with analysis of hyperextension, hyperflexion, and translational, angular, and rotational injuries, among others.

RC405

Traumatic Brain Injury

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E351



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

Participants

Roland R. Lee, MD, San Diego, CA (*Moderator*) Research Grant, General Electric Company

LEARNING OBJECTIVES

1) Discuss impact exposure in youth and high school football. 2) Recognize the imaging correlates of head impact exposure. 3) Identify how risks can be reduced. 4) Be able to identify the important findings of acute head trauma on non-contrast CT. 5) Know what the indications are for MRI in the setting of head trauma. 6) Be able to describe new techniques in imaging of concussion. 7) Identify unique characteristics of military TBI compared to civilian TBI. 8) Understand advanced imaging MRI techniques application to military TBI. 9) Recognize the potential uses and limitations of these techniques for chronic mild TBI in the US military.

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

RC405A Imaging and Subconcussive Impacts in Youth Sports

Participants

Joseph A. Maldjian, MD, Dallas, TX (*Presenter*) Consultant, BioClinica, Inc; Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Discuss impact exposure in youth and high school football. 2) Recognize the imaging correlates of head impact exposure. 3) Identify how risks can be reduced.

RC405B 'Don't Miss' Lesions in Traumatic Brain Injury

Participants

Yvonne W. Lui, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

yvonne.lui@nyumc.org

LEARNING OBJECTIVES

1) Be able to identify the important findings of acute head trauma on non-contrast CT. 2) Know what the indications are for MRI in the setting of head trauma. 3) Be able to describe new techniques in imaging of concussion.

RC405C Neuroimaging of Military TBI

Participants

Gerard Riedy, MD, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify unique characteristics of military TBI compared to civilian TBI. 2) Understand advanced imaging MRI techniques application to military TBI. 3) Recognize the potential uses and limitations of these techniques for chronic mild TBI in the US military.

RC406

The Head & Neck Spaces: Anatomy & Pathology

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E451B

HN NR

AMA PRA Category 1 Credits TM: 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

RC406A Parotid and Parapharyngeal Spaces

Participants

Ilona M. Schmalfuss, MD, Gainesville, FL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

schmai@radiology.ufl.edu

LEARNING OBJECTIVES

1) Describe the boundaries and contents of the parotid and parapharyngeal spaces. 2) Identify the origin of a lesion based on growth pattern and/or displacement of fat planes.

RC406B Masticator Space

Participants

Daniel E. Meltzer, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Become more familiar with the anatomy of the masticator space, especially with regard to its neighboring compartments in the face and neck. 2) Develop ability to generate a concise and relevant differential diagnosis for lesions in the masticator space. 3) Deepen understanding of the patterns of spread of disease from the masticator space to its neighboring compartments in the face and neck (and vice versa). 4) Understand the importance of the mandibular nerve as a potential conduit for perineural spread of tumor to and from the masticator space.

RC406C Carotid Space

Participants

Rebecca S. Cornelius, MD, Cincinnati, OH (*Presenter*) Stockholder, Gilead Sciences, Inc; Stockholder, HCP, Inc; Stockholder, CVS Health Corporation; Stockholder, 3M Company ; Spouse, Stockholder, Gilead Sciences, Inc; Spouse, Stockholder, HCP, Inc; Spouse, Stockholder, CVS Health Corporation; Spouse, Stockholder, 3M Company; Spouse, Stockholder, Celgene Corporation; Spouse, Stockholder, E. I. du Pont de Nemours & Company

For information about this presentation, contact:

cornelrs@ucmail.uc.edu

LEARNING OBJECTIVES

1) Identify the anatomic structures located in the carotid space. 2) Differentiate pathologic processes that occur within the carotid space.

ABSTRACT

The carotid space extends from the skull base to the aortic arch and is surrounded by the carotid sheath, which is composed of all 3 layers of the deep cervical fascia. The suprahyoid carotid space contains the internal carotid artery, the internal jugular vein and cranial nerves IX through XII while the infrahyoid carotid space contains the common carotid artery, internal jugular vein and cranial nerve X. Pathologic processes in the carotid space include vascular abnormalities, neoplasms and infectious/ inflammatory processes. The most common benign neoplasms are paragangliomas and schwannomas. When malignant neoplasm involves the carotid space it occurs either from direct extension of primary tumor from an adjacent space or from extranodal extension from nodal metastasis. Vascular pathology can be arterial or venous. The differential diagnosis of carotid space pathology is limited, based on the limited anatomic contents of this space.

Active Handout: Rebecca Sue Cornelius

http://abstract.rsna.org/uploads/2017/17000300/Active_RC406C.pdf

RC406D Visceral Space

Participants

Kristine M. Mosier, DMD, PhD, Indianapolis, IN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To be familiar with the anatomical components of the visceral space. 2) To be familiar with common pathology involving the visceral space. 3) To be familiar with the differential diagnoses for common lesions of the visceral space.

RC406E Retropharyngeal and Danger Spaces

Participants

Keivan Shifteh, MD, Brooklyn, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kshifteh@montefiore.org

LEARNING OBJECTIVES

1) Retropharyngeal and danger space: Normal anatomy. 2) The normal contents of the suprahyoid and infrahyoid RPS: Fasciae and terminology, including Alar fascia. 3) Anatomic variants: Retropharyngeal and danger space pathology. 4) RPS and DS: Differential Diagnosis.

Active Handout: Keivan Shifteh

[http://abstract.rsna.org/uploads/2017/17000304/Active RC406E.pdf](http://abstract.rsna.org/uploads/2017/17000304/Active_RC406E.pdf)

RC407

Controversies in Intravenous Contrast Media 2017: Getting Your Questions Answered

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S406B

GU **SQ**

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

FDA Discussions may include off-label uses.

Participants

Richard H. Cohan, MD, Ann Arbor, MI (*Coordinator*) Nothing to Disclose

Richard H. Cohan, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Matthew S. Davenport, MD, Cincinnati, OH (*Presenter*) Royalties, Wolters Kluwer nv; ;

Robert J. McDonald, MD, PhD, Rochester, MN (*Presenter*) Consultant, General Electric Company; Investigator, General Electric Company

Alexander Radbruch, MD, Heidelberg, Germany (*Presenter*) Consultant, Guerbet SA; Consultant, Bayer AG; Support, Guerbet SA; Support, Bayer AG; Advisory Board, Guerbet SA; Advisory Board, Bayer AG; Advisory Board, Bracco Group; Advisory Board, AbbVie Inc; Speaker, Guerbet SA; Speaker, Bayer AG; Speaker, Siemens AG; Speaker, prIME Oncology; Advisory Board, General Electric Company; ;

Jay K. Pahade, MD, New Haven, CT (*Presenter*) Consultant, Precision Imaging Metrics, LLC

For information about this presentation, contact:

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matdaven@med.umich.edu

LEARNING OBJECTIVES

1) To review current management recommendations regarding contrast material administration, including a) what to do in patients who have had allergic-like reactions and who require reinjection, b) current thoughts concerning the risks of contrast induced nephrotoxicity, c) the most recent observations of long-term gadolinium retention in the body, and d) how to minimize the likelihood of errors in management of contrast reactions, particularly with respect to administration of epinephrine.

ABSTRACT

Premedication: Is it worthwhile? (Matthew Davenport - University of Michigan) Objectives: During this talk, the attendee will learn the common indications for premedication and premedication regimens; the degree to which premedication reduces the incidence of subsequent reactions, the likelihood of breakthrough reactions, and the costs of premedication. CIN: Does it exist? If not, why are we trying so hard to prevent it (Robert McDonald - Mayo Clinic) Objectives: During this talk, the literature calling into question the existence of CIN will be reviewed and the necessity of prophylaxis in patients who are more likely to develop acute kidney injury will be discussed. Gadolinium Deposition in the Brain: What does this mean and what should we do about it ? (Alexander Radbruch - German Cancer Research Center, Heidelberg, Germany). Objectives: During this talk, the recent literature demonstrating gadolinium retention in the body, including the brain will be reviewed. The potential clinical implications of such retention will be discussed, along with a description of future research that needs to be performed in this area. Treating Contrast Reactions: How can we minimize errors? (Jay Pahade - Yale University) Objectives: During this talk, the indications for epinephrine administration, appropriate dose and route of epinephrine administration; common treatment errors that are made and common problems with current treatment training will be discussed. Possible solutions for reducing treatment errors will be discussed.

RC408

Emergency Neuroradiology (An Interactive Session)

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E451A



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

FDA Discussions may include off-label uses.

Participants

A. Orlando Ortiz, MD, MBA, Mineola, NY (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

oortiz@winthrop.org

LEARNING OBJECTIVES

1) To introduce common spine interventions that are performed for the evaluation of neck and back pain. 2) To learn the indications for these procedures. 3) To understand the role of imaging in patient selection.

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

RC408A Cervical Spine Trauma

Participants

Wayne S. Kubal, MD, Tucson, AZ (*Presenter*) Author, Reed Elsevier; Editor, Reed Elsevier

LEARNING OBJECTIVES

1) Understand the concept of stability as described by the "three column model". 2) Identify various cervical spine injuries on CT and MR and discuss their level of stability. 3) Appreciate the advantages of obtaining MR.

RC408B Compressive Myelopathy

Participants

A. Orlando Ortiz, MD, MBA, Mineola, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

oortiz@winthrop.org

LEARNING OBJECTIVES

1) To review the clinical presentation of patients with myelopathy. 2) To distinguish between acute and subacute clinical presentations. 3) To understand the role of imaging in patients presenting with clinical myelopathy.

