Tuesday

Program subject to change until 12/16/2019.

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105TH Scientific Assembly and Annual Meeting
December 1–6 | McCormick Place, Chicago

SPDL30

Houston, We Have a Problem (Case-based Competition)

Tuesday, Dec. 3 7:15AM - 8:15AM Room: E451B

CA GI GU MK NR OB PD PH SQ VA

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 0

Participants

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

For information about this presentation, contact:

adam.flanders@jefferson.edu

Special Information

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

LEARNING OBJECTIVES

1) Be introduced to a series of radiology case studies via an interactive team game approach designed to encourage 'active' consumption of educational content. 2) Use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) Receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance.

Printed on: 10/29/20

SPSC30

Controversy Session: MR Elastography versus US Elastography of Liver

Tuesday, Dec. 3 7:15AM - 8:15AM Room: E350

CT GI MR

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

Participants

Bachir Taouli, MD, New York, NY (*Moderator*) Research Grant, Bayer AG; Research Grant, Takeda Pharmaceutical Company Limited; Research Grant, Regeneron Pharmaceuticals, Inc; Consultant, Alexion Pharmaceuticals, Inc; Consultant, Bayer AG; ;
Anthony E. Samir, MD, Boston, MA (*Moderator*) Consultant, Pfizer Inc; Consultant, General Electric Company; Consultant, PAREXEL International Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, Canon Medical Systems Corporation; Research Grant, General Electric Company; Research Grant, Samsung Electronics Co, Ltd; Research Grant, Analogic Corporation; Research support, SuperSonic Imagine; Research support, Hitachi, Ltd; Research contract, Koninklijke Philips NV
Laura Kulik, MD, Chicago, IL (*Presenter*) Speaker, Eisai Co, Ltd; Speaker, Dova; Speaker, Gilead Sciences, Inc; Consultant, Bristol-Myers Squibb Company; Consultant, Bayer AG; Consultant, Exelixis, Inc; Consultant, Eisai Co, Ltd; Consultant, CE Outcomes
Paul S. Sidhu, MRCP, FRCR, London, United Kingdom (*Presenter*) Speaker, Koninklijke Philips NV; Speaker, Bracco Group; Speaker, Hitachi, Ltd; Speaker, Siemens AG; Speaker, Samsung Electronics Co, Ltd; Advisory Board, Samsung Electronics Co, Ltd; Advisory Board, Itreas Ltd
Scott B. Reeder, MD,PhD, Madison, WI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

paulsidhu@nhs.net

LEARNING OBJECTIVES

1) Review the current uses and diagnostic performance of ultrasound and MR elastography of the liver. 2) Review and compare advantages, pitfalls and limitations of ultrasound and MR elastography of the liver.

ABSTRACT

The use of elastography has altered the management of chronic liver disease, and modified the patient pathway. The ability to assess the degree of fibrosis within the accepted classification, either the METAVIR or Ishak scoring systems, allows for clinical disease management. The establishment of elastography in both MR imaging and US imaging has become established, with standrads measured against liver biopsy. The number of liver biopsies for assessment of liver fibrosis has predictably declines as a result. Both imaging techniques have advantages and disadvantages. Advocates of MR imaging indicate the global nature of the measurement, speed of aquisition, whereas the proponents of US based elastograpgy suggest the rapid, cost effective methodology is superior. However the need to image an increasing patient population will require a rapid, portable and acceptable method. This debate will highlight the two techniques, the accuracy, acceptance and reproducibility and allow the audience to come to a conclusion of the usefullnees of each technique.

SPSH30

Hot Topic Session: Patient-facing Nuclear Medicine Clinics for Prostate Cancer

Tuesday, Dec. 3 7:15AM - 8:15AM Room: E450B

GU NM

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

Participants
Phillip J. Koo, MD, Phoenix, AZ (*Moderator*) Advisory Board, Bayer AG; Advisory Board, Johnson & Johnson; Consultant, Blue Earth Diagnostics Ltd; Researcher, Progenics Pharmaceuticals, Inc; Speaker, Astellas Pharm Inc; Advisory Board, Pfizer Inc; Consultant, Merck & Co, Inc; Consultant, Advanced Accelerator Applications SA

Sub-Events

SPSH30A The Value and Challenges of Creating Patient Facing Clinics

Participants
Phillip J. Koo, MD, Phoenix, AZ (*Presenter*) Advisory Board, Bayer AG; Advisory Board, Johnson & Johnson; Consultant, Blue Earth Diagnostics Ltd; Researcher, Progenics Pharmaceuticals, Inc; Speaker, Astellas Pharm Inc; Advisory Board, Pfizer Inc; Consultant, Merck & Co, Inc; Consultant, Advanced Accelerator Applications SA

LEARNING OBJECTIVES

1) Describe the importance of patient facing clinics as radiopharmaceutical based therapies become approved for the treatment of prostate cancer. 2) Identify challenges for creating patient facing clinics.

SPSH30B The Nuclear Medicine Therapy Care Coordination Service: A Model for Radiologist-driven Patient-centered Care

Participants
David M. Schuster, MD, Decatur, GA (*Presenter*) Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, Blue Earth Diagnostics Ltd; Institutional Research Grant, Advanced Accelerator Applications SA; Institutional Research Grant, Telix Pharmaceuticals Inc; Consultant, Syncona Ltd; Consultant, AIM Specialty Health, Inc; ;

LEARNING OBJECTIVES

1) Understand the importance of a creating a patient-centric Nuclear Medicine Therapy Care Coordination Service. 2) Learn key components of operationalizing a nurse navigator within a traditional radiology/nuclear medicine practice. 3) Gain a better understanding of the potential for theranostic approaches for prostate and other cancer, and how radiologists/nuclear medicine physicians can increase their impact in multi-disciplinary care.

SPSH30C Co-Managing Patients with Castration Resistant Prostate Cancer: A GU Oncologist's Perspective

Participants
Alicia K. Morgans, MD,MPH, Chicago, IL (*Presenter*) Speaker, Astellas Group; Speaker, AstraZeneca PLC; Speaker, sanofi-aventis Group; Speaker, Johnson & Johnson; Speaker, Bayer AG

LEARNING OBJECTIVES

1) To understand the treatment decision implications of use of novel PET imaging approaches in prostate cancer from a medical oncology perspective. 2) To understand the oncologic outcome implications of use of novel PET therapeutics in prostate cancer from a medical oncology perspective.

MSAS31

Regulatory and Compliance Standards in Radiology (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S105AB

HP

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

Participants
Nancy McDonald, MS, Chicago, IL (*Moderator*) Nothing to Disclose
Anzi Zhao, MS, Chicago, IL (*Presenter*) Nothing to Disclose
Logan Linscheid, ARRT, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review the existing regulatory, accreditation and advisory bodies pertinent to Radiology. 2) To understand the regulatory and compliance standards that apply to institution and imaging modalities, and how they impact the safety and quality of radiology practice. 3) To provide update on new compliance standards in Radiology.

Printed on: 10/29/20

MSCC31

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

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E450B

CT HN NR 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, PhD, Ancaster, ON (*Moderator*) Nothing to Disclose

Sub-Events

MSCC31A Brain FDG and Amyloid PET/DAT Scans

Participants
Phillip Kuo, MD,PhD, Tucson, AZ (*Presenter*) Research Grant, Astellas Group; Research Grant, Blue Earth Diagnostics Ltd; Consultant, Novartis AG; Consultant and Speaker, General Electric Company; Consultant, Konica Minolta, Inc; Consultant, Imaging Endpoints

For information about this presentation, contact:

pkuo@email.arizona.edu

LEARNING OBJECTIVES

1) Apply a systematic approach to interpretation of PET imaging in dementia. 2) Explain the optimal performance and interpretation of dopamine transporter imaging. 3) Describe the complementary roles of amyloid, FDG and dopamine transporter imaging in the assessment of neurodegenerative diseases.

MSCC31B Neck

Participants
Rathan M. Subramaniam, MD,PhD, Dunedin, New Zealand (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rathan.subramaniam@utsouthwestern.edu

LEARNING OBJECTIVES

1) To review best clinical practices in Head and Neck PET/CT and case review.

Printed on: 10/29/20

MSES31

Essentials of Non-interpretive Skills (Interactive Session)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S100AB

PR

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

Sub-Events

MSES31A Ethics in Radiology Publication and Authorship

Participants
Anastasia L. Hryhorczuk, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the types of plagiarism (inadvertent plagiarism, mosaic plagiarism, self-plagiarism, image plagiarism) that may affect the integrity and credibility of published work. 2) Examine strategies that authors can use to avoid plagiarism in their writing. 3) Assess ethical issues surrounding intellectual ownership of unpublished works, and describe appropriate strategies for utilizing and crediting unpublished materials from others.

MSES31B Rewarding Opportunities for Radiologists Outside the Reading Room: From the Dark Side to the Dark Side?

Participants
Mark D. Hiatt, MD, Draper, UT (*Presenter*) Vice President, Guardant Health; Committee Vice Chairman, RadSite; Director, Myndshft

For information about this presentation, contact:

mhiatt@guardanthealth.com

LEARNING OBJECTIVES

1) Recognize the opportunities for radiologists outside the reading room through considering several radiologists' personal odysseys from clinical to entrepreneurial medicine. 2) Identify how the particular strengths of radiologists may be applied in rewarding ways outside the reading room.

ABSTRACT

This presentation will explore rewarding opportunities for radiologists outside the reading room through considering several radiologists' personal odysseys from clinical to entrepreneurial medicine. The particular strengths of radiologists that may assist in these extracurricular pursuits will be highlighted.

MSES31C Premedication for Contrast Media

Participants
Michelle D. Sakala, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

misakala@med.umich.edu

LEARNING OBJECTIVES

1) Describe basic concepts of allergic-like reactions to contrast media. 2) Estimate the likelihood of allergic-like reactions without and with premedication. 3) Recommend premedication according to indications in the American College of Radiology contrast manual v10.3. 4) Recognize the risks and benefits of premedication. 5) Specify the differences between and indications for elective versus accelerated premedication regimens. 6) Apply practice tips for premedication in unusual situations.

MSES31D Artificial Intelligence

Participants
Eliot L. Siegel, MD, Severna Park, MD (*Presenter*) Board of Directors, Carestream Health, Inc; Board of Directors, Mach7 Technologies Ltd; Founder, Parto; Founder, Chios; Founder, Topoderm; Founder, VisualTrauma; Founder, ACREW; Founder, DACREW; Founder, i-Nucs; Committee member, RadSite

For information about this presentation, contact:

esiegel@umaryland.edu

LEARNING OBJECTIVES

1) Describe the relationship between artificial learning, machine learning and deep learning. 2) List the challenges associated with the adoption of a general AI program that could interpret studies in a manner similar to a radiologist. 3) Explain the reason for the recent excitement about 'AI' in diagnostic imaging when the technology has been around for many years. 4) List machine learning applications that are not related to image pixel interpretation that can benefit imaging departments.

ABSTRACT

In their recent editorial in Academic Radiology, Cohan and Davenport refer to radiologist 'burnout' and having reached a 'tipping point'. They suggest that despite improvements in PACS and EMR systems, 'Radiologists are still being told to work faster as the screws continue to tighten; more images, greater case volume, increasing complexity and less time to do the work'. Radiologists are increasingly being asked to perform quantitative analysis on complex dynamic studies such as prostate and breast MRI, analyze multi-parametric imaging from MRI, PET, CT, and to follow new guidelines for lung cancer and other screening studies. Deep learning represents a fundamentally different approach to the development of algorithms for image acquisition, quantitative analysis, and interpretation based on learning by example from large image sets. It offers numerous advantages over more 'traditional' Computer Aided Design approaches including decreased time, and less specialized medical imaging expertise required for development as well as the potential for continuous and personalized refinement of algorithms in practice. In fact, Deep Learning may actually have its greatest initial success in solving non-image related challenges such as image quality, workflow efficiency, improved communication and patient safety. This technology, however, is also fraught with limitations including the requirement for large amounts of annotated data, regulatory, medicolegal, and relative brittleness with regard to lack of generalizability from a few to a multitude of different scanners. Overall, despite the challenges, Deep Learning will undoubtedly have a major impact in the next several years on positively resetting radiology's current 'tipping point'.

MSQI31

Quality Improvement Symposium: Staff Wellness and Development

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S402AB

LM SQ

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

Participants
Olga R. Brook, MD, Boston, MA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

obrook@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To learn strategies to improve staff wellness in Radiology, from fostering dignity and respect culture, reducing interruptions in your work environment, balancing productivity, emotional and physical wellness, mentoring and sponsoring and lessons learnt from long and fruitful career in Radiology.

Sub-Events

MSQI31A How to Foster Dignity and Respect in Radiology

Participants
Bettina Siewert, MD, Boston, MA (*Presenter*) Editor, Wolters Kluwer nv; Reviewer, Wolters Kluwer nv;

For information about this presentation, contact:

bsiewert@bidmc.harvard.edu

LEARNING OBJECTIVES

1) Describe the impact of disrespect on work environments. 2) Describe elements of a respectful work environment. 3) Implement measures to promote dignity and respect in the work environment.

MSQI31B Mentoring and Sponsoring: How to Do It Right

Participants
Amy L. Kotsenas, MD, Rochester, MN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kotsenas.amy@mayo.edu

LEARNING OBJECTIVES

1) To describe the differences between role model, mentors, coaches and sponsors. 2) To differentiate the need for role models, mentors, coaches and sponsors at various times throughout one's career. 3) To apply mentoring and sponsorship skills in developing members of your practice or team.

MSQI31C Reducing Interruptions in the Reading Room While Supporting Collaboration

Participants
Ethan A. Smith, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ethan.smith@cchmc.org

LEARNING OBJECTIVES

1) Understand how frequent interruptions can affect complex tasks such as image interpretation. 2) Describe a process to understand the source of interruptions and how to optimize them. 3) Understand the importance of balancing collaboration with referring clinicians while still working towards reducing the number of interruptions in the reading room.

ABSTRACT

Frequent interruptions in the reading room are a source of frustation for radiologists. Interruptions not only increase the stress levels in the reading room, but also may affect the ability of radiologists to perform complex tasks, most importantly image interpretation. However, it is also important to acknowledge that dealing with some interruptions, specifically those related to the the needs of patients and collaboration with refering clinicians, are an important part of the radiologist's role. The goal of presentation is to describe sources of interruptions in the reading room and to propose methods for optimizing the number of interruptions while still encouraging collaboration with clinical colleagues and providing high quality clinical care for patients.

MSQI31D Balancing Workload, Academic Productivity, and Physical and Emotional Wellness

Participants
Matthew S. Davenport, MD, Ann Arbor, MI (*Presenter*) Royalties, Wolters Kluwer nv

LEARNING OBJECTIVES

1) Learn strategies for balancing competing demands. 2) Understand how synergistic activities can improve efficiency and enhance well-being. 3) Recognize that work-life alignment requires self reflection.