RC408C Stroke Imaging: Pathway to IA Therapy

Participants

Gregg H. Zoarski, MD, Newark, DE (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Optimize recommendations for imaging algorithms in patients presenting with acute stroke. 2) Identify imaging findings that characterize patients who are likely to benefit from stroke intervention. 3) Determine if a patient is a candidate for intraarterial stroke treatment based upon imaging findings.

RC409

Imaging of the Colorectum

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E350

CT **GI** **MR**

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

LEARNING OBJECTIVES

1) Differentiate between and choose options for patient bowel catharsis. 2) Learn about the value of and options for fecal and fluid tagging. 3) Optimize bowel distension. 4) Select the proper CT scan technique and parameters. 5) Optimize radiation dose, keeping it ALARA (as low as reasonably achievable). 6) Have new ideas on increasing referrals appropriately for CT colonography. 7) Have increased knowledge on workflow optimization tasks for an improved CT Colonography program. 8) Review Clinical Background relevant to preoperative MRI of rectal cancer. 9) Demonstrate key MRI technique and anatomy critical for preoperative staging. 10) Discuss use of structured reporting and highlight salient points to be included in MRI report. 11) Review Clinical Anatomy relevant to MRI of anorectal fistulas. 12) Demonstrate key MRI technique and anatomy critical for detecting and classifying anorectal fistulas. 13) Discuss use of standardized reporting and highlight salient points to be included in MRI report.

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

RC409A CT Colonography: Practical Tips

Participants

Kevin J. Chang, MD, Sharon, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Kevin.J.Chang@gmail.com

LEARNING OBJECTIVES

1) Differentiate between and choose options for patient bowel catharsis. 2) Learn about the value of and options for fecal and fluid tagging. 3) Optimize bowel distension. 4) Select the proper CT scan technique and parameters. 5) Optimize radiation dose, keeping it ALARA (as low as reasonably achievable).

RC409B Improving Your CT Colonography Workflow

Participants

Cecelia Brewington, MD, Dallas, TX (*Presenter*) Research Grant, Toshiba Medical Systems Corporation

For information about this presentation, contact:

cecilia.brewington@utsouthwestern.edu

LEARNING OBJECTIVES

1) Have new ideas on increasing referrals appropriately for CT colonography. 2) Be more familiar with current billing rules for screening and diagnostic CT Colonography. 3) Have increased knowledge on workflow optimization tasks for an improved CT Colonography program.

RC409C Rectal Cancer: Preoperative MRI Staging

Participants

Kartik S. Jhaveri, MD, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review Clinical Background relevant to preoperative MRI of rectal cancer. 2) Demonstrate key MRI technique and anatomy critical for preoperative staging. 3) Discuss use of structured reporting and highlight salient points to be included in MRI report.

RC409D MR Imaging of AnoRectal Fistulas

Participants

Mukesh G. Harisinghani, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review Clinical Anatomy relevant to MRI of anorectal fistulas. 2) Demonstrate key MRI technique and anatomy critical for detecting and classifying anorectal fistulas. 3) Discuss use of standardized reporting and highlight salient points to be included in MRI report.

RC410

Renal Ultrasound, Doppler, and Contrast

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E352

GU **US**

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

FDA Discussions may include off-label uses.

Sub-Events

RC410A Ultrasound Evaluation of Renal Masses and Parenchymal Disease

Participants

Michael D. Beland, MD, Providence, RI (*Presenter*) Research Grant, Toshiba Medical Systems Corporation

LEARNING OBJECTIVES

1) Recognize the imaging features of a variety of etiologies of renal masses and understand the potential overlap between malignancy, non-malignant mass-like lesions and pseudomasses. 2) Recognize the potential limitations of ultrasound in the identification of renal masses and learn to maximize technique. 3) Demonstrate the wide range of appearances of parenchymal diseases on ultrasound and develop an approach to evaluation.

RC410B Renal Doppler: What You Need to Know

Participants

John S. Pellerito, MD, Manhasset, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jpelleri@northwell.edu

LEARNING OBJECTIVES

1) Apply techniques and protocols for the renal Doppler evaluation. 2) Analyze diagnostic criteria for renal artery stenosis and occlusion. 3) Utilize Doppler for the evaluation of renal artery stents. 4) Compare Doppler to other imaging modalities used to evaluate renal vascular disease.

ABSTRACT

In this presentation, we will discuss the many applications of Doppler imaging for the evaluation of renal vessels. Evaluation for renal artery patency and stenosis will be discussed. We will also review the evaluation of renal artery stents. In addition, we will review the signs associated with renal vein thrombosis. There will also be a brief discussion of renal masses, renal injuries including fistula and pseudoaneurysm and renal infarct.

RC410C Contrast Evaluation of Renal Masses

Participants

Dirk-Andre Clevert, MD, Muenchen, Germany (*Presenter*) Speaker, Siemens AG; Speaker, Koninklijke Philips NV; Speaker, Bracco Group; Speaker, Samsung Electronics Co, Ltd;

LEARNING OBJECTIVES

1) Ultrasound visualization of renal lesions using B-mode sonography, contrast enhanced ultrasound and image fusion is explained. This includes the characterization of renal cysts. 2) The Bosniak classification is explained with the five different categories of characterization of renal cysts; a common finding are non-complicated solitary lesions Bosniak type I. 3) The main differential diagnoses are explained with an emphasis on the renal cell carcinoma.

ABSTRACT

Ultrasound is the most used interdisciplinary non-ionizing imaging technique in clinical routine. Therefore, ultrasound has a special value in the diagnosis and monitoring of cystic renal lesions, which can be classified as non-complicated or complicated and by means of occurrence as solitary or multifocal lesions. The Bosniak classification (I-IV) classifies renal cysts in 5 different categories with the help of ultrasound and computed tomography image criteria and is used for decisions of further clinical treatment. Additionally to normal native B-mode sonography, several new methods are in clinical use to improve diagnostic accuracy of unclear cases. Contrast enhanced ultrasound and MRI/CT are able to find and characterize difficult pathologies. In contrast to multislice-CT (MS-CT), ultrasound image fusion is a real-time imaging technique that can be used in combination with other cross-sectional imaging techniques. This course explains the most important pathologies of cystic lesions of the kidney and stresses the different imaging methods of native B-mode sonography and the new techniques of contrast enhanced ultrasound.

RC411

New PET Tracers: Prostate and Neuroendocrine Tumors

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S504CD

NM **OI**

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

FDA Discussions may include off-label uses.

Sub-Events

RC411A Neuroendocrine Tumor Imaging

Participants

Lale Kostakoglu, MD, MPH, New York, NY (*Presenter*) Research Consultant, F. Hoffmann-La Roche Ltd

LEARNING OBJECTIVES

1) Learn indications of Ga-68 DOTA imaging. 2) Learn the management impact of Ga-68 DOTA imaging. 3) Learn the pitfalls of Ga-68 DOTA imaging.

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/> Lale Kostakoglu, MD, MPH - 2012 Honored Educator

RC411B Imaging Prostate Cancer with Fluciclovine: Practical Approach

Participants

David M. Schuster, MD, Decatur, GA (*Presenter*) Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, Blue Earth Diagnostics Ltd; Consultant, WellPoint, Inc; Speaker, Siemens AG; ;

LEARNING OBJECTIVES

1) Describe the mechanism of uptake of the PET radiotracer fluciclovine. 2) Identify normal biodistribution of fluciclovine. 3) Identify the FDA approved clinical indication of fluciclovine. 4) Discuss clinical interpretive criteria of fluciclovine PET.

RC411C Radiopharmaceutical Development with a Look to the Future

Participants

Sally J. Schwarz, MS, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

schwarzsj@wustl.edu

LEARNING OBJECTIVES

1) Discuss the development of neuroendocrine radiopharmaceuticals from In-111 Prostacint, the radiolabeled Mab, to the newly FDA approved Ga-68 NETSPOT. 2) Discuss the development of molecular imaging agents for prostate cancer, including C-11 choline and F-18 fluciclovine. 3) Outline several new agents on the horizon, including the Ga-68 and F-18 PSMA agents and potential therapeutic applications.

RC412

Thoracic Aortic Emergencies (An Interactive Session)

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E353C

VA ER

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

Participants

John P. Lichtenberger III, MD, Bethesda, MD (*Moderator*) Author, Reed Elsevier
Konstantin Nikolaou, MD, Tuebingen, Germany (*Moderator*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG

For information about this presentation, contact:

konstantin.nikolaou@med.uni-tuebingen.de

LEARNING OBJECTIVES

1) Implement and adapt various imaging modalities for imaging of aortic emergencies. 2) Appreciate the potential of advanced imaging in the clinical management of various aortic emergencies. 3) Identify the risk factors for aortic aneurysms and rupture. 4) Differentiate treatment options for patients with aortic emergencies.

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

RC412A The Spectrum of Type A Dissection

Participants

Anne S. Chin, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

annechin00@gmail.com

LEARNING OBJECTIVES

1) Review the pathology, epidemiology, and natural history of acute type A aortic dissection. 2) Describe the imaging strategies for acute aortic syndromes. 3) Review the recent classification of acute aortic dissection. 4) Illustrate imaging findings of the spectrum of acute type A aortic dissection, with a focus on recognizing subtle CT angiographic findings related to the lesser known 'Class 3' aortic limited intimal tear or 'limited dissection.'

ABSTRACT

The traditional Stanford classification distinguishes between dissections involving the ascending aorta (Type A) from those that do not involve the ascending aorta (Type B). Type A aortic dissection is rare, but remains the most lethal of aortic disorders requiring prompt surgical intervention. The common pathologic denominator in patients with acute dissection is an abnormal aortic media ('cystic medial necrosis') which can be found in genetic/inherited diseases (e.g. Marfan's) but also in patients with severe hypertension. The CT imaging strategy of suspected acute aortic syndrome should always include (i) non-enhanced images to assess for intramural hematoma (IMH); when the index of suspicion for aortic dissection is high, also consider (ii) EKG-gating for motion-free evaluation of the aortic root/ascending aorta, and (iii) including common femoral arteries in the CTA scan range to assess lesion extent and identify a percutaneous access route. The spectrum of aortic dissection has recently been classified as the following: Class 1 classic dissection with true and false lumen separated by an intimal flap; Class 2 IMH; Class 3 limited intimal tear or limited dissection; Class 4 penetrating atherosclerotic ulcer (PAU); and Class 5 iatrogenic/traumatic. A clarification and modified conceptual classification of aortic dissection will be provided, along with illustrative examples of these aortic lesions. Particular focus will be given to the lesser known Class 3 'limited dissection' which is described as a subtle and eccentric bulge of the aortic wall. While it has been reported to elude current imaging techniques, emphasis will be made on recognizing subtle CTA imaging findings characteristic of this uncommon but important dissection variant.

RC412B Acute and Chronic Complications of Aortic Dissection

Participants

Dominik Fleischmann, MD, Palo Alto, CA (*Presenter*) Research Grant, Siemens AG;

For information about this presentation, contact:

d.fleischmann@stanford.edu

LEARNING OBJECTIVES

1) Describe the natural history and radiological patterns of early and late complications of Type B aortic dissections. 2) Differentiate the mechanisms of branch ischemia and false lumen dilatation. 3) Assess different treatment strategies for acute and chronic

dissections.

Active Handout: Dominik Fleischmann

http://abstract.rsna.org/uploads/2017/16001691/Active_RC412B.pdf

RC412C Traumatic Aortic Injuries

Participants

Savvas Nicolaou, MD, Vancouver, BC (*Presenter*) Institutional research agreement, Siemens AG

LEARNING OBJECTIVES

1) Discuss the different mechanisms of injuries, pathophysiology, and types of traumatic aortic injuries including aortic dissection, laceration, transection, pseudoaneurysm and intramural hematoma. 2) Review techniques and advances in imaging including DECT/Spectral and ultra-high-pitch imaging to optimize imaging of traumatic aortic injuries and the role of gating, MRI, and TEE. 3) Discuss and demonstrate examples of the grading scheme for traumatic aortic injuries. 4) Demonstrate imaging pitfalls which can cause misinterpretation of traumatic aortic injuries. 5) Review the appropriate management and treatment options, including open surgical repair and percutaneous endovascular repair, for the traumatic aortic injuries.

RC412D Bicuspid Aortic Valve

Participants

John P. Lichtenberger III, MD, Bethesda, MD (*Presenter*) Author, Reed Elsevier

LEARNING OBJECTIVES

1) Describe the current genetic and pathophysiologic understanding of bicuspid aortic valve and associated aortopathy. 2) List the emergent and long-term aortic complications associated with bicuspid aortic valve. 3) Illustrate a comprehensive imaging approach to bicuspid aortic valve evaluation with a focus on necessary data for clinical management and surgical planning. 4) Discuss treatment options for bicuspid aortic valve, emphasizing the imaging appearances of common complications.

ABSTRACT

Bicuspid aortic valve (BAV) is the most common cardiovascular malformation, occurring in 1-2% of the population. Rather than a discrete clinical entity, BAV encompasses a spectrum of fusion abnormalities of the normal trileaflet aortic valve. Similarly, the associated diseases of the aortic valve and aorta have a broad range. The diseased bicuspid valve may be complicated by aortic valve stenosis, regurgitation and endocarditis. The associated aortic diseases include aneurismal dilation of the ascending aorta, dissection and coarctation. Aneurismal dilation of the ascending aorta in patients with BAV is thought to be a consequence of an underlying aortopathy similar to that seen in connective tissue diseases. Understanding of bicuspid aortic valve associated aortopathy has changed the guidelines for intervention on ascending aortic aneurysm based on size. The precise imaging evaluation of BAV requires knowledge of phenotypic variance, associated aortopathy, clinical management, surgical repair and complications.

RC414

Dialysis Interventions

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S403A

IR

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

FDA

Discussions may include off-label uses.

Participants

Charles E. Ray JR, MD, PhD, Chicago, IL (*Moderator*) Editor, Thieme Medical Publishers, Inc; Consultant, W. L. Gore & Associates, Inc; ; ;

James T. Bui, MD, Chicago, IL (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

jtbei@uic.edu

LEARNING OBJECTIVES

1) Learn of updates in dialysis interventions. 2) Apply newer techniques into current practice of dialysis interventions.

ABSTRACT

n/a

Sub-Events

RC414A Surveillance of the Dialysis Circuit

Participants

Paul J. Rochon, MD, Aurora, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

paul.rochon@ucdenver.edu

LEARNING OBJECTIVES

1) To identify methods of surveillance of dialysis fistulas and grafts. 2) To identify advantages and disadvantages of surveillance methods. 3) To discuss future directions of dialysis circuit surveillance.

RC414B Nontraditional Dialysis Access

Participants

James T. Bui, MD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jtbei@uic.edu

LEARNING OBJECTIVES

1) Describe nontraditional HD access options. 2) List when nontraditional HD options are clinically useful. 3) Apply nontraditional HD options to clinical practice.

ABSTRACT

n/a

RC414C Failing Access Circuits—Venous

Participants

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

For information about this presentation, contact:

rgaba@uic.edu

LEARNING OBJECTIVES

1) To recognize the pathologies that contribute to dialysis access failure. 2) To be familiar with standard technical approaches to treating dialysis access failure. 3) To describe the clinical outcome of dialysis access interventions.

RC414D Failing Access Circuits—Arterial

Participants

Charles E. Ray JR, MD, PhD, Chicago, IL (*Presenter*) Editor, Thieme Medical Publishers, Inc; Consultant, W. L. Gore & Associates, Inc; ; ;

For information about this presentation, contact:

chray@uic.edu

LEARNING OBJECTIVES

1) To discuss the common issues that may arise from arterial inflow that may affect the integrity of the dialysis access circuit.

ABSTRACT

n/a

RC415

Biology of Breast Cancer

Tuesday, Nov. 28 4:30PM - 6:00PM Room: N228

BQ **BR**

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

Participants

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

Sub-Events

RC415A Breast Cancer Genomics

Participants

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

For information about this presentation, contact:

cherie_kuzmiak@med.unc.edu

LEARNING OBJECTIVES

1) Understand the molecular classification of breast cancer and comparison with clinical definitions. 2) Describe and discuss the imaging features of each major subtype. 3) Explain the clinical and treatment outcomes that stratify with the different molecular subtypes.

RC415B Imaging as a Biomarker: Luminal Cancers

Participants

Karen S. Johnson, MD, Durham, NC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

karen.johnson2@dm.duke.edu

LEARNING OBJECTIVES

1) State the different molecular subtypes of breast cancer. 2) State the different subtypes of luminal breast cancers. 3) Explain the unique features of luminal breast cancers with respect to clinical presentation and management. 4) Explain the unique features of luminal breast cancers with respect to imaging features.

RC415C Imaging as a Biomarker: Her2 Enriched & Basal Cell Cancers

Participants

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

For information about this presentation, contact:

cherie_kuzmiak@med.unc.edu

LEARNING OBJECTIVES

Included under heading of Breast Cancer Genomics

RC415D Treatment

Participants

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

Karen S. Johnson, MD, Durham, NC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

cherie_kuzmiak@med.unc.edu

karen.johnson2@dm.duke.edu

LEARNING OBJECTIVES

Included under heading of Breast Cancer Genomics.

RC416

Equipment in the Global Radiology Environment: Why We Fail, How We Could Succeed (Sponsored by the Committee on International Radiology Education)

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S104A

OT

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 1.75

Participants

Kristen K. DeStigter, MD, Burlington, VT (*Moderator*) Medical Advisory Board, Koninklijke Philips NV; Luminary, McKesson Corporation; Research collaboration, Koninklijke Philips NV;
Jeffrey B. Mendel, MD, West Newton, MA (*Moderator*) Advisor, McKesson Corporation;
Linda T. Hlabangana, FFRAD(D)SA, MBBCh, Johannesburg, South Africa (*Presenter*) Nothing to Disclose
Omolola M. Atalabi, MBBS, Ibadan, Nigeria (*Presenter*) Nothing to Disclose
Hassen A. Gharbi, MD, PhD, Tunis, Tunisia (*Presenter*) Nothing to Disclose
Christian P. Nolsoe, MD, PhD, Herlev, Denmark (*Presenter*) Nothing to Disclose
Harvey L. Nisenbaum, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Ricardo D. Garcia-Monaco, MD, PhD, Buenos Aires City, Argentina (*Presenter*) Consultant, CeloNova BioSciences, Inc ; Consultant, BTG International Ltd; Consultant, Sirtex Medical Ltd; Grant, BTG International Ltd
Sarwat Hussain, MD, Worcester, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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cnolsoe@cnolsoe.dk

jmendel@pih.org

ricardo.garciamonaco@hospitalitaliano.org.ar

LEARNING OBJECTIVES

1) To exchange ideas on how to get the best from radiological equipment manufacturers / vendors especially in the developing countries.