MSQI31E How I Failed and Then Succeeded: Lessons Learnt

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

For information about this presentation, contact:

dmorgan@uabmc.edu

LEARNING OBJECTIVES

1) Reflect on experiential inflection points, both personal and at work, to enhance capacity for professional adaptability. 2) Understand the interplay of resilience and professional growth.

MSQI31F Q&A

MSRO31

BOOST: Gastrointestinal-Case-based Multidisciplinary Review (Interactive Session)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S103AB

GI OI RO

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

Participants
Abraham J. Wu, MD, New York, NY (*Presenter*) Research Grant, CivaTech Oncology, Inc
David D. Bates, MD, Hastings On Hudson, NY (*Presenter*) Research support, General Electric Company
Mukta Krane, MD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

wua@mskcc.org

LEARNING OBJECTIVES

1) Review anatomy relevant to local staging of rectal cancer. 2) Review the role of MRI in staging and treatment planning. 3) Discuss features of structured reporting in rectal MRI.

ABSTRACT

This lecture will focus on the role of MRI in local staging of rectal cancer, including discussion of relevant anatomy and the benefits of structured reporting.

Printed on: 10/29/20

MSRO35

BOOST: Musculoskeletal-Sarcoma Case-based Multidisciplinary Review (Interactive Session)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S103CD

MK OI RO

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

Participants
Edward Y. Kim, MD, Seattle, WA (*Presenter*) Nothing to Disclose
F. Joseph Simeone, MD, Boston, MA (*Presenter*) Nothing to Disclose
Seth Pollack, MD, Seattle, WA (*Presenter*) Consultant, Back Bay Consulting; Consultant, Bayer AG; Consultant, Eli Lilly and Company; Consultant, Puretech; Consultant, Seattle Genetics, Inc; Consultant, DAIICHI SANKYO Group; Consultant, Blueprint Medicines Corporation
Kevin Raskin, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To better understand standard of care management relevant to radiation management of musculoskeletal tumors. 2) To understand best imaging practices with respect to bone and soft tissue tumors.

ABSTRACT

This session will review the multidisciplinary evaluation and treatment of musculoskeletal tumors (sarcomas and other soft tissue tumors) with discussion provided by diagnostic radiology, orthopedic oncology, medical oncology, and radiation oncology panelists.

RC301

HRCT of Interstitial Lung Disease: Interactive Read with the Experts

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S406A

CH CT

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

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

After participating in the HRCT of Interstitial Lung Disease session the participants will acquire:1. Capacity to identify key imaging features of interstitial lung disease that lead to a useful categorization.2. Capacity to describe the most recent Fleischner criteria for the diagnosis of Idiopathic pulmonary fibrosis.3. Capacity to analyze the key imaging features of diffuse lung disease that lead to pulmonary fibrosis including: organizing pneumonia, idiopathic pulmonary fibrosis, acute interstitial pneumonia/ARDS, cigarette smoke related fibrosis and sarcoidosis.4. Capacity to better manage and contribute to a multi-disciplinary conference (MDD) that focuses on diffuse lung disease.

ABSTRACT

The assessment of fibrotic diffuse lung injury is difficult and radiologists are a key member of multidisciplinary conferences (MDD) that are recommended for a more accurate diagnosis of the underlying disease. This session is designed to help the radiologist understand the strengths and weaknesses of the MDD. Ten cases of diffuse lung injury will be presented to 4 experienced chest radiologists. The complete DICOM set of images will be displayed to both the panelists and the participants. This will allow the 4 panelists to describe the key features that support a diagnosis. The design of the session will also allow the participants to gauge the degree of agreement between experienced chest radiologists. The chief of pulmonary pathology at the Joint Pathology Center in Silver Spring will also participate giving a more accurate picture of the MDD. The case review session will begin with short presentation explaining the current Fleischner criteria for idiopathic pulmonary fibrosis provided by David Lynch from National Jewish Health in Denver. Additionally, there will be a short presentation providing a general approach to the imaging features of fibrotic lung disease by Jeffrey Galvin from the University of Maryland and the American Institute for Radiologic Pathology.The unknown cases can also be viewed on your internet enabled phone, tablet or computer.

Active Handout:Jeffrey R. Galvin

http://abstract.rsna.org/uploads/2019/19000313/Active RC301.pdf

Sub-Events

RC301A Introduction

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

RC301B Fleischner Criteria for IPF

Participants
David A. Lynch, MBBCh, Denver, CO (*Presenter*) Research support, Siemens AG; Research Consultant, Siemens AG; Research Consultant, PAREXEL International Corporation; Research Consultant, Boehringer Ingelheim GmbH; Research Consultant, F. Hoffmann-La Roche Ltd; Research Consultant, Veracyte, Inc; Research Consultant, Acceleron, Inc;

LEARNING OBJECTIVES

1) Apply Fleischner Society criteria for diagnosis of idiopathic pulmonary fibrosis. 2) Identify features of definite UIP, probable UIP, indeterminate fibrosing interstitial pneumonia, and suggestive of an alternative diagnosis.

RC301C Brief Overview to Approach and Management

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

Active Handout:Jeffrey R. Galvin

http://abstract.rsna.org/uploads/2019/19000315/Active RC301C.pdf

RC301D Panel

Participants
Gerald F. Abbott, MD, Boston, MA (*Presenter*) Nothing to Disclose
H. Page McAdams, MD, Durham, NC (*Presenter*) Consultant, MedQIA Imaging Core Laboratory ; Author, Reed Elsevier; Author, Wolters Kluwer nv; Research Consultant, F. Hoffmann-La Roche Ltd; Research Consultant, Boehringer Ingelheim GmbH; Research Consultant, Novartis AG
David A. Lynch, MBBCh, Denver, CO (*Presenter*) Research support, Siemens AG; Research Consultant, Siemens AG; Research Consultant, PAREXEL International Corporation; Research Consultant, Boehringer Ingelheim GmbH; Research Consultant, F.

Hoffmann-La Roche Ltd; Research Consultant, Veracyte, Inc; Research Consultant, Acceleron, Inc;
Santiago E. Rossi, MD, Buenos Aires City, Argentina (*Presenter*) Speaker, Boehringer Ingelheim GmbH; Speaker, Novartis AG
Teri J. Franks, MD, Silver Spring, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To discuss ILD cases and establish differential diagnosis and key points.

Printed on: 10/29/20

RC302

TRaD Talks

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E351

ED

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

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

Sub-Events

RC302A The Effective Luddite: Engaging Learners without Fancy Technology

Participants
Monica M. Sheth, MD, Manhasset, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

monica.sheth@nyulangone.org

LEARNING OBJECTIVES

1) Explain why incorporating the learner into a teaching activity is a more effective way of teaching. 2) Review techniques to promote a collaborative learning environment.

RC302B BST Mode: Bite Size Teaching for a Distractible Audience

Participants
Deborah A. Baumgarten, MD, MPH, Decatur, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dbaumga@emory.edu

LEARNING OBJECTIVES

1) What is BST mode and why does it work. 2) How to employ BST mode in your program.

RC302C Resident Education in Patient-centered Care: Impossible or Imperative?

Participants
Andrew J. Gunn, MD, Vestavia Hills, AL (*Presenter*) Consultant, BTG International Ltd; Speakers Bureau, BTG International Ltd; Research support, Penumbra Inc

LEARNING OBJECTIVES

1) Define patient-centered care in radiology. 2) Describe opportunities and challenges to incorporating patient-centered care into practice. 3) Identify available resources for teaching patient-centered care.

RC302D Teaching Wellness at the Workstation: Professional Modeling in the Burnout Era

Participants
Jessica G. Fried, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Jessica.Fried@uphs.upenn.edu

LEARNING OBJECTIVES

1) Identify factors that contribute to burnout in Radiology residents.2) Assess barriers to wellbeing for trainees in your program.3) Develop strategies that can be used on a daily basis in the reading room to promote wellness and resilience in Radiology residents.

RC302E Picture Radiology: Use of Narrative Paintings in Medical Education

Participants
Kari L. Visscher, MD,FRCPC, Cambridge, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Define narrative paintings. 2) Discuss relevance of narrative paintings in radiology education. 3) Describe techniques to use narrative paintings in medical education.

RC302F The Troubled Trainee: When and How to Intervene

Participants
Diana L. Lam, MD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Dllam@uw.edu

LEARNING OBJECTIVES

1) Identify common concerning trainee scenarios. 2) Examine factors which can contribute to trainee performance. 3) Discuss strategies on when and how to intervene.

Printed on: 10/29/20

RC303

Cardiac Series: Emerging Cardiovascular MR and CT Imaging

Tuesday, Dec. 3 8:30AM - 12:00PM Room: E350

CA CT MR

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

FDA Discussions may include off-label uses.

Participants
Karen G. Ordovas, MD, Seattle, WA (*Moderator*) Advisor, Arterys Inc;
Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV
Albert Hsiao, MD,PhD, La Jolla, CA (*Moderator*) Founder, Arterys, Inc; Consultant, Arterys, Inc; Shareholder, Arterys, Inc; Speaker, Bayer AG; Research Grant, Bayer AG; Speaker, General Electric Company; Research Grant, General Electric Company;
Michael K. Atalay, MD, PhD, Providence, RI (*Moderator*) Nothing to Disclose

Sub-Events

RC303-01 Applications of AI for Cardiovascular Imaging

Tuesday, Dec. 3 8:30AM - 9:00AM Room: E350

Participants
Albert Hsiao, MD,PhD, La Jolla, CA (*Presenter*) Founder, Arterys, Inc; Consultant, Arterys, Inc; Shareholder, Arterys, Inc; Speaker, Bayer AG; Research Grant, Bayer AG; Speaker, General Electric Company; Research Grant, General Electric Company;

LEARNING OBJECTIVES

1) Identify the recent innovations that have enabled a resurgence of interest in applying artificial intelligence (AI) in medical practice. 2) Identify potential applications for AI in the acquisition, analysis and interpretation of cardiovascular CT and MRI. 3) Apply concepts of analytical validity, clinical applicability, to become knowledgeable consumers of AI.

RC303-02 Deep-Learning Quantification of Coronary Calcium on CT and Mortality in the National Lung Screening Trial (NLST)

Tuesday, Dec. 3 9:00AM - 9:10AM Room: E350

Participants
Roman Zeleznik, Boston, MA (*Presenter*) Nothing to Disclose
Borek Foldyna, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Parastou Eslami, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Jakob Weiss, MD, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexander Ivanov, BS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Chintan Parmar, Allston, MA (*Abstract Co-Author*) Nothing to Disclose
Jana Taron, MD, Tuebigen, Germany (*Abstract Co-Author*) Nothing to Disclose
Julia Karady, MD, Budapest, Hungary (*Abstract Co-Author*) Nothing to Disclose
Lili Zhang, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Raza Alvi, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Yasuka Kikuchi, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Dahlia Banerji, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Mio Uno, MD, Tsu-city , Japan (*Abstract Co-Author*) Nothing to Disclose
Jan-Erik Scholtz, MD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Udo Hoffmann, MD, Boston, MA (*Abstract Co-Author*) Research Grant, Kowa Company, Ltd ; Research Grant, Abbott Laboratories; Research Grant, HeartFlow, Inc; Research Grant, AstraZeneca PLC;
Michael T. Lu, MD, Boston, MA (*Abstract Co-Author*) Grant, NVIDIA Corporation; Institutional Research Grant, Kowa Company, Ltd ; Institutional Research Grant, AstraZeneca PLC
Hugo Aerts, PhD, Boston, MA (*Abstract Co-Author*) Stockholder, Sphera Inc

For information about this presentation, contact:

roman_zeleznik@dfci.harvard.edu

PURPOSE

Coronary artery calcification (CAC) is quantifiable on low-dose chest CT and can guide statin therapy. Quantification is not routinely performed due to time and equipment limitations. We developed a deep-learning algorithm that automatically quantifies coronary calcium on standard lung screening CT and evaluated prognostic value in 14,959 National Lung Screening Trial (NLST) participants.

METHOD AND MATERIALS

The deep learning algorithm was developed in 1,600 cardiac CTs from with manual CAC measurement as the reference. The deep learning calcium score was categorized as: High (CAC>300), Moderate (CAC: 101-300), Low (CAC: 1-100), and Very Low (CAC: 0). The association of the deep learning calcium score with all-cause and cardiovascular mortality was then tested in 14,959 heavy smokers aged 55-74 having lung cancer screening chest CT at 33 US sites in NLST. The intraclass correlation coefficient (ICC) between automated and human manual CAC was assessed in 396 NLST chest CTs.

RESULTS

All-cause (7.3% (1,092/14,959)) and cardiovascular (1.9% (288/14,959)) mortality was assessed over median follow-up of 6.5 years. There was a significant association between deep learning calcium score and all cause mortality: High: HR 2.9 (95%CI: 2.4-3.5), Moderate: 1.9 (1.5-2.3), Low: 1.3 (1.1-1.6), all p<0.01 compared to Very Low; as well as for cardiovascular mortality: High: HR 6.6 (4.3-10.3), Moderate: 3.8 (2.3-6.1), Low: 2.2 (1.4-3.6), all p<0.001 compared to Very Low. The ICC between manual and automatic calcium classes was 0.858 (95%CI: 0.830-0.882).

CONCLUSION

The automated deep learning algorithm quantified CAC on lung screening CT. Automated CAC corresponded closely to human readers and was strongly associated with all-cause and cardiovascular mortality in a large multicenter cohort of NLST participants having lung screening.

CLINICAL RELEVANCE/APPLICATION

Automated quantification of coronary calcium using existing lung screening CTs identifies persons at high and low risk to guide cardiovascular prevention.

RC303-03 Estimation of Agatston Calcium Scores on Chest Radiographs Using Machine Learning

Tuesday, Dec. 3 9:10AM - 9:20AM Room: E350

Participants
Peter Kamel, MD, Ellicott City, MD (*Presenter*) Nothing to Disclose
Paul H. Yi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Haris I. Sair, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Tocagen
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PURPOSE

The Agatston calcium score quantifies the severity of coronary artery disease (CAD) and is typically measured on an EKG-gated cardiac CT. The purpose of this study was to assess the ability of deep convolutional neural networks (DCNNs) to estimate Agatston scores on chest radiographs (CXRs).

METHOD AND MATERIALS

Our dataset was comprised of 471 patients who had undergone a cardiac CT and a PA and lateral CXR in the same year. CT-derived Agatston scores were considered ground truth and used as labels for DCNN training on radiographs. Radiographs were split into 70% training and 30% testing, balancing the distribution of Agatston scores. Weighted augmentation was performed on images to increase data size and balance class distribution. An attention-based network architecture was built on a variety of standard DCNNs such as VGG-16, pretrained with ImageNet weights, and used for (1) binary classification of Agatston scores at variable thresholds and (2) linear regression prediction of absolute calcium scores. Classifier performance was measured using area under the curve (AUC) and regression assessed with the mean absolute error. Attention maps were produced to highlight areas of decision-making and results were additionally compared to radiologist mention of CAD on CXR reports.