ABSTRACT

The course will discuss experience with the expanding use of digital equipment in resource-limited countries and includes data gathered from diverse international departments and data from equipment vendors augmented by the personal experience of radiologists active in global health

RC417

Emerging Technologies: Imaging and Management of Pain

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S505AB

MR NM

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

Participants

Sandip Biswal, MD, Stanford, CA (*Moderator*) Stockholder, SiteOne Therapeutics Inc; Scientific Advisory Board, SiteOne Therapeutics Inc; Research Grant, General Electric Company;

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

RC417A Challenges in Pain Diagnosis: A Pain Specialist's Perspective on the Potential of Imaging

Participants

Vivianne Tawfik, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the basics of pain transmission. 2) Understand the current challenges of pain diagnosis. 2) Identify patients suffering from chronic pain in whom specialized imaging studies add diagnostic value. 3) Develop a multidisciplinary team to better evaluate and treat complex pain conditions.

RC417B MR Imaging of Peripheral Nerves in Patients with Pain

Participants

Cynthia T. Chin, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

cynthia.t.chin@ucsf.edu

LEARNING OBJECTIVES

1) Understand the anatomy of the peripheral nerves, brachial and lumbosacral plexus. 2) Know the MRI sequences that best demonstrate normal and abnormal nerve. 3) Understand the variety of diseases that affect the peripheral nervous system. 4) Apply diffusion imaging to evaluate peripheral nerve disease.

Active Handout:Cynthia T. Chin

http://abstract.rsna.org/uploads/2017/16001538/Active_RC417B.pdf

RC417C PET/MRI of Inflammation and Pain Generators

Participants

Sandip Biswal, MD, Stanford, CA (*Presenter*) Stockholder, SiteOne Therapeutics Inc; Scientific Advisory Board, SiteOne Therapeutics Inc; Research Grant, General Electric Company;

LEARNING OBJECTIVES

1) Understand the challenges of current conventional imaging approaches in diagnosing peripheral pain generators. 2) Understand the basis for identifying specific molecular and cellular biomarkers of pain and how these biomarkers can be exploited with molecular and cellular imaging techniques. 3) Demonstrate clinical PET/MR or advanced MRI approaches in identifying pain generators.

ABSTRACT

Chronic pain is now the most prevalent disease in the world. The chronic pain sufferer is currently faced with a lack of objective tools to identify the source of their pain. The goal of this session is to describe new clinical molecular imaging and emerging molecular/cellular imaging methods to more accurately localize chronic pain generators/drivers so that we may objectively identify and more intelligently act upon the cause in a pain sufferer. Successful imaging of pain is relying heavily upon a multidisciplinary effort that include expertise from a number of scientists and clinicians in the fields of synthetic chemistry, radiochemistry, magnetic resonance physics/engineering, molecular pain neurobiology, clinical pain, radiology and others. A number of clinical and emerging pre-clinical approaches in positron emission tomography (PET) and magnetic resonance imaging (MRI) will be described. These imaging methods will demonstrate how the site of increased physiologic or inflammatory activity can potentially be used to more accurately identify and localize pain generators.

RC418

Tumor Imaging Metrics: Is It Time to Invest in a Service?

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S502AB

BQ **OI**

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

Participants

Michelle S. Ginsberg, MD, New York, NY (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

ginsberm@mskcc.org

Sub-Events

RC418A Current Response Assessment Tools in Clinical Trials

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) Understand current RECIST and PERCIST criteria of response to therapy. 2) Introduce additional acceptable criteria such as Choi criteria and bone scan index. 3) Discuss future potential imaging response criteria for human clinical trials.

ABSTRACT

Imaging is playing an increasing role in response criteria in clinical trials, especially in cancer trials. Time to progression is increasingly accepted as an endpoint in studies and imaging plays a major role. Established criteria (RECIST, PERCIST) are expanding to include other more functional parameters (e.g. Choi, bone scan index). Response criteria are in flux both in terms of what is measured and how it is measured as more automation is introduced and regulatory guidance evolves.

RC418B Developing Robust Imaging Biomarkers for Use in Drug Development

Participants

Nina Tunariu, MD, London, United Kingdom (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

nina.tunariu@icr.ac.uk

LEARNING OBJECTIVES

1) To be able to understand and differentiate different types of imaging biomarkers. 2) Achieve an understanding of the use and value of imaging-based biomarkers in the various phases of clinical drug development. 3) Have a better understanding of the barriers and opportunities for using robust quantitative imaging biomarkers in oncological drug development.

RC418C Should Every Radiology Department Invest on a Quantitative Imaging Lab?

Participants

Krishna Juluru, MD, New York, NY (*Presenter*) Advisory Board, Bayer AG; Consultant, General Electric Company

For information about this presentation, contact:

juluruk@mskcc.org

LEARNING OBJECTIVES

1. To review the added value of quantitative imaging in radiology practice 2. To understand the practice settings in which centralized imaging processing could lead to efficiency and quality gains 3. To outline steps needed to establish a quantitative imaging lab

ABSTRACT

Radiology continues its transition from a purely qualitative discipline to one that mixes qualitative and quantitative data. Imaging quantification, in all its varieties, requires expertise in software tools without which quantitative data may be unusable or inaccurate. To achieve accurate, efficient, and scalable imaging quantification, some centers have established dedicated Quantitative Imaging Labs. In this session, we will review the needs and applications of these dedicated labs.

RC420

The Role of Molecular and Functional Imaging in Radiation Oncology

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E263

MI RO

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

FDA Discussions may include off-label uses.

Participants

Feng-Ming Kong, MD, PhD, Augusta, GA (*Moderator*) Research Grant, Varian Medical Systems, Inc Speaker, Varian Medical System, Inc Travel support, Varian Medical System, Inc

Sub-Events

RC420A The Role of Molecular/Functional Imaging for Radiotherapy in Gynecologic Cancer

Participants

Nina A. Mayr, MD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ninamayr@uw.edu

RC420B The Role of Molecular/Functional Imaging for Radiotherapy in Prostate Cancer

Participants

Anca L. Grosu, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

anca.grosu@uniklinik-freiburg.de

LEARNING OBJECTIVES

1) Describe new developments in Molecular/Functional Imaging for initial staging in patients with primary prostate cancer and to address possible implications for radiation treatment planning. 2) Assess the role of PSMA PET/CT for staging in patients with recurrent prostate cancer and to address possible implications for radiation treatment planning.

ABSTRACT

Staging has a crucial role in patients with primary prostate cancer and with recurrent prostate cancer after surgery or operation, since it differentiates between localized and disseminated disease. Furthermore, the concept of a focal dose escalation to imaging-defined intraprostatic lesions, lymph nodes or bone metastases has gained interest, in order to improve local tumor control. This talk will discuss new developments in Molecular/Functional Imaging for prostate cancer patients and the possible implications for radiation treatment planning.

RC420C The Role of Molecular/Functional Imaging for Radiotherapy in Renal Cell Carcinoma

Participants

Shankar Siva, PhD, FRANZCR, Melbourne, Australia (*Presenter*) Travel support, Astellas Group; Research Grant, Varian Medical Systems, Inc; Speaker, Bristol-Myers Squibb Company

LEARNING OBJECTIVES

1) The role of FDG-PET and PSMA-PET scanning in RCC. 2) Evidence for radiotherapy in renal cell carcinoma. 3) Use of PET for response assessment after radiotherapy. 4) Preliminary investigations of multiparametric MRI in primary RCC.

ABSTRACT

Radiotherapy is undergoing a renaissance in renal cell carcinoma coinciding with advances in delivery of high-dose per fraction treatments such as SRS and SBRT. Functional/molecular imaging affords an opportunity to better screen for occult metastatic disease and for improved response assessment after radiotherapy. In this course I will discuss the role of FDG-PET and PSMA PET as functional imaging biomarkers of RCC in the context of radiotherapy. I will also briefly overview the clinical evidence for radiotherapy in renal cell carcinoma and early work into multi-parametric MRI in primary RCC.

RC420D The Role of Molecular/Functional Imaging for Radiotherapy in Esophageal Cancer

Participants

Steven H. Lin, MD, PhD, Houston, TX (*Presenter*) Research Grant, STCube Pharmaceuticals, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Elekta AB; Research Grant, Peregrine Pharmaceuticals, Inc; Research Grant, Hitachi, Ltd; Speaker, AstraZeneca PLC; Speaker, Elekta AB

For information about this presentation, contact:

shlin@mdanderson.org

LEARNING OBJECTIVES

1) Assess the critical role of functional imaging in the diagnosis and treatment of esophageal cancer. 2) Critically appraise the utility of FDG-PET imaging as predictive and prognostic markers in esophageal cancer. 3) Describe the role of novel imaging approaches to help enhance preoperative therapy.

ABSTRACT

Preoperative therapy using chemotherapy or chemoradiation therapy is a current standard of care for the management of esophageal cancer. However, it is difficult to determine responders from nonresponders using clinical parameters, and the use of Imaging as a surrogate for response assessment has become important in esophageal cancer. Some early indications demonstrated FDG-PET, either pretreatment or posttreatment changes, was predictive or prognostic; however, multiple studies have eventually demonstrated its relative lack of accuracy in serving as a predictive surrogate marker for response assessment. Novel approaches will be needed to further improve the accuracy of predicting preoperative therapy response, in order to determine who will need surgery. This session will review the current state of the art approaches and the incorporation of novel imaging for esophageal cancer therapy.

RC421

Advances in CT: Technologies, Applications, Operations-CT Operation

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S103AB

CT PH SQ

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

RC421A Statistical and Iterative Reconstruction and Image Domain Denoising

Participants

Norbert J. Pelc, DSc, Stanford, CA (*Presenter*) 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

LEARNING OBJECTIVES

1) Learn, at a high, intuitive, and non-mathematical level, how statistical and iterative reconstruction methods work. 2) Understand the differences between conventional reconstruction and statistical/iterative methods. 3) Appreciate the benefits and possible drawbacks of advanced processing methods. 4) Be able to anticipate when the new methods may be useful clinically and what image quality differences to expect.

RC421B Protocol Optimization and Management

Participants

Mannudeep K. Kalra, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mkalra@mgh.harvard.edu

LEARNING OBJECTIVES

1) CT protocol optimization begins with justification of clinical indication and proceeds to tailoring of scan parameters according to clinical region of interest, clinical indication, and patient size. Taking a nuanced and stratified approach to protocol stratification helps in the optimization process. 2) CT protocol management is a team effort involving attention to CT image quality and associated radiation doses. Medical physicists, radiologists, and CT technologists have a common responsibility in CT protocol optimization and management.

ABSTRACT

Optimization and management of CT protocols are joint responsibilities of medical physicists, radiologists and CT technologists. Attributes of optimized CT protocols include adaptation of image quality and radiation dose through suitable choice of scan parameters based on body area of interest, clinical indication, presence of prior imaging, patient size, and need for contrast enhancement. In an ideal practice, scan protocols must be divided according to the area of interest, and then clinical indication for which CT has been requested. Management of CT protocols must include frequent audits of image quality and radiation dose monitoring to ensure that good practices are maintained.

RC421C Dose Monitoring and Analytics

Participants

Joshua Wilson, PhD, Durham, NC (*Presenter*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Presenter*) Research Grant, General Electric Company; ; Research Grant, Siemens AG; ; Advisory Board, medInt Holdings, LLC

For information about this presentation, contact:

joshua.wilson@duke.edu

samei@duke.edu

LEARNING OBJECTIVES

1) Describe conventional radiation dose monitoring workflows and analytics. 2) Critique the current shortcomings and future potential value of dose monitoring solutions. 3) Identify opportunities for improving clinical operations and consistency with dose monitoring.

ABSTRACT

Recent legislative and accreditation requirements have driven rapid development and implementation of radiation dose monitoring platforms. Multiple solutions are available that require financial commitment and oversight. How can institutions derive added-value, beyond minimum regulatory requirements, from their monitoring program by improving the quality of their clinical performance? Global alert thresholds, the standard in commercial products, naïve to system model and patient size have limited value. Setting a threshold presupposes a clinically-relevant level is known. For an arbitrary level, appropriately-dosed obese patients triggered false alerts, but over-dosed small patients were missed. Numerous study parameters must be retained because chronologic trends, the industry standard, are rarely useful without controlling for other moderators. Dashboards must be interactive enabling dynamic drill-down into cohorts. Dose databases require curation tools and maintenance, largely absent from all solutions, because wrong information will be inadvertently entered, and the utility of the analytics is entirely dependent on the data quality. Dose monitoring can satisfy requirements with global alert thresholds and patient dose records, but a program's real value is in optimizing patient-specific protocols, balancing image quality trade-offs that dose-reduction strategies promise, and improving the performance and consistency of a clinical operation.

Active Handout: Joshua Wilson

[http://abstract.rsna.org/uploads/2017/16001066/Active RC421C.pdf](http://abstract.rsna.org/uploads/2017/16001066/Active_RC421C.pdf)

RC422

Imaging for Personalized Medicine: Abdomen

Tuesday, Nov. 28 4:30PM - 6:00PM Room: N230B



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

Participants

Kristy K. Brock, PhD, Houston, TX (*Moderator*) License agreement, RaySearch Laboratories AB; ;

For information about this presentation, contact:

kkbrock@mdanderson.org

LEARNING OBJECTIVES

1) Describe the processes necessary for the safe and accurate integration of multi-modality imaging for treatment planning. 2) Understand the role of image guidance for abdominal radiotherapy. 3) Illustrate methods to perform functional and anatomical adaptation in the abdomen.

ABSTRACT

The use of imaging and other biomarkers to increase the efficacy of treatment and decrease the risk of toxicity increased in the abdomen. Functional imaging and serum-based biomarkers can enable a more detailed understanding of the tumor, its characteristics, and early indications of its response to therapy. In addition, they can also be utilized to assess an individual patients risk for toxicity, enabling a personalize approach to radiotherapy. These advanced imaging techniques can be combined with anatomical information to generate high precision treatment plans which can be adapted over the course of treatment to account for identified uncertainties, changes, and deviations which may compromise the delivery of the intended treatment or identify the ability to re-optimize treatment to improve the therapeutic ration. In this session, technical and clinical concepts will be described to design and deliver personalized radiotherapy in the abdomen. Technical concepts will include incorporation of multi-modality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaption. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

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

RC422A Anatomical Imaging for Personalized Medicine in the Abdomen

Participants

Kristy K. Brock, PhD, Houston, TX (*Presenter*) License agreement, RaySearch Laboratories AB; ;

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC422B Functional Imaging for Personalized Medicine in the Abdomen

Participants

Parag Parikh, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC423

Molecular Imaging Mini-Course: Advanced Molecular Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S504AB

MI MR NM PH

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

FDA Discussions may include off-label uses.

Sub-Events

RC423A Novel Tracers

Participants

Timothy R. DeGrado, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the major considerations when developing a novel molecular imaging probe. 2) Compare the strengths and weaknesses of the various imaging modalities with regard to probe development and implementation. 3) Define appropriate experiments for probe validation. 4) Gain an understanding of the process of translation of a probe to clinical practice.

ABSTRACT

Molecular imaging is rapidly advancing as new imaging biomarkers are invented to allow noninvasive assessment of biochemical function. Those who embark on the process of developing novel probes come to know the excitement of imaging biological processes for the first time, but are also well aware of the great effort and many pitfalls that can impede progress. This introductory lecture will provide an overview of the process of molecular imaging probe conception, development, preclinical validation, and translation. Specific examples will be used to illustrate the presenter's experience with meeting these challenges.

RC423B Novel Instrumentation (PET/MR)

Participants

Ciprian Catana, MD, PhD, Charlestown, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Distinguish the technical approaches that have been proposed for integrating PET and MRI for the purpose of simultaneous data acquisition. 2) Evaluate the latest methodological developments in PET/MRI for improving PET data quantification. 3) Incorporate simultaneous PET/MRI techniques into research and clinical projects.

RC423C Molecular Imaging with MR

Participants

Peter D. Caravan, PhD, Charlestown, MA (*Presenter*) Research Grant, Pfizer Inc;

LEARNING OBJECTIVES

1) To describe the strengths and limitations of molecular MR imaging. 2) To list the different classes of molecular MR imaging probes and provide examples of each. 3) To understand the process for clinical translation of a novel molecular imaging probe.

ABSTRACT

Magnetic resonance imaging is considered by some to be too insensitive a technique for molecular imaging. Despite some limitations, molecular MR imaging offers a number of advantages compared to other molecular imaging modalities in terms of temporal and spatial resolution, deep tissue imaging, lack of ionizing radiation, shelf-stable molecular probes, complementary functional and anatomic information, and in some cases, exquisite sensitivity. Here, we will describe with examples the strengths and limitations of molecular MR, different classes of molecular MR probes, and opportunities for clinical translation of promising preclinical data.

RC424

Why Do Radiologists Burn Out, and What Can We Do About It?

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E450B

OT PR

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

Participants

Richard B. Gunderman, MD, PhD, Indianapolis, IN (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

rbgunder@iu.edu

LEARNING OBJECTIVES

1) Identify common causes of burnout. 2) Describe techniques for avoiding burnout. 3) Develop strategies to enhance resilience and thriving.

ABSTRACT

Burnout is becoming an increasingly important problem in medicine, with adverse consequences for patients, health care organizations, and physicians themselves. In this course, we explore the causes of burnout in contemporary radiology practice, strategies for preventing and remedying it when it develops, and steps radiologists can take to enhance their professional resiliency and fulfillment.

Sub-Events

RC424A Causes of Burnout

Participants

Richard B. Gunderman, MD, PhD, Indianapolis, IN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rbgunder@iu.edu

LEARNING OBJECTIVES

1) Describe the causes of burnout. 2) Discuss the respective roles of personal and institutional factors in causing burnout. 3) Outline strategies for better recognizing burnout.

RC424B Strategies for Avoiding Burnout

Participants

Cheri L. Canon, MD, Birmingham, AL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ccanon@uabmc.edu

LEARNING OBJECTIVES

1) List strategies to avoid burnout.

ABSTRACT

Burnout is becoming an increasingly important problem in medicine, with adverse consequences for patients, health care organizations, and physicians themselves. In this course, we explore the causes of burnout in contemporary radiology practice, strategies for preventing and remedying it when it develops, and steps radiologists can take to enhance their professional resiliency and fulfillment.

RC424C Resiliency and Thriving

Participants

David P. Fessell, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

fessell@umich.edu

LEARNING OBJECTIVES

1) Know principles of resiliency and thriving. 2) Develop at least one strategy you will apply to increase your personal resiliency and thriving.

ABSTRACT

Knowledge and awareness of burnout can help individuals avoid this difficult place. What can help individuals move to a place of truly enjoying their work and their life? Strategies for increasing resiliency and thriving will be discussed. The goal is to have each individual leave this session with at least one strategy to apply to their current life.