RESULTS

Binary classification performed best for discrimination of Agatston scores greater than 75 with AUC of 0.73 (Fig. 1a). Best performing regression algorithms predicted Agatston scores with a mean absolute error of 159. DCNNs trained on PA radiographs outperformed those on lateral radiographs. Attention maps primarily localized to the cardiac silhouette (Fig. 1b), with highest performing binary algorithms additionally including the aortic arch and other vessels in predictions. Of the radiographs with calcium scores >75, none of the reports included mention of CAD.

CONCLUSION

DCNNs on CXRs may have utility in estimating calcium scores and predicting clinically-significant CAD, a finding not often reported by radiologists on radiographs. These results provide proof-of-concept in the promise of deep learning to extract additional information that may not typically be noted on human review.

CLINICAL RELEVANCE/APPLICATION

We illustrate the potential for deep learning to estimate Agatston calcium scores and predict the severity of coronary artery disease on chest radiographs.

RC303-04 Spectral Detector CT

Tuesday, Dec. 3 9:20AM - 9:50AM Room: E350

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

RC303-05 Advanced Coronary Plaque Characterization Using a Dual-Layer Spectral CT: Quantitative Assessment of Iodine Uptake in Plaques

Tuesday, Dec. 3 9:50AM - 10:00AM Room: E350

Participants
Jonathan Nadjiri, MD, Munich, Germany (*Presenter*) Nothing to Disclose

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PURPOSE

Spectral CT-coronary angiography (SCCTA) with a dual-layer detector allows for quantitative determination of iodine uptake with high accuracy with just one scan. In this pilot project we sought to prospectively evaluate this quantitative method to measure iodine uptake in coronary plaques as a possible surrogate for inflammation.

METHOD AND MATERIALS

We investigated 46 consecutive patients. 50ml of Iodine 400mg/ml was administered 2min before standard contrast-enhanced SCCTA with a regular contrast bolus. Hounsfield Units (HU) as well as iodine content (mg/ml) in each detectable non-calcified plaque were determined. In patients with indication for invasive coronary angiography (ICA) additionally Optical Coherence Tomography (OCT) was performed.

RESULTS

In the study population 18 non-calcified plaques were found in SCCTA. Mean density was 70 ± 56 HU. Mean Iodine uptake was 2.4 ± 2.1mg/ml, respectively. There was significant correlation between iodine uptake and density of coronary plaques; $r = 0.9$, $p < 0.001$. 11 patients underwent ICA; in these group 11 non-calcified plaques were found by SCCTA. For all of those plaque formations a correlate in OCT was found. For low-attenuation plaques (<90HU) there was no significant correlation between density and iodine uptake. In these plaques variance of iodine uptake was very high (standard deviation was 155% of mean) while in plaques with higher density (>=90 HU) variance was small (standard deviation was 33% of mean).

CONCLUSION

In our pilot study we found that in general in non-calcified plaques iodine uptake corresponds to the density of the plaques and we found a correlate of every non-calcified plaque detected by SCCTA in OCT. However, there is relevant difference in iodine uptake of coronary plaques with similar HU in very low attenuation plaques (HU < 90) indicating additional information through determination of quantitative iodine uptake.

CLINICAL RELEVANCE/APPLICATION

Coronary plaque characterization in CT is known to stratify a patient's individual risk for cardiovascular events beyond clinical risk scores, calcification and stenosis. However, a gap in predicting outcomes remains. This gap might be closed by more information about the plaque and its composition. Measuring iodine content as proposed in this abstract might be one of the missing parts to further close the prognostic gap of cardiac CT which has to be evaluated in further outcome studies.

RC303-06 Can Spectral Imaging Technique Reduce Agents Dosage in "One-Stop" Coronary and Aortic CT Angiography?

Tuesday, Dec. 3 10:00AM - 10:10AM Room: E350

Participants
Li Wei, MD,PhD, Liaocheng, China (*Presenter*) Nothing to Disclose
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Kunpeng Wu, Liaocheng , China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess the feasibility of 'one-stop' coronary and aortic examination with low contrast agentss by using spectral imaging technique .

METHOD AND MATERIALS

From Oct. 2017 to Apr. 2018, 96 consecutive patients undergoing both coronary and aortic CT angiography(CTA) examination in hospital were randomly divided into two groups. Conventional group (group A):Single-beat prospective electrocardiogram(ECG)-gated coronary CTA examination was followed by aortic CTA.The coronary artery axial scanning was performed before the spiral scanning. The whole scanning process was completed altogether with one-time injection of contrast agent,and the contrast agents was used for 0.85ml/kg. The Spectral group (group B): Single-beat prospective ECG-gated coronary CTA examination was followed by aortic spectral CTA. The contrast agents used 0.55ml/kg. The routine axial CCTA scanning was performed, and the spectrum of aorta was scanned after CCTA. All data were transferred to AW workstation for post-processing and measurement. The coronary artery and the best monochromatic images were processed by workstation. The contrast agent used 0.55ml/kg and recorded the CT values of descending aortic root in both 120kV and 50keV images were calculated. The radiation dose and the contrast agents dosage was recorded. The image quality of the two groups were evaluated by two radiologists by using 5-point scale. The student t test was used to evaluate continuous variables and the Manny-Whitney U test for image quality evaluation.

RESULTS

There was no significant difference in the image quality and radiation dose between the two groups(p>0.5). (Aotic4.6±0.5:4.4±0.6,RCA4.7±0.5:4.8±0.4,LAD4.6±0.4:4.5±0.5 LCX4.7±0.5:4.6±0.5,z=1.76,1.38,0.77,0.97) .Compared with the conventional group, the contrast agent was compared: (38.0± 4.3:57.6±8.3) ml, and the use of contrast agent was reduced in group B. The ED in Group A was not different from the combined ED in Group B and C (2.1 ± 0.6:1.9±0.5) mSv.

CONCLUSION

The"one-stop" coronary CTA and aortic spectral CTA is the feasible examination with low contrast agents dosage.

CLINICAL RELEVANCE/APPLICATION

"One-stop" CTA examination with low contrast agents dosage, is a suitable method for the patients with renal function impairment .

RC303-07 Valvular Flow Quantification with Phase Contrast Imaging

Tuesday, Dec. 3 10:20AM - 10:50AM Room: E350

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 4D Flow MRI Before and After Bicuspid Aortic Valve Sparing Surgery: Assessment of Aortic Flow Patterns for Monitoring of Successful Repair

Tuesday, Dec. 3 10:50AM - 11:00AM Room: E350

Participants
Alexander Lenz, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

To assess the feasibility of 4D flow MRI for evaluation of aortic flow patterns in patients with congenital aortic valve disease before and after aortic valve sparing surgical repair.

METHOD AND MATERIALS

20 patients (median age 34.5 years, IQR 29-47; 16 male) with severe aortic regurgitation [15 bicuspid aortic valves (BAV) and 5 unicuspid aortic valves (UAV)] underwent 4D flow MRI at 3T before and after valve sparing aortic repair. Analysis planes were placed at the aortic valve, sinotubular junction, mid-ascending aorta, and proximal arch. The aortic regurgitant fraction (%) was estimated. The degree of helical and vortical flow was evaluated according to a 3-point scale. Relative flow displacement (FD) as a measure of flow eccentricity and wall shear stress (WSS) were estimated. Results before and after surgery were statistically compared using a paired t-test or a Wilcoxon matched-pairs test.

RESULTS

All patients underwent successful aortic valve surgery (17 isolated aortic valve repairs, 3 aortic root procedures with a significant reduction of the aortic regurgitant fraction (27±13% vs. 6±3, P=0.001).The degree of both helical (1.6±0.6 vs. 0.9±0.5, P<0.0001) and vortical flow (1.2±0.8 vs. 0.5±0.6, P=0.002) in the ascending aorta was significantly reduced after valve sparing surgery. Both FD (0.3±0.1 vs. 0.1±0.1, P=0.003) and WSS (0.6±0.2 vs. 0.4±0.2, P=0.007) were significantly reduced after surgery at the level of the mid-ascending aorta.

CONCLUSION

4D flow MRI-based assessment of aortic flow patterns allows to monitor the success of valve sparing surgery in patients with bicuspid aortic valve disease.

CLINICAL RELEVANCE/APPLICATION

4D flow MRI allows to evaluate the success of valve repair surgery and may optimize surgical procedures in the future.

RC303-09 Cardiac Magnetic Resonance with 4D Flow Imaging for Mitral Regurgitation Severity Assessment

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E350

Participants
Marco Guglielmo, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Cardiac Magnetic Resonance (CMR) has recently emerged as a technique more accurate than echocardiography in assessing the severity of mitral regurgitation (MR). Standard method for mitral regurgitation determination with CMR is measuring the regurgitant volume (RV) as the difference between the LV stroke volume obtained with SSFP (Steady state free precession) cine imaging and the forward flow obtained with phase contrast (PC) imaging. It has already been demostrated that there is a strong correlation between post-surgical left ventricle (LV) remodeling and MR severity as assessed by CMR SSFP - PC. More recently, time-resolved phase contrast CMR with velocity encoding along all three flow directions and three-dimensional (3D) anatomic coverage (also termed '4D flow') has been developed.The purpose of this study was to compare CMR 4D flow and SSFP imaging for the assessment of MR severity using the degree of left ventricular (LV) remodeling after surgery as the reference standard.

METHOD AND MATERIALS

10 consecutive patients (age: 59 ± 10) with indication to mitral valve plasty for severe mitral regurgitation were enrolled. MR severity was assessed using both CMR SSFP - PC imaging and CMR 4D flo imaging without the use of contrast agents. The pre-surgical estimate of regurgitant severity was correlated with the postoperative decrease in LV end-diastolic volume.

RESULTS

Agreement between CMR SSFP-PC imaging and CMR 4D flow imaging for MR regurgitant volume (RV) was excellent for both pre ($r = 0.8$, $p<0.05$, mean difference 5.1 mL) and post surgery ($r= 0.9$, $p<0.05$) evaluations. There was a strong correlation between post-surgical LV remodeling and MR severity as assessed by CMR 4D flow imaging ($r=0.81$, $p <0.005$) that was comparable to CMR SSFP-PC ($r=0.78$, $p<0.005$). The average time for MR assessment with CMR SSFP and PC imaging evaluation was 10 minutes, 2 minutes with CMR 4D flow imaging.

CONCLUSION

CMR 4D flow imaging without contrast agents allows an accurate and quick evaluation of MR regurgitant volume. There is a strong correlation between MR severity assessed with CMR 4D flow imaging and post-surgical LV remodeling. Indeed, CMR 4D flow imaging may represent an alternative method for MR severity assessment.

CLINICAL RELEVANCE/APPLICATION

4D flow approach can be extremely helpful for the management of patients with mitral regurgitation.

RC303-10 Multi-parametric Myocardial MR Mapping (T1, T2, T2*)

Tuesday, Dec. 3 11:10AM - 11:40AM Room: E350

Participants
Kate Hanneman, MD, FRCPC, Toronto, ON (*Presenter*) Medical Advisory Board, sanofi-aventis Group

LEARNING OBJECTIVES

1) Describe analysis approaches for T1/T2/T2* parametric maps. 2) Discuss clinical role of T1/T2/T2* parametric mapping. 3) Identify findings of common diseases on T1/T2/T2* parametric maps.

RC303-11 Tissue Heterogeneity in Native MR T1/T2 Map Helps Diagnose Cardiac Involvement in Neuromuscular Diseases

Tuesday, Dec. 3 11:40AM - 11:50AM Room: E350

Participants
Lu Huang, MD, Wuhan, China (*Presenter*) Nothing to Disclose
Qian Tao, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Cardiac involvement is common in neuromuscular diseases (NMDs), and is a major cause of progressive heart failure. Subclinical cardiac involvement in NMDs is however difficult to detect. The aim of this study was to investigate the diagnostic value of native MR T1/T2 mapping parameters to detect cardiac involvement in NMDs.

METHOD AND MATERIALS

Sixty subjects (41±16y) diagnosed as NMDs, including 40 idiopathic inflammatory myopathy, 20 non-inflammatory myopathies, and 20 age and gender-matched healthy controls were enrolled in this study. NMDs patients with abnormal ECG or LGE or reduced LVEF/ RVEF were categorized as the cardiac involvement subgroup. All subjects underwent a CMR exam on a 3T MR scanner (Skyra, Siemens Healthineers, Erlangen, Germany), including short-axis SSFP cine, LGE, native T1 and T2 mapping, covering the whole heart. Endocardial and epicardial contours of the left ventricle were manually drawn on short-axis T1 and T2 maps. Six parameters, including mean, median, minimum, maximum and entropy, were calculated from the T1 and T2 map.

RESULTS

Forty-one NMDs patients were categorized as the cardiac involvement subgroup, and the remaining 19 were categorized as the non-involvement subgroup. Compared to the controls, T1 mean, median, SD and entropy, as well as T2 mean, median, and entropy of the cardiac involvement subgroup all elevated significantly ($P<0.05$ for all 8 parameters), while in the non-involvement subgroup, only native T1 mean and median increased ($P<0.05$ for both). The heterogeneity parameters, namely, the native T1/T2 SD and entropy, were all significantly higher in the cardiac involvement subgroup compared to then non-involvement subgroup ($P <0.05$ for all). A multi-variate regression model including all heterogeneous parameters exhibited a diagnostic accuracy of 83% (AUC 0.81, 95%CI: 0.67-0.94) to detect cardiac involvement in NMDs patients.

CONCLUSION

Tissue heterogeneity in the native MR T1/T2 map showed high diagnostic value in identifying cardiac involvement in NMDs patients. The heterogeneity parameter may substitute LGE acquisition which requires contrast agent.

CLINICAL RELEVANCE/APPLICATION

Early detection of cardiac involvement in NMDs can help prevent overt heart failure. Tissue heterogeneity in the native MR T1/T2 map showed high diagnostic value, without use of contrast agent.

RC303-12 Role of Cardiac MRI in Diagnosis in Patients of Cardiac Sarcoidosis Using T1 Mapping, T2 Mapping and Late Gadolinium Enhancement (LGE)

Tuesday, Dec. 3 11:50AM - 12:00PM Room: E350

Participants
Amarinder Singh SR, MBBS,MD, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose
Manish Shaw JR, MD, MBBS, Kolkata, India (*Presenter*) Nothing to Disclose
Gurpreet S. Gulati, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
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Rishabh Khurana, MBBS, DMD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Sheragaru H. Chandrashekhara, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To determine whether quantitative tissue characterization with T1 mapping, T2 mapping and late gadolinium enhancement supports recognition of myocardial involvement in patients of cardiac sarcoidosis. To correlate cardiac MRI with PET and echocardiography findings.