RC425

Radiomics Mini-Course: Informatics Tools and Databases

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S103CD

BQ IN PH

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

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

RC425A The Role of Challenges and Their Requirements

Participants

Jayashree Kalpathy-Cramer, MS, PhD, Charlestown, MA (*Presenter*) Consultant, Infotech Software Solution

LEARNING OBJECTIVES

1) Understand the role of challenges and benchmarks in image analysis, radiomics and radiogenomics. 2) Learn about challenge infrastructure and requirements to host and participate in challenges. 3) Learn about past and upcoming challenges that focus on topics in radiology, radiomics and radiogenomics.

ABSTRACT

Challenges and benchmarks have been used successfully in a number of scientific domains to make significant advances in the field by providing a common platform for collaboration and competition. By provide a common dataset and common set of evaluation metrics, they also facilitate a fair and rigorous evaluation of algorithms. Challenge organizers often sequester the test data from the training data, further enhancing the rigor of the evaluation. These efforts can introduce experts in machine learning and data science to problems in medical imaging. They also serve to allow computer scientists access to clinical data which they may not otherwise have. Many challenges have also highlighted the need for collaboration as the best results are often obtained by combining a range of complementary techniques. We will discuss recent challenges from a number of domains including imaging and bioinformatics, explore the informatics infrastructure to host and participate in challenges and discuss the needs for future challenges including those in radiomics and radiogenomics.

RC425B Quantitative Image Analysis Tools: Communicating Quantitative Image Analysis Results

Participants

Andriy Fedorov, PhD, Boston, MA (*Presenter*) Research support, Siemens AG

For information about this presentation, contact:

andrey.fedorov@gmail.com

LEARNING OBJECTIVES

1) Review the meaning and importance of interoperability for quantitative image analysis tools. 2) Review specific use cases motivating interoperable communication of the analysis results. 3) Learn about the tools that support interoperable communication of analysis results using DICOM standard.

ABSTRACT

Quantitative imaging holds tremendous but largely unrealized potential for objective characterization of disease and response to therapy. Quantitative imaging and analysis methods are actively researched by the community. Certain quantitation techniques are gradually becoming available both in the commercial products and clinical research platforms. As new quantitation tools are being introduced, tasks such as their integration into the clinical or research enterprise environment, comparison with similar existing tools and reproducible validation are becoming of critical importance. Such tasks require that the analysis tools provide the capability to communicate the analysis results using open and interoperable mechanisms. The use of open standards is also of utmost importance for building aggregate community repositories and data mining of the analysis results. The goal of this talk is to improve the understanding of the interoperability, as applied to quantitative image analysis, with the focus on clinical research applications.

RC425C Public Databases for Radiomics Research: Current Status and Future Directions

Participants

Justin Kirby, Bethesda, MD (*Presenter*) Stockholder, Myriad Genetics, Inc

LEARNING OBJECTIVES

1) Understand the importance of open science methods to facilitate reproducible radiomics research. 2) Become familiar with

publicly available sites where you can download existing radiomic data sets, request to upload new radiomic/radiogenomic data sets, and manage your research projects. 3) Learn about data citations and new data-centric journals which help enable researchers to receive academic credit for releasing well-annotated data sets to the public.

ABSTRACT

Lack of reproducibility in scientific research, particularly in healthcare, has become an increasing issue in recent years. The National Institutes of Health (NIH) and many major publishers have since called for increased sharing of raw data sets so that new findings can be easily validated. This is especially important in the emerging field of radiomics where large data sets and huge numbers of image features lead to an increased risk of spurious correlations which are not actually driven by biology. A number of public tools and databases have since been created by governments and other organizations to help facilitate the sharing of data sets. Publishers have developed new 'data journals' and services specifically designed to encourage researchers to annotate and share their data sets. It is now up to the imaging research community to begin taking advantage of these resources. Other disciplines such as genomics and proteomics are significantly leading imaging in the adoption of these new open science workflows. Significant engagement with NIH and other organizations providing open databases and related services is critical to enabling imaging researchers to successfully shift to a culture of data sharing and transparency.

RC427

Basic Principles of Cost-Effectiveness Analysis in Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: N229

HP **RS**

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

FDA Discussions may include off-label uses.

Participants

Pari Pandharipande, MD, MPH, Boston, MA (*Moderator*) Nothing to Disclose
Christoph I. Lee, MD, Seattle, WA (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the value of cost-effectiveness analyses in affecting reimbursement policies and practice guidelines. 2) Identify potential databases that can be used for input parameters for both effectiveness data and cost data. 3) Describe the incremental cost effectiveness ratio in laymen's terms to patients, physicians, and policymakers.

ABSTRACT

Cost-effectiveness analysis (CEA) is commonly used by policymakers to gain insight into the value of healthcare interventions. Standard CEA methods, grounded in principles of economics and resource allocation, are unfamiliar to most radiologists. In the current era of value-based care, radiologists' understanding of how health services researchers and economists project CEA outcomes will be increasingly important for identifying efficient and affordable imaging strategies. In this course, basic research concepts and applications relevant to CEA in imaging will be reviewed, including decision-analysis and simulation modeling, life expectancy and lifetime cost metrics, health-related quality-of-life measurement, and incremental cost-effectiveness ratios (ICERs). Our goal will be to expose early investigators and the general radiology community to CEA in imaging.

Sub-Events

RC427A An Introduction to Cost-Effectiveness Analysis in Diagnostic Testing

Participants

Pari Pandharipande, MD, MPH, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the basic structure of a decision-analytic model that is designed to evaluate the long-term health and economic consequences of a diagnostic test. 2) Describe how an incremental cost-effectiveness ratio (ICER) is calculated and used for policy-level decision-making. 3) Explain the strengths and limitations of cost-effectiveness analysis as method to determine the value of an imaging test.

RC427B An Example of Cost-Effectiveness Analysis in Imaging: MRI for Choledocholithiasis

Participants

Stella Kang, MD, MSc, New York, NY (*Presenter*) Author, Wolters Kluwer nv

For information about this presentation, contact:

stella.kang@nyumc.org

LEARNING OBJECTIVES

1) Understand how to approach the question of whether risk-stratified or non-risk-stratified use of imaging is more cost-effective. 2) Apply methods of evidence synthesis and probabilistic modeling to a cost-effectiveness analysis of MRI versus risk-stratified diagnostic evaluation for suspected acute biliary obstruction. 3) Evaluate the clinical and research implications of results from a cost-effectiveness analysis of diagnostic strategies for suspected acute biliary obstruction.

RC427C Use of Simulation Modeling to Identify High-Value Colorectal Cancer Screening Strategies in the U.S.

Participants

Amy Knudsen, PhD, Boston, MA (*Presenter*) Nothing to Disclose

RC429

The Added Value of DWI in Clinical Practice

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S402AB

BQ **MR**

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

FDA Discussions may include off-label uses.

Participants

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

Sub-Events

RC429A Diffusion Weighted Imaging in the Evaluation of Inflammatory Bowel Disease

Participants

Stuart A. Taylor, MBBS, London, United Kingdom (*Presenter*) Research Consultant, Robarts Clinical Trials, Inc

For information about this presentation, contact:

stuart.taylor1@nhs.net

LEARNING OBJECTIVES

1) To explain the histopathological changes in inflammatory bowel disease that underpin changes in diffusion weighted imaging. 2) To describe the advantages and pitfalls of adding diffusion weighted imaging to standard MR enterography protocols. 3) Appraise the current role of diffusion weighted imaging in the diagnosis and staging of inflammatory bowel disease.

RC429B Whole Body DWI for Tumor Detection and Assessment of Response

Participants

Anwar R. Padhani, MD, FRCR, Northwood, United Kingdom (*Presenter*) Advisory Board, Siemens AG Speakers Bureau, Siemens AG Researcher, Siemens AG Speakers Bureau, Johnson & Johnson

LEARNING OBJECTIVES

1) To provide a rationale for the use of whole body MRI when evaluating malignant disease extent and for therapy response assessment. 2) To show how measurements are acquired distinguishing between tumor detection (core) and response assessment (comprehensive) protocols that are MET-RADS compliant. 3) To highlight and review the MET-RADS response assessment guidelines. 4) To provide the scientific evidence and illustrate by case reviews the efficacy of WB-MRI comparing with PET/CT, bone and CT scans including areas of potential synergy. 5) To highlight specific clinical indications for WB-MRI use and highlight patient and clinical pathway altering benefits and limitations.

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/> Anwar R. Padhani, MD, FRCR - 2012 Honored Educator

RC429C DWI Beyond ADC

Participants

Bachir Taouli, MD, New York, NY (*Presenter*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA

For information about this presentation, contact:

bachir.taouli@mountsinai.org

LEARNING OBJECTIVES

1) Review strengths and limitations of ADC quantification outside the brain. 2) Review the potential added value of non-mono exponential processing methods, including IVIM, stretched exponential and kurtosis for diffusion quantification outside the brain.

ABSTRACT

Recent advances in MRI hardware and software have made diffusion-weighted imaging (DWI) an important part of MRI protocols outside the brain. In this presentation, we will review the current data on exponential and non-monoexponential diffusion models outside the brain, particularly for oncologic applications.

RC431

Interventional Stroke Treatment: Practical Techniques and Protocols

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S404CD

ER NR IR

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

Participants

Joshua A. Hirsch, MD, Boston, MA (*Moderator*) Consultant, Medtronic plc; Consultant, Globus Medical, Inc; Data Safety Monitoring Board, Johnson & Johnson;

LEARNING OBJECTIVES

1) Describe the diagnostic evaluation and decision making algorithms leading to urgent endovascular treatment of acute stroke. 2) Review endovascular techniques for the treatment of acute stroke from microcatheter set up to intraarterial thrombolysis to mechanical thrombectomy. 3) Discuss case examples of endovascular treatment including patient selection, technique, and pitfalls.

ABSTRACT

Rapid advances in the evaluation, selection, treatment and management of the acute stroke patient necessitates an ongoing educational event highlighting the newest information, techniques and strategies for obtaining the best outcomes for our patients. In this session, all of these topics will be covered in a practical "how to" and case based approach which is designed to help the practitioner implement best practices. The course is useful for those performing imaging, treatment or both. Analysis of the latest ongoing trials, devices and techniques will be presented. Endovascular tips and tricks will be discussed, as well as pitfalls in the treatment of these patients.

Sub-Events

RC431A Devices and Data that Support IA Treatment as the Standard of Care for Ischemic Stroke

Participants

Allan L. Brook, MD, Bronx, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC431B Optimizing Patient Selection with Imaging

Participants

Ramon G. Gonzalez, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the essential ischemic stroke physiology parameters that are essential in selecting patients for endovascular treatment of a large vessel occlusion. 2) Be familiar with the imaging methods that can measure ischemic stroke physiology parameters and their relative accuracy. 3) Use the best available evidence, recognize the optimal imaging approach to select patients with acute ischemic stroke for endovascular treatment.

RC431C Breaking: Imaging Extends the Window: DAWN AND DEFUSE 3

Participants

Sameer A. Ansari, MD, PhD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

s-ansari@northwestern.edu

LEARNING OBJECTIVES

1) Understand the essential ischemic stroke physiology parameters that are essential in selecting patients for endovascular treatment of a large vessel occlusion. 2) Be familiar with the imaging methods that can measure ischemic stroke physiology parameters and their relative accuracy. 3) Use the best available evidence, recognize the optimal imaging approach to select patients with acute ischemic stroke for endovascular treatment.

ABSTRACT

Properly selected patients with acute ischemic stroke caused by large vessel occlusion (LVO) may be effectively and safely treated endovascularly with modern thrombectomy devices. We have developed a high-precision imaging tool for selecting such patients. It is an experience and evidence-based clinical triage tool that uses advanced imaging to identify INDIVIDUAL patients most likely to benefit from endovascular stroke therapy. It was based on over a decade of using advanced imaging (CT, CTA, CT perfusion, DWI, MR perfusion) in acute stroke patients and a critical review of the literature and has been validated in clinical trials. The approach focuses on answering the following key questions using modern imaging: 1. Is there a hemorrhage? Noncontrast CT 2. Is there an occlusion of the distal ICA and/or proximal MCA? CTA 3. Is irreversible brain injury below a specific threshold (e.g. <70ml)? DWI Perfusion imaging is not employed unless patients cannot undergo MRI, or they do not meet the criteria for intervention.

Investigations to understand the reasons for the unsuitability of perfusion CT to substitute for DWI have revealed theoretical and practical shortcomings of CTP. A major problem is the low signal-to-noise (SNR) ratio of CT perfusion that results in a poor contrast-to-noise (CNR) ratio in severely ischemic brain. In a comparison between DWI and CTP in over 50 consecutive patients with LVA, Schaefer, et al. showed that the mean CNR of DWI was >4 while it was <1 for CTP derived CBF. The poor CNR results in large measurement error: using Bland-Altman analyses it was found that the 95% confidence interval was $\sim \pm 50$ ml for ischemic lesion volume measurements in individual patients. The Cleveland Clinic adopted a nearly identical algorithm and their results were published. They reported that after the new algorithm was adopted, there was a $\sim 50\%$ reduction in mortality and a ~ 3 -fold increase in good outcomes, despite a $\sim 50\%$ decrease in the number of procedures. A recent prospective observational trial at the MGH using stentriever and this imaging approach demonstrated $>50\%$ favorable outcomes (mRS 0-2) that is similar to recent randomized clinical trials. However, only 3 patients were evaluated for every patient that was treated, a screening to treatment ratio that is much lower than in recently published clinical trials.

1. Gonzalez RG, Copen WA, Schaefer PW, Lev MH, Pomerantz SR, Rapalino O, et al. The Massachusetts General Hospital acute stroke imaging algorithm: an experience and evidence based approach. *Journal of neurointerventional surgery*. 2013;5 Suppl 1:i7-12.
2. Wisco D, Uchino K, Saqqur M, Gebel JM, Aoki J, Alam S, et al. Addition of hyperacute MRI AIMS in patient selection, decreasing the use of endovascular stroke therapy. *Stroke; a journal of cerebral circulation*. 2014;45(2):467-72.
3. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986 Feb 8;1(8476):307-10.
4. Schaefer PW, Souza L, Kamalian S, Hirsch JA, Yoo AJ, Kamalian S, Gonzalez RG, Lev MH. Limited reliability of computed tomographic perfusion acute infarct volume measurements compared with diffusion-weighted imaging in anterior circulation stroke. *Stroke*. 2015 Feb;46(2):419-24.

RC432

Hospital Contracting: The Radiologist's and The Attorney's Perspectives

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S403B

LM

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

LEARNING OBJECTIVES

1) Identify the important elements of a hospital professional services agreement (radiology contract). 2) Describe the principles of negotiations that will benefit radiologists in their interactions with hospital administrators. 3) Discuss the roles of the radiologist and the attorney in hospital contract negotiations.

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

RC432A Hospital Contracting: The Attorney's Perspective

Participants

William K. Davis JR, JD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ken.davis@kattenlaw.com

LEARNING OBJECTIVES

1) Identify the important elements of a hospital professional services agreement (radiology contract). 2) Describe the principles of negotiations that will benefit radiologists in their interactions with hospital administrators. 3) Outline a process for hospital contract negotiations.

ABSTRACT

Negotiating a Difficult Hospital Contract: The Attorney's Perspective

W. Kenneth Davis, Jr, Chicago, IL

ABSTRACT

This course is structured to explore the issues and opportunities involved in the process of negotiating a hospital radiology professional services agreement (hospital radiology contract). The principles of contract negotiations will be discussed. Potentially problematic clauses will be presented, and suggestions will be made to modify or eliminate these clauses. The importance of having the practice integrated into the medical, social, and political fabrics of the hospital and the community will be stressed. The faculty will introduce the concept of power in a negotiation, and they will define common negotiation terms. Issues of radiology group communication and unity during the process will be discussed. There will be sufficient time for questions from the attendees.

RC432B Hospital Contracting: The Radiologist's Perspective

Participants

Lawrence R. Muroff, MD, Tampa, FL (*Presenter*) CEO, Imaging Consultants, Inc; President, Imaging Consultants, Inc;

LEARNING OBJECTIVES

1) Identify potentially problematic hospital contract clauses that could negatively impact your practice. 2) Discuss alternative contract clauses that will satisfy both the hospital and the radiology group. 3) Describe ways to align the interests of the hospital with those of the practice.

ABSTRACT

This course is structured to explore the issues and opportunities involved in the process of negotiating a hospital radiology professional services agreement (hospital radiology contract). The principles of contract negotiations will be discussed, and the role of both the radiologist and the radiology-knowledgeable attorney will be covered. How the radiology leadership and the practice attorney interact will be explored. Potentially problematic clauses will be presented, and suggestions will be made to modify or eliminate these clauses. The importance of having the practice integrated into the medical, social, and political fabrics of the hospital and the community will be stressed. The faculty will introduce the concept of power in a negotiation, and they will define common negotiation terms. Issues of radiology group communication and unity during the process will be discussed. There will be sufficient time for questions from the attendees.

RC450

CTA from Head to Toe

Tuesday, Nov. 28 4:30PM - 6:00PM Room: N226

CA VA CT

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

Participants

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

For information about this presentation, contact:

chrisleemd@gmail.com

LEARNING OBJECTIVES

1) Describe techniques for CTA of the neck, upper and lower extremities. 2) Distinguish common artifacts on CTA of these anatomic regions. 3) Evaluate protocol/scanner modifications for optimal CTA imaging. 4) Formulate a CTA protocol to optimally image acute aortic syndrome. 5) Distinguish the imaging appearances and pitfalls of acute aortic syndrome. 6) Summarize the important measurements that help guide therapy. 7) Describe the common complications following TEVAR. 8) Describe pre-procedural patient preparation including appropriate patient selection, contraindications, and beta-blockade. 9) Evaluate peri-procedural issues including vasodilation, continued heart rate control, and breathholding. 10) Evaluate Image acquisition including radiation dose reduction techniques and technique choice. 11) Describe postprocedural complications including contrast reactions and their management.

Sub-Events

RC450A Head and Neck CTA

Participants

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

LEARNING OBJECTIVES

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

RC450B Aortic CTA

Participants

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

For information about this presentation, contact:

chrisleemd@gmail.com

LEARNING OBJECTIVES

1) Formulate a CTA protocol to optimally image acute aortic syndrome. 2) Distinguish the imaging appearances and pitfalls of acute aortic syndrome. 3) Summarize the important measurements that help guide therapy. 4) Describe the common complications following TEVAR.