METHOD AND MATERIALS

Prospective study with size of 19, Patients with biopsy proven extracardiac sarcoidosis presenting to us with suspicion of cardiac involvement were included. MRI was done on 1.5 Tesla scanner (Aera; Siemens, Erlangen, Germany). Cardiac MRI protocol- localizer sequences->cine images in short axis/vertical long axis/4 chamber view->T1W, T2W F - perfusion imaging in short axis/ vertical long axis/ 4 chamber view->T1 scout, PSIR sequences after 5 and 15 minutes and Post contrast T1W sequence. T1 (using modified Look-Locker imaging-MOLLI T1 maps) and T2 mapping (using hybrid gradient and spin-echo sequence) were performed in a single midventricular short-axis section.

RESULTS

The mean age was 38 years, F:M=10:9. Most common presenting symptom was palpitations. Presence of characteristic mid-myocardial LGE was seen in 11/12 patients with confirmed sarcoidosis. T1 mapping is a technique that helps in tissue characterization without contrast. In our study, we did segment wise analysis of T1 mapping values. We compared T1 mapping values in the involved segments in patients with cardiac sarcoidosis with the values from normal segments in healthy controls. We used ROC curve analysis to establish an optimal cut-off value of 1029 sec's with a sensitivity of 87.5% and high specificity of 96.9%. Using this cut-off value we observed that T1 mapping abnormalities were observed in patients with pulmonary sarcoidosis who were suspected to have cardiac involvement but did not show any LGE. Hence, T1 mapping may add incremental value to LGE in patients with suspected cardiac involvement and allow detection of patients who may be LGE negative. Similar to T1 mapping, T2 mapping (tiissue water content and are indicative of myocardial edema. can be used to quantify myocardial tissue characteristics. T2 values represent Elevated T2 map values reflect tissue inflammation and are suggestive of disease activity. In the present study we compared T2 values in the LGE positive segments with the T2 values in normal controls and observed statistically significant difference between the two groups. ROC curve analysis yielded a cut-off value of 46.3 milli seconds.with a sensitivity and specificity of 75% and 71.1% respectively.

CONCLUSION

Quantitative tissue characterization in the myocardium with native T1 and T2 mapping helps in the detection of cardiac involvement in patients with systemic sarcoidosis, in relation to inflammation of the myocardium and disease recognition. Cardiac MRI with T1, T2 mapping and LGE have excellent performance in detecting myocardial involvement in patients suspected to have cardiac sarcoidosis.

CLINICAL RELEVANCE/APPLICATION

T1 and T2 mapping values can be used to diagnose the cardiac sarcoidosis (T1 mapping for fibrosis, T2 mapping for edema/inflammation) without giving contrast.

RC304

Musculoskeletal Series: Ultrasound

Tuesday, Dec. 3 8:30AM - 12:00PM Room: E450A

MK US

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.50

Participants
Ogonna K. Nwawka, MD, New York, NY (*Moderator*) Research Grant, General Electric Company
Marnix T. van Holsbeeck, MD, Detroit, MI (*Moderator*) Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder, MedEd3D;
Robert R. Lopez, MD, Cornelius, NC (*Moderator*) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (*Moderator*) Research Consultant, BioClinica, Inc; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier

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Sub-Events

RC304-01 Shoulder Ultrasound (Demonstration)

Tuesday, Dec. 3 8:30AM - 9:00AM Room: E450A

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

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LEARNING OBJECTIVES

1) To identify the musculoskeletal structures in the shoulder that can be visualized and effectively assessed under ultrasound.

RC304-02 Weight-Bearing Ultrasound Evaluation of Medial Meniscal Extrusion: Correlation with MRI and Meniscal Tears

Tuesday, Dec. 3 9:00AM - 9:10AM Room: E450A

Participants
Anna L. Falkowski, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
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Mark Cresswell, MBBCh, Vancouver, BC (*Abstract Co-Author*) Consultant, Koninklijke Philips NV
Asheesh Bedi, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Vivek Kalia, MD, MPH, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to compare medial meniscal extrusion as seen on weight-bearing ultrasound compared with MRI and meniscal tears.

METHOD AND MATERIALS

In this IRB-approved study with informed consent, patients obtaining a routine knee MRI were prospectively evaluated with supine and weight-bearing ultrasound (US) of the medial meniscus. Position of the outer boundary of the medial meniscus on US images and MRI was measured relative to the tibia by a fellowship-trained musculoskeletal radiologist. Correlation was made to the presence or absence of meniscal tear or meniscal root tear, and statistical significance was calculated via student t-test.

RESULTS

50 knees from 49 subjects (23 male, 26 female; mean age 44±15 years) were included (18 right, 32 left; one bilateral). The mean medial meniscal extrusion on supine US was 1.3 mm (range -1.5 to 3.6 mm), with no significant difference compared with MRI ($p=0.21$), which increased to 2.1 mm on weight-bearing US. In the 38% (19/50) of subjects with meniscal tears, the mean medial meniscal extrusion on weight-bearing US was 2.13 mm (range 0 to 4.4 mm) with a change between supine and weight-bearing of 0.63 mm (range -1.8 to 2.7 mm). In the 62% (31/50) of subjects with no meniscal tear, the mean medial meniscal extrusion on weight-bearing US was 2.05 mm (range 0 to 3.8 mm) with a change between supine and weight-bearing of 0.87 mm (range -0.1 to 2.2 mm), and no significant difference between subjects with and without tear ($p=0.805$ and $p=0.413$). Of note, the subject with a medial meniscal root tear showed a change of -1.8 mm from supine to weight-bearing US.

CONCLUSION

Supine US was comparable with supine MRI for assessment of medial meniscal extrusion. The presence of meniscal tear or meniscal root tear did not result in increased medial meniscal extrusion on weight-bearing US compared with no meniscal tear.

CLINICAL RELEVANCE/APPLICATION

Assessment of meniscal extrusion is comparable to MRI. Meniscal extrusion on weight-bearing US should not be equated with the presence of meniscal tear.

RC304-03 Value of Sonoelastography in Achilles Tendon Assessment: Is it Possible to Predict the Rupture?

Tuesday, Dec. 3 9:10AM - 9:20AM Room: E450A

Participants
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Gordana Ivanac, MD, Zagreb, Croatia (*Abstract Co-Author*) Nothing to Disclose
Domagoj Lemac, MD, Zagreb, Croatia (*Abstract Co-Author*) Nothing to Disclose
Boris Brkljacic, MD,PhD, Zagreb, Croatia (*Abstract Co-Author*) Advisory Board Member, contextflow GmbH

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PURPOSE

Rupture of Achilles tendon is a common problem in sports medicine and affects both professional and recreational athletes. Currently it is impossible to predict whether someone is under increased risk for rupture. However, it was demonstrated that about 6% of patients with previously ruptured Achilles tendon experienced the rupture of contralateral tendon in the future. Therefore, the aim of this study was to assess the risk for rupture of contralateral tendon in patients who underwent surgical reconstruction of ruptured Achilles tendon by using standardized questionnaires and ultrasound shear wave elastography (SWE). Finally, we hypothesized that SWE could be used to predict which Achilles tendon will be at higher risk to future rupture.

METHOD AND MATERIALS

Fifty patients who underwent surgical repair of the ruptured Achilles tendon and twenty aged matched healthy controls were examined with ultrasound B-mode and SWE. Functional outcomes and subjective feeling were assessed with American Orthopedic Foot and Ankle Society (AOFAS) scoring system and subjective rating system which we introduced and validated. Elastograms captured by SWE were analyzed with newly developed software, which enabled detailed quantification of whole area of interest.

RESULTS

The stiffness of injured Achilles tendon was markedly decreased (by 54%, $P<0.01$) when compared to both contralateral tendon of the patient and tendons of healthy individuals. Additionally, AOFAS score and newly introduced subjective assessment scale positively correlated with ultrasound SWE values in ruptured and healthy Achilles tendons. The stiffness of contralateral Achilles tendons in patients was significantly lower than among healthy individuals ($P<0.01$).

CONCLUSION

Irrespective of the lack of difference in function and subjective feeling, the contralateral tendon in the patients with repaired Achilles tendon had significantly lower stiffness than healthy individuals. Therefore, contralateral tendons in patients who suffered rupture are more prone to future injuries.

CLINICAL RELEVANCE/APPLICATION

According to our results SWE is capable to detect individuals with increased risk for Achilles tendon injury.

RC304-04 Determining Ultrasound Predictors for Tendon Healing in Lateral Epicondylitis (LE): A Cohort Study Correlating Ultrasound Findings with Pain and Functional Disability

Tuesday, Dec. 3 9:20AM - 9:30AM Room: E450A

Participants
Shubham Shubham, MBBS, Amritsar, India (*Presenter*) Nothing to Disclose
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Siddharth Gupta, MBBS, Ambala, India (*Abstract Co-Author*) Nothing to Disclose
Rajesh K. Chopra, MBBS,MS, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Sunil K. Bajaj, MD, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose
Vinay Hc, MD,MBBS, Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Arka Bhattacharya, MBBS, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Correlation of US findings with Patient-Rated Tennis Elbow Evaluation (PRTEE) scores before and after six months of conservative management in LE cases to determine predictors for tendon healing.

METHOD AND MATERIALS

In this institutional review board approved cohort study, fifty three consenting clinically diagnosed adult patients of LE without any history of elbow injection within last one month, trauma or surgery were evaluated by a validated outcome measure the PRTEE scale and US. It was followed by nonoperative standardized treatment (physiotherapy with eccentric loading) for six months and evaluation again for post treatment PRTEE scores. PRTEE scale comprises of five questions to assess pain and ten questions to assess disability each graded from 0 to 10. The minimum and maximum scores being 0 and 100 respectively. US was done using a 8-

18 MHz linear transducer on a slightly flexed elbow with supine forearm to assess common extensor tendon (CET) thickness, CET echotexture, CET tears, CET neovascularity and radial collateral ligament (RCL) tears. Using linear regression post treatment PRTEE scores were correlated with aforementioned US parameters.

RESULTS

The mean pretreatment PRTEE score was 73.43 (range 55-92) and post treatment PRTEE score was 43.19 (range 12-90). Using mann-whitney test the difference in means was found to be significant ($p < .0001$). Using linear regression a positive association of post treatment PRTEE scores with CET hypoechogenicity ($p < .05$), percentage of CET ($p < 0.05$) and RCL tears ($p < 0.05$) was identified. No correlation was found with age, sex, side, symptom duration, CET tendon thickness, or amount of CET neovascularity.

CONCLUSION

US can reliably diagnose as well as grade CET tears, radial collateral ligament tears, and quantify CET hypoechogenicity which are less likely to respond to nonoperative management thus can potentially guide management in such cases who may require more invasive treatment. CET thickning and CET neovascularity may be poor predictors of prognosis.

CLINICAL RELEVANCE/APPLICATION

Ultrasound (US) is non-invasive, cost-effective and can reliably diagnose lateral epicondylitis (LE) and potentially determine predictors of delayed healing thus avoiding morbidity and guide management.

RC304-05 Knee Ultrasound (Demonstration)

Tuesday, Dec. 3 9:30AM - 10:00AM Room: E450A

Participants
Marnix T. van Holsbeeck, MD, Detroit, MI (*Presenter*) Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder, MedEd3D;

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LEARNING OBJECTIVES

1) Recognize important anatomic landmarks in knee according to four quadrant knee scanning approach. 2) Question the integrity of the quadriceps using a layered approach. 3) Discriminate anatomy in popliteal space via surface screening of femoral and tibial condyles. 4) Judge the knee's capsular integrity by applying appropriate dynamic maneuvers.

RC304-06 Elbow Ultrasound (Demonstration)

Tuesday, Dec. 3 10:30AM - 11:00AM Room: E450A

Participants
Jon A. Jacobson, MD, Ann Arbor, MI (*Presenter*) Research Consultant, BioClinica, Inc; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier

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LEARNING OBJECTIVES

1) Define regional anatomy of the elbow. 2) List the anatomic structures evaluated with ultrasound. 3) List the steps of an ultrasound examination of the elbow.

RC304-07 Vibro-Acustography Characterization of Bone Tissue in an Experimental Model

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E450A

Participants
Marcello H. Nogueira-Barbosa, MD, PhD, Ribeirao Preto, Brazil (*Presenter*) Nothing to Disclose
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PURPOSE

This study aimed to evaluate the potential of vibro-acustography (VAC) on the diagnosis of osteoporosis. As such, we used microCT as a reference technique to evaluate femur bone properties and estimated the correlation of VAC and microCT parameters in control and mice subjected to hepatotoxic drug (CCl_4).

METHOD AND MATERIALS

The experimental protocol included three groups of mice: a) control group= C; b) submitted to intraperitoneal injection of CCl_4= HO and C) submitted to intraperitoneal injection of CCl_4 and antiresorptive drug (pamidronate) = HOP. The evaluation of the specimens was conducted in an acoustic tank, by the VAC technique, whereby a confocal ultrasonic transducer generates two high frequency (MHz) focused beams, with a difference frequency of 45 KHz between them. These two beams interact with each other and with the bone sample, producing a low frequency Acoustic response (AR) that is registered by a hydrophone. The AC signals have been processed in order to obtain numerical values which carries information about the mechanical properties of the samples.

Experiments were repeated three times. Statistical analysis included Interclass Correlation Coefficient (ICC), ANOVA multiple comparisons and Spearman's rank correlation coefficient.

RESULTS

VAC spectral analysis of the AR differentiate the experimental groups ($p<0.01$) and the results were reproducible (ICC = 0.43 [95%CI = 0.15 - 0.71]). There was a statistically significant relationship between VAC and MicroCT in connectivity ($p<0.01$; $r=0.80$) and connectivity density ($p<0.01$; $r=0.76$) and a trend between VAC and trabecular number and trabecular separation ($p=0.06$).

CONCLUSION

The present study shows that VAC has sufficient sensitivity to detect impairment of bone properties in hepatic osteodystrophy. In addition, it was observed positive correlation between VAC and microCT assessment. These results encourage further studies to evaluate the potential of VAC estimation on the diagnosis of osteoporosis.

CLINICAL RELEVANCE/APPLICATION

This is an experimental study using an emerging technique (US-based) to evaluate bone tissue. This provides foundations to reach clinical use.

RC304-08 Reliable Sonographic Features of Benign Soft Tissue Lipomas: Can We Obviate the Need for Advanced Imaging?

Tuesday, Dec. 3 11:10AM - 11:20AM Room: E450A

Participants
Michael R. Shroads, MD, San Diego, CA (*Presenter*) Nothing to Disclose
Eman Alqahtani, MD, MPH, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Sonography is often the initial diagnostic modality for palpable soft tissue lesions; however, specificity is limited and advanced cross-sectional imaging is frequently pursued. Previous studies report a low accuracy of sonography in diagnosing lipomas. Using pathologic and MRI/CT correlation, our study aims to identify reliable sonographic features to distinguish benign lipomas from other lesions.

METHOD AND MATERIALS

Sonographic images of 53 soft tissue lipomas (26 pathologically-proven, 27 diagnosed on MRI, CT, or PET/CT) and 49 non-lipoma lesions (all pathologically-proven) were retrospectively reviewed. Lesions were characterized by the following parameters: echogenicity relative to subcutaneous fat and underlying muscle, echotexture, the presence of septa, nodularity, through transmission, shadowing, vascularity, and location (superficial vs. deep). Characteristics of the lipoma and non-lipoma groups were compared using chi-square analysis. Performance testing (sensitivity, specificity, PPV, NPV, and overall accuracy) of combined grayscale and color Doppler findings was also obtained.

RESULTS

There were statistically significant differences between the groups with respect to echogenicity, presence of septa, nodularity, shadowing, vascularity, and location. All lipomas were isoechoic or hyperechoic relative to subcutaneous fat ($p <.001$), 41 of 53 were isoechoic or hyperechoic relative to muscle ($p=.002$), 47 of 53 showed thin septa ($p <.001$), 51 of 53 showed no nodularity ($p <.001$), 6 of 53 showed shadowing ($p=.034$), 48 of 53 were avascular ($p <.001$), and 38 of 53 were superficial in location ($p <.001$). Combined grayscale parameters yielded a sensitivity and specificity of 71 and 94%, respectively. The addition of avascularity increased specificity to 98%.

CONCLUSION

Specific grayscale and color Doppler sonographic features of soft tissue lesions, particularly those located superficially, improves confidence in diagnosing benign lipomas, potentially obviating the need for more advanced imaging.

CLINICAL RELEVANCE/APPLICATION

Reliable predictors of benignity on ultrasound may reduce the need for costly and time-consuming advanced imaging in the evaluation of soft tissue lipomas.

RC304-09 Augmented Reality IN-SITU Visualization for Ultrasound-Guided Interventions

Tuesday, Dec. 3 11:20AM - 11:30AM Room: E450A

Participants
Nadja A. Farshad-Amacker, MD, Zurich, Switzerland (*Presenter*) Spouse, Research funded, Balgrist
Till Bay, Zurich, Switzerland (*Abstract Co-Author*) CEO, Balgrist Start-up Company
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Jose Spirig, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Florian Wanivenhaus, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Mazda Farshad, Zurich, Switzerland (*Abstract Co-Author*) Founder, Incremed

PURPOSE

The purpose of this study was to access the performance of Ultrasound (US)-guided needle placement without and with augmented reality in-situ US viewing, in dependence of the expertise of the operator.

METHOD AND MATERIALS

Three untrained operators and two experienced radiologists performed 200 US-guided punctures: 100 with and 100 without AR in-situ US. The punctures were performed in two different phantoms, a leg phantom with soft tissue lesions and a vessel phantom. Time to puncture and number of needle passes were compared.

RESULTS

AR in-situ US resulted in reduced time (mean: 22 vs. 30s) and number of needle passes (median; range: 1;1-4 versus 1;1-8) compared to the conventional US technique. The initial gap in performance of untrained operators vs experienced radiologists with the conventional method (time: 37 vs 20s; needle passes: 1;1-8 vs 1;1-2) was reduced (time: 25 vs 18s; needle passes: 1;1-4 vs 1; 1-4).

CONCLUSION

AR in-situ US could be a potential brake-trough in US imaging by the concept of simplifying spatial orientation for the operator, thus reducing experience-based differences in performance of US-guided interventions.

CLINICAL RELEVANCE/APPLICATION

AR in-situ US could be a potential brake-trough in US imaging by reducing experience-based differences in performance of US-guided interventions.

RC304-10 Small Joints Ultrasound (Demonstration)

Tuesday, Dec. 3 11:30AM - 12:00PM Room: E450A

Participants
Robert R. Lopez, MD, Cornelius, NC (*Presenter*) Nothing to Disclose

Printed on: 10/29/20

RC305

Neuroradiology Series: Brain Tumors

Tuesday, Dec. 3 8:30AM - 12:00PM Room: S406B

NR OI

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

FDA Discussions may include off-label uses.

Participants
Soonmee Cha, MD, San Francisco, CA (*Moderator*) Nothing to Disclose
Ji-hoon Kim, MD, PhD, Seoul, Korea, Republic Of (*Moderator*) Nothing to Disclose

Sub-Events

RC305-01 Integrated Next-Generation Sequencing for Glioma Diagnosis and Treatment: What is it and Where Does Imaging Fit In?

Tuesday, Dec. 3 8:30AM - 9:00AM Room: S406B

Participants
David Solomon, MD,PhD, San Francisco, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Comprehend the basic principles of next-generation sequencing. 2) Recognize the role of genetic characterization using NGS for diagnostic classification of CNS tumors. 3) Appreciate that an 'integrated diagnosis' for CNS tumors requires integration of radiographic, histologic, and molecular findings.

RC305-02 Interrater Agreement Using a Brain Tumor MRI Structured Reporting System in a Tumor Board Setting

Tuesday, Dec. 3 9:00AM - 9:10AM Room: S406B

Participants
Maxwell Cooper, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
Michael J. Hoch, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Syed A. Abidi, BS, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Longitudinal imaging evaluation of brain tumor patients with MRI is a challenging endeavor, as there is considerable overlap between imaging findings of tumor progression and treatment related changes, including radiation necrosis. Additionally, there is felt to be a high degree of variation between individual interpreters, particularly in complex cases such as those presented at multidisciplinary tumor board (TB). Structured reporting systems, such as the recently described brain tumor reporting and data system (BT-RADS), attempt to maximize consistency between reading radiologists, although how successful they are at achieving this is unknown.

METHOD AND MATERIALS

Patients with a diagnosis of a primary brain tumor with imaging presented at adult brain tumor board between October 2017 and March 2019 were reviewed. The most recent follow-up MRI was scored on an 8-point scale as described by BT-RADS, ranging from 0 to 4 with increasing suspicion for worsening disease, as described in the original radiologist report. Secondary review of MRI was performed by one of three neuroradiologists participating in brain tumor conference. Interrater agreement between primary and secondary review were calculated using rates of exact agreement and linear weighted kappa.

RESULTS

Of studies reviewed, 270 out of 275 had imaging and reports suitable for repeat structured scoring. Grade 4 astrocytoma (glioblastoma) was the most common diagnosis, followed by grade 2 oligodendroglioma and grade 2 astrocytoma (Figure 1A). The overall agreement rate between initial and secondary review was 83.0% with kappa of 0.89 +/- .05. There was perfect agreement on studies with improvement (1a or 1b) with lower levels of agreement (63.6-82.4%) for studies with worsening imaging findings (3a-4) (Figure 1B).

CONCLUSION

Using a structured reporting system to categorize MRIs in brain tumor patients presented at tumor board allows for precise characterization of variation between report conclusions on primary and secondary review. Overall agreement is good, but variation rates increase with worsening findings which may be harder to correctly interpret.

CLINICAL RELEVANCE/APPLICATION

Structured reporting system of MRIs in brain tumor patients allows quantitation of report variation between readers, with further study needed to understand the impact on patient care.

RC305-03 Metabolic Characterization of Human Glioma Subtypes Using pH-Weighted Amine Chemical Exchange Saturation Transfer Echoplanar Imaging (CEST-EPI) at 3T

Tuesday, Dec. 3 9:10AM - 9:20AM Room: S406B

Participants
Jingwen Yao, MBBS,MS, Los Angeles, CA (*Presenter*) Nothing to Disclose
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David A. Nathanson, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Isocitrate dehydrogenase (IDH) mutant and chromosome 1p/19q co-deleted gliomas may have distinct metabolic characteristics, which may explain their sensitivity to therapy and slow growth rates. We hypothesized a new pH-sensitive molecular MRI technique could be used to non-invasive quantify abnormal metabolic behavior in glioma subtypes.

METHOD AND MATERIALS

pH-weighted MRI was obtained at 3T using amine chemical exchange saturation transfer echoplanar imaging (CEST-EPI). The pH-dependent measure of MTRasym at 3ppm along with an estimate of acidic tumor volume were quantified in 136 patients with gliomas. Acidic tumor volume was defined by tissue with MTRasym at 3ppm>99% confidence interval of normal measurements on a voxel-wise basis in a set of 20 healthy volunteers.

RESULTS

MTRasym at 3ppm (acidity) and acidic tumor volume fraction within T2 hyperintense areas (excluding necrosis) increased with increasing WHO grade (*MTRasym: P=0.0189, Acidic Volume: P=0.0050*). In untreated tumors (pre-operative, post-operative, or not on active therapy for at least 1 year (N=89)), MTRasym at 3ppm (acidity) and acidic tumor volume fraction were significantly higher in IDH wild-type compared to mutant gliomas (*MTRasym: P=0.0399, Acidic Volume: P=0.0219*). In untreated patients with 1p/19q status available (N=58), MTRasym at 3ppm (acidity) was significantly lower in 1p/19q co-deleted compared to non-co-deleted gliomas (*P=0.0246*). Acidic tumor volume fraction was slightly lower in 1p/19q co-deleted gliomas (*P=0.1535*). In patients with complete molecular data, untreated and on active therapy, 1p/19q co-deleted tumors were significantly less acidic than 1p/19q non-co-deleted tumors when accounting for IDH status (*P=0.00038*), with significant interaction effects between 1p/19q and IDH status (*P=0.00088*). Acidic volume fraction was lower in 1p/19q co-deleted compared with non-co-deleted gliomas when accounting for IDH status (*P=0.00916*).

CONCLUSION

IDH mutant and 1p/19q co-deleted gliomas have distinct metabolic characteristics as measured using pH-weighted amine CEST-EPI at 3T.

CLINICAL RELEVANCE/APPLICATION

pH-weighted molecular MRI suggests IDH mutant and 1p/19q co-deleted gliomas (oligodendrogliomas) have unique metabolic characteristics that may be useful for as a therapeutic targeting.

RC305-05 Molecularly Defined CNS Tumors (IDH, 1p19q, CDK, BRAF, RELA)-What All Radiologists Who Read Brain Tumor Imaging Must Know

Tuesday, Dec. 3 9:30AM - 10:00AM Room: S406B

Participants
Soonmee Cha, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List several CNS tumors that are newly classified based on molecular and genetic markers in the 2016 CNS Tumor Classification of World Health Organization. 2) Describe salient imaging features associated with the molecularly and genetically defined CNS tumors. 3) Explain the importance of molecular/genetic features of CNS tumors in interpreting imaging before, during, and after targeted therapy.

RC305-06 Hot Topic Panel: What's Next for Brain Tumor Imaging in the Era of 2016 CNS WHO?

Tuesday, Dec. 3 10:10AM - 10:40AM Room: S406B

Participants
David Solomon, MD,PhD, San Francisco, CA (*Presenter*) Nothing to Disclose
Soonmee Cha, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Michael Lim, Baltimore, MD (*Presenter*) Research Support, Arbor; Research Support, Aegenus; Research Support, Altor; Research Support, Bristol-Myers Squibb Company; Research Support, Accuray Incorporated; Research Support, DNAtrix; Consultant, Tocagen Inc; Consultant, SQZ Technologies; Consultant, VBI Vaccines Inc; Consultant, Stryker Corporation; Consultant, Baxter International Inc
Susan L. McGovern, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose

RC305-07 Immunotherapy: Where is this Going and What Does Imaging Look Like Post Therapy?

Tuesday, Dec. 3 10:40AM - 11:10AM Room: S406B

Participants
Michael Lim, Baltimore, MD (*Presenter*) Research Support, Arbor; Research Support, Aegenus; Research Support, Altor; Research Support, Bristol-Myers Squibb Company; Research Support, Accuray Incorporated; Research Support, DNAtrix; Consultant, Tocagen Inc; Consultant, SQZ Technologies; Consultant, VBI Vaccines Inc; Consultant, Stryker Corporation; Consultant, Baxter International Inc

LEARNING OBJECTIVES

1) To understand the current state of immunotherapy for brain tumors. 2) To understand the challenges of radiographic endpoints in brain tumor immunotherapy trials. 3) Identify obstacles for effective immunotherapy in brain tumors.

RC305-08 Prognostic Value of Deep-Learning-Based Quantitative MRI Analysis in Diffuse Glioma

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S406B

Participants
Xue Feng, Charlottesville, VA (*Presenter*) Nothing to Disclose
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Craig Meyer, Charlottesville, VA (*Abstract Co-Author*) Research Grant, Siemens AG
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Sohil H. Patel, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Diffuse gliomas exhibit highly variable prognosis due to heterogeneous molecular and genetic characteristics. Pre-operative MRI provides important diagnostic information, but its prognostic value is less well understood. The purpose was to use a deep-learning-based method to automatically extract quantitative imaging features and study their prognostic value for overall survival.

METHOD AND MATERIALS

Data from a total of 140 diffuse glioma patients with pre-operative MR using pre- and post-contrast T1, T2, FLAIR was obtained from a local clinical database. Age at diagnosis, gender, tumor grade, IDH status as well as the overall survival in days was determined for each patient. The tumor region was first automatically segmented using a deep convolutional neural network. After segmentation, the whole tumor volume and surface area were obtained as well as the sphericity, which measures how closely the shape approaches a sphere. The overall survival was classified as < 5 and > 5 years. First, the age, gender, tumor grade and IDH status were used as non-imaging features to predict the overall survival class. The volume, area and sphericity were then combined with age and gender for the same task to evaluate the classification accuracy with only pre-operative information. Finally, all features were used in the classifier. 5-fold cross validation was performed and the average accuracy and area-under-the-curve (AUC) were calculated. Logistic regression models were trained on 4/5 of the data and tested on the remaining 1/5 at each fold.

RESULTS

Statistical significance was observed between each of the three imaging features (volume, surface area, sphericity) and patient overall survival (Fig 1), with sphericity showing highly significant differences (p=1e-6), indicating that larger and irregular tumors tend to have shorter survival. Survival prediction accuracy using pre-operative information was 0.836 with AUC of 0.905. The combined non-imaging features obtained an accuracy of 0.921 and AUC of 0.947; adding the imaging features slightly reduced the accuracy to 0.907 but the AUC increased to 0.958.

CONCLUSION

Quantitative information extracted from multi-contrast MRI using deep-learning-based segmentation provides prognostic value in the pre-surgical setting for diffuse glioma patients.

CLINICAL RELEVANCE/APPLICATION

For diffuse glioma patients, deep-learning-based segmentation of pre-operative MRI provides prognostic value.