ABSTRACT

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

Active Handout: Christopher Lee

<http://abstract.rsna.org/uploads/2017/9001496/Active RC450B.pdf>

RC450C Cardiac CTA

Participants

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

For information about this presentation, contact:

ch602nyc@gmail.com

LEARNING OBJECTIVES

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

RC452

Techniques for Interventional Sonography and Thermal Ablation (Hands-on)

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E264

US **IR**

AMA PRA Category 1 Credits™: 1.50

ARRT Category A+ Credit: 1.75

FDA

Discussions may include off-label uses.

Participants

Veronica J. Rooks, MD, Tripler AMC, HI (*Presenter*) Nothing to Disclose
 Patrick Warren, MD, Columbus, OH (*Presenter*) Nothing to Disclose
 Stephen C. O'Connor, MD, Boston, MA (*Presenter*) Nothing to Disclose
 Corrie M. Yablon, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
 Kristin M. Dittmar, MD, Columbus, OH (*Presenter*) Nothing to Disclose
 Kal Dulaimy, MD, Springfield, MA (*Presenter*) Nothing to Disclose
 Mahesh M. Thapa, MD, Seattle, WA (*Presenter*) Nothing to Disclose
 John M. Racadio, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
 Hisham A. Tchelepi, MD, Los Angeles, CA (*Presenter*) Research Grant, General Electric Company Research Grant, Roper Industries, Inc
 Christian L. Carlson, MD, MS, Jbsa Ft Sam Houston, TX (*Presenter*) Nothing to Disclose
 Adam S. Young, MD, MBA, Boston, MA (*Presenter*) Nothing to Disclose
 Linda J. Warren, MD, Vancouver, BC (*Presenter*) Shareholder, Hologic, Inc
 Christopher A. Molvar, MD, Chicago, IL (*Presenter*) Nothing to Disclose
 James W. Murakami, MD, Columbus, OH (*Presenter*) Nothing to Disclose
 Leah E. Braswell, MD, Columbus, OH (*Presenter*) Nothing to Disclose
 Jeremiah J. Sabado, MD, Kennett Square, OH (*Presenter*) Nothing to Disclose
 Brian H. Ching, DO, Tripler Army Medical Center, HI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Stephen.o'connor@bhs.org

brian.h.ching.civ@mail.mil

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.

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/> Corrie M. Yablon, MD - 2017 Honored Educator

RC453

Virtual Reality in the Reading Room

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S404AB

IN

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 1.75

Participants

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

LEARNING OBJECTIVES

1) Be able to define virtual reality and augmented reality and explain how they differ. 2) Describe current wearable VR and AR devices that are commercially available and accessible for medical applications. 3) Discuss the implications of VR and AR in diagnostic imaging. 4) Detail the applications of VR and AR in image guided intervention. 5) Explain current limitations of VR and AR technology and future technologies and applications.

ABSTRACT

Virtual reality (VR) and augmented reality (AR) represent a rapidly developing area of technology that offers a novel way to display, manipulate and acquire information. The recent advancement of optical head mounted (OHM) displays has resulted in the emergence of individualized cost effective, mainstream applications of VR and AR. Driven by technological advances in stereoscopic displays, positional / environmental sensors, and microcomputing, this subset of wearable technology is primed to introduce novel ways of not only displaying information but transforming how we interact with our environment. To date, applications of VR and AR have become influential in many technologically based industries (such as manufacturing, engineering and entertainment) and have garnered interest in medicine as well. As an information rich and inherently visual discipline, radiology is a logical and well-suited field for these transformative devices. This technology has important applications for both the diagnostic and interventional radiologist and consequently will significantly impact radiology as a whole. To date, limited research has been reported regarding applications of this technology to radiology. We present an overview of wearable technology, describe applications pertinent to radiology that are currently under development at our institution and evaluate the impact they may have on the practice of radiology.

RC454

Enterprise Imaging for the Practicing Radiologist

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E353A



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

Participants

Christopher J. Roth, MD, Durham, NC (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the various descriptions of enterprise imaging, and their implications for radiologists. 2) Recognize the business needs driving enterprise imaging at health care organizations. 3) Appreciate the clinical, technical, governance, and financial challenges of enterprise imaging, and how radiologists can assist with solving them while leading local enterprise imaging initiatives.

Sub-Events

RC454A Clinical Challenges in Enterprise Imaging

Participants

Alex Towbin, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Siemens AG; Consultant, Reed Elsevier; Advisory Board, IBM Corporation;

For information about this presentation, contact:

alexander.towbin@cchmc.org

LEARNING OBJECTIVES

1) Describe the concept of an enterprise imaging archive. 2) Identify the unique challenges associated with incorporating non-DICOM images into an enterprise imaging archive.

ABSTRACT

Over the past 20 years, the field of radiology has built an impressive digital infrastructure, automating many portions of the imaging process from the time of order entry through image distribution. With the advent of small, low-cost, high quality digital cameras, other medical specialties have turned to imaging to visualize and document disorders yet, they have not implemented the same type of digital infrastructure as radiology. Today, thousands of medical images are obtained in hospitals each day. With the increasing reliance on imaging, there is a greater need to build systems and processes to obtain, store, and distribute these images across the enterprise so that health care providers can better care for their patients. Even though many of these problems have been solved in radiology, the solutions are not easily transferred to other specialties due to the differences in imaging hardware and the image acquisition workflow. The purpose of this talk is to describe the problems facing hospitals as they begin to build enterprise imaging archives and to discuss potential solutions to these problems.

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RC454B Technical Challenges in Enterprise Imaging

Participants

David A. Clunie, MBBS, Princeton, NJ (*Presenter*) Owner, PixelMed Publishing LLC; Consultant, Carestream Health, Inc; Consultant, CureMetrix, Inc; Consultant, MDDX Research & Informatics; Consultant, General Electric Company; ;

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC454C Finance and Governance Challenges in Enterprise Imaging

Participants

Christopher J. Roth, MD, Durham, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appreciate challenges with respect to enterprise-wide imaging governance and administration in a multi-specialty hospital or health system requiring systematic image capture, storage, metadata association, viewing, and exchange. 2) Learn how radiologists can take a leadership role in procurement, governance, infrastructure sharing and workflow design for specialties just beginning to store and use imaging.

RCA35

Creating Vector-based Drawings for Presentations and Publications with Adobe Illustrator (Hands-on)

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S401AB



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

Participants

Sarah C. Abate, BS, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Elise Van Holsbeeck, DO, Lima, OH (*Presenter*) Nothing to Disclose
Darren L. Wendt, Rochester, MN (*Presenter*) Nothing to Disclose
Richard Wendt, Grand Meadow, MN (*Presenter*) Nothing to Disclose
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
Bea Van Holsbeeck, Northville, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Discuss why we use vector based programs. 2) Explain how to use the tools in Illustrator. 3) Demonstrate how to import and label an image. 4) Demonstrate how to make one's own line drawing. 5) Demonstrate how to color and shade drawing. 6) Demonstrate how to export an image for print, PowerPoint, and Internet.

Active Handout: Sarah C. Abate

[http://abstract.rsna.org/uploads/2017/16005085/Active RCA35 11.20.17.pdf](http://abstract.rsna.org/uploads/2017/16005085/Active_RCA35_11.20.17.pdf)

RCB35

Hands-On Basic DICOM with Horos/Osirix (Hands-on)

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S401CD

IN

AMA PRA Category 1 Credits [™]: 1.50

ARRT Category A+ Credit: 1.75

Participants

Ross W. Filice, MD, Chevy Chase, MD (*Moderator*) Nothing to Disclose

Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

Simon Rascovsky, MD, MSc, Bogota, Colombia (*Presenter*) Director, Nucleus Health, LLC

Ross W. Filice, MD, Chevy Chase, MD (*Presenter*) Nothing to Disclose

Bryce A. Merritt, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe basic DICOM object metadata structure. 2) Demonstrate familiarity with Osirix/Horos DICOM viewer functions including image display, and measurements. 3) Use Osirix/Horos to send/receive DICOM objects.

RCC35

Creation of Radiology Reports

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits TM: 1.50
ARRT Category A+ Credit: 1.00

Participants

Curtis P. Langlotz, MD, PhD, Menlo Park, CA (*Presenter*) Advisory Board, Nuance Communications, Inc; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG;
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC

For information about this presentation, contact:

langlotz@stanford.edu

LEARNING OBJECTIVES

1) Learn about the history of radiology reporting. 2) Review the attributes of a high-quality radiology report. 3) Understand key shortcomings of radiology report style and how to address them. 4) Learn what you can do today to improve your radiology reports.

MSRO39

BOOST: Genitourinary-eContouring

Tuesday, Nov. 28 4:45PM - 6:00PM Room: S104B



AMA PRA Category 1 Credits [™]: 1.25
ARRT Category A+ Credits: 1.50

Participants

Tristan Barrett, MBBS, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Stanley L. Liauw, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Brian J. Davis, MD, PhD, Rochester, MN (*Presenter*) Stockholder, Pfizer Inc; Speaker, Augenix Inc

For information about this presentation, contact:

tristan.barrett@addenbrookes.nhs.uk

sliauw@radonc.uchicago.edu

LEARNING OBJECTIVES

1) To review contouring guidelines for the treatment of intact or post-operative prostate cancer with radiation therapy. 2) To address the radiological challenges of radiotherapy volume delineation and planning at MRI. 3) To highlight the important aspects of radiological anatomy applied to treatment planning and delivery.

ABSTRACT

This course intends to cover the radiological anatomy relevant to the prostate and address the challenges encountered for its application for treatment planning and delivery.

Active Handout: Tristan Barrett

http://abstract.rsna.org/uploads/2017/17001735/Active_MSRO39.pdf