RC305-09 Assessment of Safety Profile of Tumor Treating Fields on Normal Brain in Glioblastoma Patients Using Diffusion Tensor Imaging

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S406B

Participants
Sanjeev Chawla, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Tumor treating fields (TTFields) is a novel therapeutic modality recently approved for the management of patients with glioblastoma (GBM). No quantitative evidence of safety profile of TTFields on normal brain parenchyma in patients with GBM is available. The purpose of present study was to assess whether TTFields induce any tissue damage to normal brain regions in patients with GBM by using diffusion tensor imaging (DTI).

METHOD AND MATERIALS

Twelve patients GBM previously treated with surgery and chemo-radiation therapy received TTFields. Patients underwent anatomical imaging and DTI on a 3T MR system at baseline (prior to TTFields) and at two-month following initiation of TTFields. DTI data were acquired using a single-shot spin-echo EPI sequence (30 directions). After motion and eddy current correction of raw DTI data, parametric maps [mean diffusivity (MD), fractional anisotropy (FA), coefficient of linear (CL), planar (CP) and spherical anisotropy (CS)] were computed. DTI maps at two time points were co-registered. Mean values of MD, FA, CL, CP and CS were computed from different normal appearing gray-matter, and white-matter regions bilaterally by drawing circular regions of interests (ROIs, 20pixels). Adequate care was taken to avoid different tissue compartments with infiltrating neoplasms while drawing these ROIs. Paired t-tests were performed with an assumption that significant differences ($p<0.05$) in DTI parameters from baseline to post-TTFields would reflect adverse effects.

RESULTS

No significant differences ($p>0.05$) in DTI parameters (MD, FA, CL, CP and CS) were observed from different brain regions at a post-TTFields period relative to baseline. The average values of MD and FA from white-matter regions [frontal (FWM), occipital (OWM), centrum semiovale (CS), genu, splenium (spl) and body of corpus callosum) and gray-matter regions (basal ganglia (BG), thalamus (Th), caudate nucleus (CN) and hippocampus (Hip) are shown as bar-diagrams (Figure).

CONCLUSION

Our preliminary findings provide objective and quantitative measures of evaluating safety profile of TTFields. DTI analyses support the notion that TTFields therapy does not induce any tissue injury to normal brain regions in patients with GBM.

CLINICAL RELEVANCE/APPLICATION

Favorable safety profile of TTFields makes this therapy as an attractive choice for treating GBM patients. This information will help in enhancing compliance rate and thus efficacy of TTFields.

RC305-10 Proton Beam Therapy for CNS Tumors: Reinventing the Wheel or Fresh New Start-Imaging Changes Post Therapy

Tuesday, Dec. 3 11:30AM - 12:00PM Room: S406B

Participants
Susan L. McGovern, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand how proton therapy differs from photon therapy for brain tumors. 2) Identify risk factors for imaging changes after proton therapy for brain tumors. 3) Describe the incidence and types of imaging changes that may develop after proton therapy for brain tumors.

RC306

How Do I Image That? Tips for Improving Challenging Head and Neck Protocols

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E353C

CT HN MR NR

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

LEARNING OBJECTIVES

1) Appraise the adequacy of CT and MR protocols for temporal bone imaging. 2) Appropriately modify temporal bone CT and MR protocols based on specific clinical indications. 3) To understand the anatomic challenges faced in imaging structures at the thoracic inlet. 4) To appreciate the importance of adequate dose in parathyroid CT imaging. 5) To be familiar with positioning techniques that will help reduce artifacts and improve visualization of parathyroid adenomas. 6) To simplify the complex imaging anatomy of the brachial plexus using clear anatomical landmarks. 7) To outline the different MR protocols that could be used to image the brachial plexus at 1.5T and 3T. 8) To illustrate the benefits of an adequate MRI technique with some examples. 9) List the MRI pulse sequences used for cranial nerve imaging. 10) Compare the imaging requirements for extracranial versus intracranial cranial nerves. 11) Describe the impact of high resolution cranial nerve imaging on clinical decision making.

Sub-Events

RC306A Optimizing Temporal Bone CT and MRI

Participants
Joseph M. Hoxworth, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appraise the adequacy of CT and MR protocols for temporal bone imaging. 2) Appropriately modify temporal bone CT and MR protocols based on specific clinical indications.

RC306B Optimizing Pituitary MRI

Participants
Joshua Lantos, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review current techniques in pituitary MRI 2) Briefly review some evidence behind which sequences provide highest yeild imaging 3) Discuss potential future directions of pituitary MRI including sequences to consider adding to our protocols

Active Handout:Joshua Lantos

http://abstract.rsna.org/uploads/2019/19000229/Active RC306B.pdf

RC306C Optimizing TMJ MRI

Participants
Bidyut K. Pramanik, MD, Short Hills, NJ (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1. Optimize TMJ imaging techniques a) Image acquisition b) Review sequences 2. Evaluate normal TMJ anatomy 3. Briefly review MRI findings of internal derangement

RC306D Optimizing Parathyroid 4D CT

Participants
Deborah R. Shatzkes, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To understand the anatomic challenges faced in imaging structures at the thoracic inlet. 2) To appreciate the importance of adequate dose in parathyroid CT imaging. 3) To be familiar with positioning techniques that will help reduce artifacts and improve visualization of parathyroid adenomas.

Active Handout:Deborah Rachelle Shatzkes

http://abstract.rsna.org/uploads/2019/19000231/Active RC306D.pdf

RC306E Optimizing Brachial Plexus MRI

Participants
Carlos H. Torres, MD,FRCPC, Ottawa, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To simplify the complex imaging anatomy of the brachial plexus using clear anatomical landmarks. 2) To outline the different MR protocols that could be used to image the brachial plexus at 1.5T and 3T. 3) To illustrate the benefits of an adequate MRI technique with some examples.

RC306F Optimizing Cranial Nerve MRI

Participants
Nafi Aygun, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List the MRI pulse sequences used for cranial nerve imaging. 2) Compare the imaging requirements for extracranial versus intracranial cranial nerves. 3) Describe the impact of high resolution cranial nerve imaging on clinical decision making.

RC307

Genitourinary Series: Imaging with Impact in Gynecologic Oncology

Tuesday, Dec. 3 8:30AM - 12:00PM Room: E353B

GU OI

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

FDA Discussions may include off-label uses.

Participants
Katherine E. Maturen, MD, Ann Arbor, MI (*Moderator*) Royalties, Reed Elsevier; Royalties, Wolters Kluwer nv; ;
Hebert Alberto Vargas, MD, Cambridge, United Kingdom (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Recognize stages in the diagnosis and treatment process for gynecologic cancers where imaging changes management. 2) Identify key sequences for MR imaging in the female pelvis. 3) Understand fundamentals of adnexal mass characterization with US and MRI. 4) Describe important staging considerations in endometrial and cervical cancer. 5) Appreciate the important role of radiotherapy in gynecologic oncology.

Sub-Events

RC307-01 Global Scope and Morbidity of Gynecologic Cancers

Tuesday, Dec. 3 8:30AM - 8:45AM Room: E353B

Participants
Carolyn M. Johnston, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learn how to do more with less. 2) Develop an awareness of the existing challenges for cancer care in Ghana and Ethiopia. 3) Understand what you can do and how those in the developing world can help.

RC307-02 Imaging and the FIGO Staging Paradigm: Gaps and Opportunities

Tuesday, Dec. 3 8:45AM - 9:00AM Room: E353B

Participants
Stephanie Nougaret, MD, Montpellier, France (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To present the difficulties with the current FIGO staging in female pelvic malignancy. 2) To discuss the gap between FIGO staging and imaging in female pelvic malignancy. 3) To present the need of a staging system incorporating advanced imaging.

RC307-03 Fundamentals of Imaging in Endometrial Cancer

Tuesday, Dec. 3 9:00AM - 9:15AM Room: E353B

Participants
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the current staging and treatment of endometrial cancer. 2) Review the MRI protocol for imaging endometrial cancer. 3) Recognize MRI findings in endometrial cancer which alter treatment.

RC307-04 MRI-Assessed Tumor-Free Distance to Serosa Predicts Deep Myometrial Invasion and Poor Prognosis in Endometrial Cancer

Tuesday, Dec. 3 9:15AM - 9:25AM Room: E353B

Participants

Julie Andrea Dybvik, MD, Bergen, Norway (*Presenter*) Nothing to Disclose
Kristine E. Fasmer, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Jone Trovik, MD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Camilla Krakstad, PhD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Ingfrid H. Haldorsen, MD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of this study was to explore the diagnostic accuracy of preoperative magnetic resonance imaging (MRI) and MRI-based tumor measurements for prediction of pathological deep (>=50%) myometrial invasion (pDMI) and for prognostication in endometrial carcinomas (EC).

METHOD AND MATERIALS

Preoperative pelvic MRI scans of 357 prospectively included patients with histologically confirmed EC were read independently by three radiologists blinded to clinical information. The radiologists recorded the following imaging data in a standardized registration form: findings suggesting deep (>=50%) myometrial invasion (iDMI) and the tumor measurements: axial anteroposterior tumor diameter (APD), depth of myometrial tumor invasion (DOI) and tumor free distance to serosa (TFD). Receiver operating characteristic (ROC) curves for prediction of pDMI (in 38.1% of the patients) using hysterectomy specimen as reference standard, were plotted for the different tumor measurements and optimal cut-off values were determined. The predictive and prognostic value of the tumor measurements were analyzed using binary logistic regression and Cox proportional hazard model, respectively. Interobserver agreement was assessed using Fleiss' kappa (κ).

RESULTS

TFD yielded the highest area under the ROC-curve (AUC) for prediction of pDMI with an AUC of 0.83 whereas DOI, APD and iDMI yielded AUCs of 0.72, 0.81 and 0.74, respectively. Multivariate analysis (including cut-off based imaging variables and preoperative histological risk-status) for predicting pDMI yielded highest predictive value of TFD<6 mm with OR of 6.1 (p<0.001) and lower figures for DOI >=5mm (OR=2.2; p=0.04), APD >=17mm (OR=3.1, p<0.001) and iDMI (OR=1.1 (p=0.76). Patients with TFD<6 mm also had significantly reduced survival with hazard ratio of 1.9; p=0.01. The interobserver agreement was good for APD>=17mm (κ=0.70) and moderate for TFD<6 mm (κ=0.52), but only fair for DOI >=5mm (κ=0.25) and iDMI (κ=0.36)

CONCLUSION

At preoperative MRI TFD<6 mm was the strongest predictor of pDMI and was associated with poor survival. TFD<6 mm outperforms iDMI for prediction of pDMI and could aid in identifying high-risk disease in endometrial carcinomas.

CLINICAL RELEVANCE/APPLICATION

Preoperative TFD at MRI using cut-off value <6 mm, represents a promising imaging biomarker that could aid in prediction of pDMI and high-risk disease in endometrial cancer.

RC307-05 Integrated Clinical Parameters and Diffusion-weighted Imaging Radiomics for Predicting Lymph Node Metastasis in Endometrial Cancer: Added Values of Computer-Aided Segmentation and Machine Learning

Tuesday, Dec. 3 9:25AM - 9:35AM Room: E353B

Participants
Gigin Lin, MD, Taoyuan, Taiwan (*Presenter*) Nothing to Disclose
Tiing Yee Siow, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Lan-Yan Yang, Guishan, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Yu-Chun Lin, MSC, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Chyong-Huey Lai, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Precise risk stratification in lymphadenectomy is important for patients with endometrial cancer, to balance the therapeutic benefit against perioperative morbidity and mortality. We aim to investigate added values of computer-aided segmentation and machine learning based on clinical parameters and diffusion-weighted imaging radiomics for predicting nodal metastasis in endometrial cancer.

METHOD AND MATERIALS

This prospective study included 119 women with endometrial cancer who underwent magnetic resonance (MR) before surgery during July 2010-June 2015. Decision-tree machine learning comprised the apparent diffusion coefficient (ADC) of whole tumor volumetric and lymph nodes (LNs) segmentations, MR morphological measurement, and relevant clinical parameters. Areas under the receiver operating characteristics curve (AUCs) were used to compare diagnostic performances of the decision-tree model, mean ADC model, and LN short-axis diameter criteria.

RESULTS

For decision-tree modeling, 106 MR imaging features and 7 clinical factors were extracted. A decision-tree model was constructed based on grade (1 vs 2 and 3), CA125 level (cutoff, 190 U/mL), short-axis diameter of LN (cutoff, 2.2 mm), 75th percentile and minimum ADC of tumor (cutoff, 0.8 × 10-3 and 0.4 × 10-3 mm2/s, respectively), and difference of LN ADC skewness to tumor ADC skewness (cutoff, 1.3). The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value for the decision-tree model were 100%, 91.1%, 92.0%, 56.8%, and 100%, respectively. The AUC of the decision-tree model was 0.96- significantly higher than the mean ADC model (AUC = 0.59) and LN short-axis diameter criteria (AUC = 0.68) (both P < .0001).

CONCLUSION

A combination of clinical and MR radiomics generates a prediction model for LN metastasis in endometrial cancer, with diagnostic performance surpassing the conventional ADC and size criteria.

CLINICAL RELEVANCE/APPLICATION

Computer-aided segmentation and machine learning added values of clinical parameters and diffusion-weighted imaging radiomics for predicting nodal metastasis in endometrial cancer, with a diagnostic performance superior to criteria based on lymph node size or apparent diffusion coefficient.

RC307-06 Preoperative 3D Tumor Texture Features from MRI Predict Aggressive Disease in Endometrial Cancer

Tuesday, Dec. 3 9:35AM - 9:45AM Room: E353B

Participants
Kristine E. Fasmer, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Erlend Hodneland, PhD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Julie Andrea Dybvik, MD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Camilla Krakstad, PhD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Ingfrid H. Haldorsen, MD, Bergen, Norway (*Presenter*) Nothing to Disclose

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PURPOSE

To extract whole-volume texture features in primary tumor based on preoperative MRI and explore whether 3D image features relate to stage and outcome in endometrial cancer (EC).

METHOD AND MATERIALS

Preoperative pelvic MRI including contrast-enhanced T1-weighted (T1+c), T2-weighted and diffusion-weighted imaging (DWI) were performed in 99 EC patients. 3D tumor volumes were manually delineated on axial oblique T1+c and the corresponding T2, b1000 and apparent diffusion coefficient (ADC) maps were co-registered to the T1+c images. Grey level histogram features (kurtosis, skewness, entropy), gray level co-occurrence matrix (GLCM) features (energy, homogeneity, contrast, correlation) and tumor cluster analyses (cluster-size and -index) were computed for each of the sequences. Associations between image texture and surgicopathological features were assessed by Mann-Whitney U-tests and controlled for false discovery rates (alpha=0.01). Receiver-operating-characteristics (ROC) curves were used for the three top-ranked significant texture features for prediction of staging parameters and high-risk histology (endometrioid grade 3 and non-endometrioid). Kaplan-Meier, uni- and multivariable Cox regression analyses were applied for survival analysis.

RESULTS

Top-ranked tumor texture features significantly predicting advanced stage were high correlation T1+c (AUC=0.85), homogeneity T1+c (AUC=0.81) and entropy ADC (AUC=0.81) predicting deep myometrial invasion; and high tumor cluster-index T2 (AUC=0.84), entropy ADC (AUC=0.82) and entropy T1+c (AUC=0.82) predicting lymph node metastases. Features predicting high-risk histology were high correlation ADC (AUC=0.76), clustersize b1000 (AUC=0.75) and correlation T1+c (AUC=0.73). High tumor entropy on ADC, b1000 and T1+c all predicted reduced recurrence- and progression-free survival (HR=2.0, $p<=0.014$ for all).

CONCLUSION

3D tumor texture features derived from MRI, significantly predict deep myometrial invasion, lymph node metastases, high-risk histological subtype and reduced survival in endometrial cancer.

CLINICAL RELEVANCE/APPLICATION

3D MRI tumor texture analyses yield markers that can be utilized for preoperative risk assessment and may ultimately enable more tailored treatment strategies in endometrial carcinomas.

RC307-07 Cervical Cancer Imaging Essentials

Tuesday, Dec. 3 9:45AM - 10:00AM Room: E353B

Participants
Evan S. Siegelman, MD, Media, PA (*Presenter*) Advisory Board, Spreemo Health; Consultant, BioClinica, Inc; Consultant, ICON plc; Consultant, inviCRO, LLC

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LEARNING OBJECTIVES

1) Describe the role of human papilloma virus in the development of cervical cancer and critique the ability of an HPV vaccine to prevent the development of cervical cancer. 2) Apply the FIGO classification system of cervical cancer and explain what imaging features are not incorporated in the FIGO system. 3) Identify the essential MR pulse sequences and imaging findings to accurately stage women with cervical cancer. 4) Assess the utility of PET imaging in the staging of cervical cancer.

RC307-08 MRI-Assessed Tumor Size Parameters Predict Survival in Uterine Cervical Cancer

Tuesday, Dec. 3 10:00AM - 10:10AM Room: E353B

Participants
Njal G. Lura, MD, Bergen, Norway (*Presenter*) Nothing to Disclose
Kari Wagner-Larsen, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose

Mari Halle, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Julie Andrea Dybvik, MD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Jone Trovik, MD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Camilla Krakstad, PhD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose
Ingfrid H. Haldorsen, MD, Bergen, Norway (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of this study was to compare the value of different tumor size measurements at magnetic resonance imaging (MRI) for predicting disease specific survival in patients with uterine cervical cancer

METHOD AND MATERIALS

A total of 421 patients with histologically confirmed uterine cervical cancer who had a pelvic MRI at primary diagnostic work-up were reviewed. Maximum tumor diameters were measured in three orthogonal planes; anteroposterior (AP), transverse (TV), and craniocaudal planes (CC); maximum diameter irrespective of plane (MAX), and tumor volumes (TVOL) were estimated. Tumor size parameters were analyzed in relation to disease-specific survival and clinical FIGO stage. Kaplan-Meier survival analyses and uni- and multivariate Cox regression analyses were performed. Receiver operating characteristics (ROC) curves for the different tumor measurements were calculated and optimal cut-off values were determined.

RESULTS

All tumor size parameters yielded high area under the ROC curve (AUC) (range of 0.82-0.84 for all), for predicting disease-specific death. All size parameters were significant predictors of disease specific survival in univariate analyses (hazard ratios (HR) ranging from 1.025-1.053; p<0.001 for all); when including all size parameters in a multivariate model, only TV had an independent impact on survival (HR of 1.04; p=0.002). The optimal cut of value for TV was >= 31 mm yielding a sensitivity and specificity of 82 % and 73%, respectively, for predicting disease specific death. TV>=31 mm yielded a HR of 6.9; p<0.001; when adjusting for clinical FIGO stage (4 categories) TV>=31 mm had an independent prognostic impact with HR of 4.0; p<0.001 for TV>=31 mm and HR of 2.1; p<0.001 for FIGO stage.

CONCLUSION

All tumor size parameters from pelvic MRI predict disease-specific survival. TV was the only independent predictor of poor survival amongst the tumor size parameters, and TV>31 mm was a significant predictor of poor survival also when adjusting for clinical FIGO stage. Thus, preoperative tumor measurements including assessment of TV may yield prognostic information in uterine cervical cancer potentially relevant for therapy.

CLINICAL RELEVANCE/APPLICATION

Transverse tumor diameter measurements based on MRI using cut-off of >=31 mm represents a promising imaging marker that may aid in the prediction of aggressive disease in uterine cervical cancer.

RC307-09 Cervical Carcinoma Post-Treatment Neoplasm or Post-Treatment Sequalae: Can Diffusion-Weighted Imaging (DWI) with ADC Mapping Solve the Ongoing Dilemma?

Tuesday, Dec. 3 10:10AM - 10:20AM Room: E353B

Participants
Samar A. Hussein, MSc, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Eman F. Kamal, MBChB, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Rasha M. Kamal, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

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PURPOSE

To assess the value of each of the applicable MRI pulse sequences include diffusion weighted imaging with ADC mapping in the evaluation of tumor residual, recurrence or post-treatment complications after tumor resection and/or chemotherapy/radiotherapy on cervical cancer. We also aim to assess the possibility of using DW imaging instead of contrast studies especially in patients with impaired renal functions and trying to define cut off ADC values of residual/recurrent lesions.

METHOD AND MATERIALS

The study included 61 patients with pathologically proven cancer cervix and a control group of 60 patients. All patients underwent post treatment Contrast Enhanced and Diffusion weighted MRI examinations to assess, confirm or exclude the presence of residual/recurrence mass lesions or post therapy complications.The reported MRI findings of both studies were correlated with histopathology results and/or with follow -up imaging.

RESULTS

In post-treatment cervical cancer malignant lesions detection and differentiation from benign post treatment changes, contrast enhanced MRI calculated sensitivity and specificity of 86% and 88% respectively. The inclusion of CE MRI resulted in statistically a non-significant improvement of the diagnostic accuracy in post-treatment malignant lesions detection compared to conventional non-enhanced sequences as both had low specificity (88%) with a high false-positive rate. The addition of DW imaging and ADC mapping provided 100 % specificity in post-treatment malignant lesions detection and raised the sensitivity to 97.2%. Mean ADC values of malignant post-treatment lesions (1.019±0.15 x10-3 mm2/sec) were significantly different than those of benign post -treatment changes (1.5482± 0.07 x10-3 mm2/sec) (P < 0.001).The cut off average ADC value for detecting post-treatment malignant lesions was found to be <= 1.2 x10-3 mm2/sec with 100% specificity and 97.2% sensitivity. Patients with lower baseline mean ADC values (<= 0.8 ± 0.024 x10-3 mm2/sec) are more likely to have post-treatment complete response than patients with higher baseline mean ADC values (>= 0.96± 0.045 x10-3 mm2/sec) (P < 0.001).

CONCLUSION

The use of contrast-enhanced MR imaging does not improve the accurate assessment of post-treatment cancer cervix with a high probability of false negative and false positive results . The use of DW imaging with ADC mapping provide added value with improved sensitivity and specificity in detection of cancer cervix post-treatment malignant lesions and differentiating them from post-treatment benign changes.

CLINICAL RELEVANCE/APPLICATION

Addition of DW imaging with ADC mapping further improve detection of post-treatment residual/recurrent lesions in cancer cervix patients and differentiating them form post -treatment sequalae.

RC307-10 Image Based Radiotherapy in Gynecologic Oncology: Radiologists as Partners in Treatment Planning

Tuesday, Dec. 3 10:20AM - 10:35AM Room: E353B

Participants
Aradhana M. Venkatesan, MD, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Provide an overview of the contemporary role for MRI for radiotherapy (RT) planning and management of gynecologic cancer patients, with an emphasis on HPV-associated gynecologic malignancies. 2) Summarize technical requirements, patient preparation and image acquisition protocols. 3) Describe fundamental radiotherapy concepts and asociated radiologic findings pertinent to management, illustrative of the team-based approach between radiologists and radiation oncologists.

RC307-11 Ultrasound of Adnexal Lesions and Introduction to ACR O-RADS US

Tuesday, Dec. 3 10:45AM - 11:00AM Room: E353B

Participants
Phyllis Glanc, MD, Toronto, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discuss the emerging role of ultrasound in the evaluation of adnexal lesions. 2) Review the ACR Ovarian-Adnexal Reporting Lexicon. 3) Evaluate the new O-RADS Ultrasound Risk Stratification and Management System.

ABSTRACT

Over the last 2 decades there has been an evolution in the approach to incidentally detected ovarian lesions. We will review the key changes which incorporate more conservative therapy for benign lesions and appropriate triage to gynecological oncologists for malignant lesions. We will discuss the recently published O-RADS (Ovarian and Adnexal) lexicon and highlight key features approach to it's use. Finally, we will evaluate the O-RADS Ultrasound risk stratification and mangement system, an international consensus guideline from the O-RADS committee which incorporated the international ovarian tumor analysis (IOTA) group data with other published data to provide a useful risk stratification and management system for patients with ovarian lesions.

Active Handout:Phyllis Glanc

http://abstract.rsna.org/uploads/2019/19000195/Active RC307-11.pdf

RC307-12 MRI Characterization of Adnexal Lesions and Introduction to ACR O-RADS MRI

Tuesday, Dec. 3 11:00AM - 11:15AM Room: E353B

Participants
Andrea G. Rockall, FRCR,MRCP, London, United Kingdom (*Presenter*) Speaker and Chairman, Guerbet SA

LEARNING OBJECTIVES

1) To know the indications of MRI for adnexal mass characterisation. 2) To be familiar with MRI protocol used. 3) To be familiar with the O-RADS MR lexicon. 4) To know how to apply the O-RADS MR score.

ABSTRACT

In this lecture, the indication for MRI characterisation of adnexal masses will be reviewed and the protocol will be described. The key lexicon terms will be presented and a link to the full lexicon will be provided. A systematic approach to applying the O-RADS MR score will be described, with case examples.

RC307-13 Contrast-Enhanced SHI Imaging for Characterization of Adnexal Masses

Tuesday, Dec. 3 11:15AM - 11:25AM Room: E353B

Participants
Priscilla Machado, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Lauren J. DeLaney, PhD, Philadelphia , PA (*Abstract Co-Author*) Nothing to Disclose
Mehnoosh Torkzaban, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Andrej Lyshchik, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Research support, Bracco Group; Advisory Board, Bracco Group; Research support, General Electric Company; Research support, Siemens AG; Research support, Canon Medical Systems

Corporation; Speaker, SonoScape Co, Ltd
Corinne Wessner, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Norman G. Rosenblum, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Research Grant, General Electric Company
Christine Kim, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Scott Richard, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Kirk Wallace, PhD, Niskayuna, NY (*Abstract Co-Author*) Employee, General Electric Company
Flemming Forsberg, PhD, Philadelphia, PA (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Lantheus Medical Imaging, Inc

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PURPOSE

To evaluate the use of contrast-enhanced subharmonic ultrasound imaging (SHI) to characterize adnexal masses prior to surgical intervention.

METHOD AND MATERIALS

Ten women scheduled to undergo surgery for adnexal masses underwent a SHI examination of their adnexal region using a modified Logiq E9 scanner (GE, Waukesha, WI). Baseline images were acquired using B-mode and color Doppler using both curvilinear and endocavitary probes. After the baseline imaging, which was also used to locate the region of interest, SHI imaging was done using the endocavitary probe following both bolus and infusion of the ultrasound contrast agent Definity® (Lantheus Medical Imaging, N Billerica, MA). Subjects first received a 1.5 ml Definity bolus injection and, digital clips were acquired up to 5 minutes after injection (time of wash-out). After a 10 minute interval, subjects received an infusion consisting of 1.5 ml of Definity in 25.0 ml of saline over 5 minutes, digital clips were acquired using pulse destruction/replenishment SHI imaging across the lesion. Time intensity curves were created off-line to quantitatively evaluate SHI parameters. These parameters were compared to the pathological findings.

RESULTS

The 10 subjects had a total of 12 adnexal masses, as 2 subjects had bilateral adnexal masses. The final pathological diagnosis determined that 8adnexal masses were benign and 4 were malignant. Qualitative analysis of the CEUS SHI images by an experienced radiologist resulted in a diagnostic accuracy of 70%, compared to 56% without contrast, demonstrating the benefit of SHI. Quantitative analysis of CEUS SHI parameters produced diagnostic accuracy as high as 81%. Peak contrast intensity was significantly greater in malignant than benign masses (0.109 ± 0.088 vs. 0.046 ± 0.030, $p = 0.046$). Malignant masses also demonstrated significantly greater perfusion than benign masses ($24.79 \pm 25.34\%$ vs. $7.62 \pm 6.50\%$, $p = 0.045$).

CONCLUSION

The use of SHI for characterization of adnexal masses may improve the determination of malignancy, reducing cost and risk to patients, while improving diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

SHI characterization of ovarian masses is a noninvasive and safe method that could be used in the future to differentiate benign from malignant lesions.

RC307-14 Non-Invasive Prediction of Laparoscopy-Based Score System Using Preoperative CT in Advanced Ovarian Cancer Patients

Tuesday, Dec. 3 11:25AM - 11:35AM Room: E353B

Participants
Nayoung Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Dae Chul Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyunghwa Han, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jeon Jong Seob, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Young Taik Oh, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To construct a CT based Fagotti scoring system without staging laparoscopy by analyzing correlation between the laparoscopic findings and the corresponding CT findings in advanced ovarian cancer patients.

METHOD AND MATERIALS

The pre-operative CT and staging laparoscopic records based on Fagotti score system of 157 patients with stage III/IV ovarian cancer were reviewed, who underwent debulking surgery between 2010 and 2018. Ten CT features known as predictor of sub-optimal resection were evaluated by two independent radiologists who were blinded to the laparoscopy and the surgical outcome. Each imaging features were matched with relevant laparoscopic parameters by Spearman correlation between them. Variable selection and Model construction was performed by logistic regression with a least absolute shrinkage and selection operator (LASSO) method. Final CT-based scoring system was internally validated using 5-fold cross validation.

RESULTS

Among the 157 patients, 120 (76.4%) was rated predictive index value (PIV, sum of scores) >= 8 on staging laparoscopy, who assigned to non-resectable group initially. Complete/optimal cytoreduction was achieved in 23 (63.5%)/37(100%) among the remaining 37 patients (PIV < 8), respectively. Table 1 shows regression coefficient between CT features and laparoscopic parameters as result of LASSO regression modeling. The ROC analysis showed that the area under the curve(AUC) was 0.7234 (95% CI 0.6225~0.8243) (Fig.2).

CONCLUSION

Central tumor burden such as mesenteric diseases and paraaortic lymphadenopathy and upper abdominal spread including diaphragm and gastro-transverse-splenic (GTS) space involvement on preoperative CT was identified distinct prediction factor for high PIV. The CT based PIV prediction model may be useful for patient stratification in the era of staging laparoscopy.

CLINICAL RELEVANCE/APPLICATION

Although the achievement of complete cytoreduction was known as the important prognostic factor of advanced ovarian cancer, there is no standardized model for predicting surgical outcome.

RC307-15 Deep Learning in the Differentiation of Benign and Malignant Ovarian Lesions Based on Routine Magnetic Resonance Imaging

Tuesday, Dec. 3 11:35AM - 11:45AM Room: E353B

Participants
Yeyu Cai, MD, Changsha, China (*Abstract Co-Author*) Nothing to Disclose
Robin Wang, BA, Philadelphia, PA (*Presenter*) Nothing to Disclose
Iris Lee, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Hui Liu, Changsha, China (*Abstract Co-Author*) Nothing to Disclose
Jing Wu, Changsha, China (*Abstract Co-Author*) Nothing to Disclose
Ting Huang, Changsha, China (*Abstract Co-Author*) Nothing to Disclose
Harrison X. Bai, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Ovarian cancer is one of the most common causes of cancer death among women. However, definite diagnosis of benign versus malignant ovarian lesion is difficult based on pre-operative imaging. We proposed using deep learning based on routine MR imaging to distinguish the two using routine MR imaging and compare performance with expert radiologists.

METHOD AND MATERIALS

A total of 335 ovarian lesions were identified from the institution's database with definitive pathology and pre-operative MR imaging. Preprocessing of the images involved n4 bias correction, intensity normalization, and registration. The images were divided into training, validation, and test sets in a 7:2:1 split. Individual models were trained on T2-weighted (T2WI) and T1-contrast enhanced (T1C) sequences independently, using the ResNet50 architecture. A stochastic gradient descent optimizer was used with Nesterov momentum. The training involved 500 epochs with a batch size of 16 and early stopping (patience=300 epochs). An ensemble model was created by combining clinical variables (age and volume), T2WI and T1C sequences with a bagging classifier to predict ovarian tumor outcomes. Final performance was compared with two experts' interpretation (two radiologists with 23 and 10 years of experience reading pelvic MR, respectively).

RESULTS

Among all 335 lesions, the mean age is 51.33 years old ranging from 13 to 90, and there was no significant difference in age (50.9 ± 15.5 vs 53.1±14.9, p=0.425) and tumor location(p=0.966) between benign and malignant group. The final ensemble model achieved a test accuracy of 85.3% with 33.3% sensitivity and 96.4% specificity. In comparison, expert 1 achieved an accuracy of 67.6% with a sensitivity of 100% and specificity of 60.7%. Expert 2 achieved an accuracy of 64.7% with a sensitivity of 66.7% and 64.3% specificity.

CONCLUSION

Deep learning can distinguish benign from malignant ovarian lesions with high accuracy when compared to experts. Further work on optimization of algorithm and incorporation of a larger, more diverse input cohort will boost performance.

CLINICAL RELEVANCE/APPLICATION

Definite diagnosis of benign from malignant ovarian lesions is difficult based on preoperative imaging. A deep learning algorithm based on routine MRI that can distinguish the two with high accuracy can potentially save patients from unnecessary surgeries/biopsies and guide treatment decisions.

RC307-16 Essential and Emerging MRI Techniques for Gynecologic Cancer Diagnosis and Staging

Tuesday, Dec. 3 11:45AM - 12:00PM Room: E353B

Participants
Caroline Reinhold, MD, MSc, Montreal, QC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To outline patient preparation that will allow the optimization of the MR imaging acquisition. 2) To determine the essential MR pulse sequences to accurately stage women with gynaecological malignancies. 3) To review emerging MR technologies for staging gynaecological cancers.

RC308

Emergency Radiology Series: Current Imaging of the Acute Abdomen

Tuesday, Dec. 3 8:30AM - 12:00PM Room: S401CD

ER GI GU

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

Participants
Douglas S. Katz, MD, Mineola, NY (*Moderator*) Nothing to Disclose
Vincent M. Mellnick, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

RC308-01 Abdominal Fluoroscopic Emergencies

Tuesday, Dec. 3 8:30AM - 9:00AM Room: S401CD

Participants
William M. Thompson, MD, Albuquerque, NM (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Know the ins and outs of performing emergency gastrointestinal examinations. 2) Know the common presentations of emergency esophageal and abdominal disorders. 3) Know how to diagnose the common emergency gastrointestinal disorders demonstrated on fluoroscopic examinations.

RC308-02 Diagnostic Performance and Efficiency of Magnetic Resonance Imaging (MRI) in Suspected Acute Appendicitis

Tuesday, Dec. 3 9:00AM - 9:10AM Room: S401CD

Participants
Nicolas Murray, MD, Vancouver, BC (*Presenter*) Nothing to Disclose
David Jung, West Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG; Stockholder, Canada Diagnostic Centres

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PURPOSE

Evaluate the diagnostic performance and efficiency of MRI in suspected acute appendicitis compared to ultrasound (US) and computed tomography (CT).

METHOD AND MATERIALS

Single institution, IRB-approved, retrospective study of adult patients presenting to emergency department with suspected acute appendicitis from May 2017 to May 2018. Diagnostic characteristics of US, MRI, and CT were analyzed using a contingency table. Diagnostic efficiency was examined by average patient wait time, defined between times of initial imaging and final management decision.

RESULTS

599 patients met the eligibility criteria, with 445 US (54.7%), 137 MRI (16.9%), and 231 CT scans (28.4%) performed. Sensitivity, specificity and diagnostic yield of MRI were respectively 91.7% (95%CI, 73.0%-99.0%), 85.0% (95%CI, 77.0%-91.0%), and 88.3% (95%CI, 81.9%-92.7%), not significantly different than CT with respective values of 94.3% (95%CI, 84.3%-98.8%), 88.8% (95%CI, 83.2%-93.0%) and 93.1% (95%CI, 89.0%-95.7%). Using an intention-to-diagnose approach, diagnostic properties of US were significantly lower than both MRI and CT ($p<0.01$) with sensitivity of 61.5% (95%CI, 51.5%-70.9%), specificity of 18.2% (95%CI, 14.2%-22.7%), and diagnostic yield of 29.7% (95%CI, 25.6%-34.1%). Mean wait time for patients undergoing MRI as initial investigation (n=21, 3.5%, 100.6 minutes) was not significantly different from patients examined initially by CT (n=133, 22.2%, 104.3 minutes, $p=0.78$) or US (n=238, 39.7%, 125.6 minutes, $p=0.29$). All imaging routes where patients experienced multiple modalities had significantly longer wait times than routes involving one modality ($p<0.01$).

CONCLUSION

Diagnostic performance of MRI is comparable to CT and superior than US. With favourable patient wait times, MRI can be considered as initial investigation modality in suspected acute appendicitis.

CLINICAL RELEVANCE/APPLICATION

The greater role of MRI as first-line investigation modality in suspected acute appendicitis will reduce exposure to ionizing radiation without compromising diagnostic performance or timeliness.

RC308-03 Intraluminal Gas in an Inflamed Non-Perforated Appendix: A Reliable CT Sign of Gangrenous Changes and Imaging Occult Perforation

Tuesday, Dec. 3 9:10AM - 9:20AM Room: S401CD

Participants
Mohammad Haroon, MD, New Delhi, ON (*Presenter*) Nothing to Disclose
Yashmin Nisha, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Blair MacDonald, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (*Abstract Co-Author*) Speaker, Siemens AG
Kashif Iqubal, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Paul Anton Reymond Prakash Sathiadoss, MBBS, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess the utility of intraluminal air in an inflamed, apparently non-perforated appendix in predicting gangrenous changes or occult perforation. Determine, if obstructive appendicolith has an added value in predicting the same.

METHOD AND MATERIALS

This retrospective study was done on adult patients (n=554) of histopathologically proven appendicitis who underwent enhanced MDCT prior to surgery, presenting at our hospital over a consecutive period of 3 years. Patients with obvious CT signs of perforation were excluded to create a cohort of acute uncomplicated appendicitis. These CT were reviewed by an Emergency Radiology Fellow and 2 Emergency Radiologists for presence or absence of intraluminal gas and obstructive appendicoliths. These findings were compared with surgical/pathological results regarding presence or absence of gangrenous/perforated appendicitis. Statistical analysis was performed with the help of contingency tables and sensitivity, specificity, positive and negative predictive values were determined and correlation was tested with Chi-squared test and p value < 0.05 was considered statistically significant.

RESULTS

Of the total 554 cases of acute uncomplicated appendicitis on imaging, 130 had intraluminal gas (90 gangrenous), 178 had obstructive appendicoliths (74 gangrenous) and 66 were with both gas and appendicoliths (50 gangrenous). Sensitivity, specificity, positive and negative predictive values for intraluminal gas and presence or absence of gangrene were 69%, 90%, 69% and 90% respectively. These values for obstructive appendicolith were 42%, 72%, 42% and 72% respectively. These values for the presence of both intraluminal gas and appendicolith were 39%, 96%, 75% and 84% respectively. These values for the presence of either intraluminal gas or appendicoliths were 86%, 69%, 46% and 94% respectively. All these results were significant with p value < 0.05.

CONCLUSION

Presence of intraluminal gas in otherwise acute uncomplicated appendicitis on imaging is a reliable sign of underlying gangrenous changes or image-occult perforation. Presence of obstructive appendicolith, although less reliable sign as an independent risk factor as compared to intraluminal gas, it notably adds to the predective value.

CLINICAL RELEVANCE/APPLICATION

These CT signs are reliable in predicting the risk of gangrene and perforation and can help surgeons to avoid delays in surgery thereby reducing incidence of complications.

RC308-04 Intrapatient Analysis of CT Diagnosis of Acute Diverticulitis: Is Non-Contrast CT Enough?

Tuesday, Dec. 3 9:20AM - 9:30AM Room: S401CD

Participants
Tugce Agirlar Trabzonlu, MD, Chicago, IL (*Presenter*) Grant, Siemens AG
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Kamal Subedi, MBBS, Kathmandu, Nepal (*Abstract Co-Author*) Nothing to Disclose
Donald Kim, DO, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the performance of computed tomography (CT) without oral and intravenous (iv) contrast material for the diagnosis of acute diverticulitis by comparing dual energy CT (DECT) contrast enhanced and virtual non-contrast (VNC) images.

METHOD AND MATERIALS

In this retrospective analysis, we reviewed CT studies with oral and IV contrast obtained with DECT scanner for abdominal pain. Cohort included 153 patients with 306 sets of CT images with a radiological diagnosis of acute diverticulitis (n=76) and control cases without evidence of diverticulitis (n=77) scanned between October 2018 and March 2019. In the first session, the virtual non-contrast images were randomized and analyzed for the presence of diverticulitis. The findings and presence of complication (perforation, abscess formation or fistula) were also noted. In the second session, true contrast enhanced images were randomized and analyzed. Diagnostic performance of VNC images were compared with contrast enhanced CT studies. Sensitivity, specificity and accuracy were calculated.

RESULTS

Out of 153 patients, 76 (49.7%) had acute diverticulitis and 77 (50.3%) did not have findings of acute diverticulitis on contrast enhanced computed tomography (CECT). 18 of 76 (23.7%) patients with acute diverticulitis had findings of complicated diverticulitis on CECT. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of VNC images were 96.1% (95% CI= 88.9-99.2%), 97.4% (95% CI= 90.9-99.7%), 97.3% (CI= 90.3-99.3%), 96.2% (CI= 89.2- 98.7%) and 96.7% (95% CI= 92.5-98.9%) respectively. The complications of acute diverticulitis was detected in 11 of 18 (61.1%) patients with VNC images.

CONCLUSION

When compared to routine CT imaging with iv and oral contrast, non-contrast images have high diagnostic accuracy for acute colonic diverticulitis. However, for the assessment of the signs of complicated diverticulitis, non-contrast CT had much lower diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

Non-contrast CT can be beneficial for diagnosing uncomplicated diverticulitis. However, the use of contrast remains necessary when complicated diverticulitis is present.

RC308-05 CT in the Setting of Suspected Colonic Diverticulitis: Prevalence and Diagnostic Yield for Diverticular Disease and Alternative Diagnosis in a Large Cohort in 1069 Patients

Tuesday, Dec. 3 9:30AM - 9:40AM Room: S401CD

Participants
Julius M. Weinrich, Hamburg, Germany (*Presenter*) Nothing to Disclose
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Maxim Avanesov, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
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Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Frank Oliver G. Henes, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the prevalence and diagnostic yield of CT in the detection of diverticulitis and alternative diagnoses (AD) in a large cohort of patients with suspected colonic diverticulitis (CD).

METHOD AND MATERIALS

We retrospectively included 1069 patients (560 women) undergoing CT for the evaluation of suspected CD. The final clinical diagnosis derived from the discharge report was used to determine the prevalence of CD and AD and to calculate the diagnostic accuracy of CT. Differences in the prevalence of diagnoses by age (<45;45-69;>=70 y/o) were compared using Cochran-Armitage test with a p-value <0.05 indicating statistical significance.

RESULTS

Prevalence of CD was 52.4% (561/1069) and of AD 40% (427/1069). In the remaining 7.6% (81/1069) no final clinical diagnoses was established. Overall, CT had a sensitivity and specificity of 99.1%/99.8% for diagnosing CD and for AD 92.7%/96.4%, respectively. The prevalence of diverticulitis was significantly lower in patients >=70 y/o (43%; 128/298) when compared with patients <45 y/o (54.1%;100/185) and 45-69 y/o (56.8%;333/586) (p<=0.0004). The most frequent alternative diagnoses were appendicitis (12.6%; 54/427), infectious colitis (10.5%;45/427), infectious enteritis (8.2%;35/427), urolithiasis (6.1%;26/427), and pyelonephritis (4.9%;21/427). Prevalence of specific AD varied significantly according to age (p<0.05). Appendicitis was significantly more frequent in patients <45 y/o (5.4%;10/185), whereas ischemic colitis, hemorrhage and pneumonia were more frequent in patients >=70 y/o. In the latter group colorectal carcinoma was also a frequent AD (10/298).

CONCLUSION

In the clinical setting of suspected diverticulitis the prevalence of acute diverticulitis and alternative diagnoses varies according to age. CT provides high diagnostic accuracy in the diagnosis of both, diverticular disease and alternative conditions.

CLINICAL RELEVANCE/APPLICATION

Clinicians must be aware that in about 40% of patients with suspected diverticulitis alternative diagnoses are the causes for their symptoms, and that there is an age-related prevalence of AD.

RC308-06 Ultrasound of First Trimester Pregnancy

Tuesday, Dec. 3 9:40AM - 10:10AM Room: S401CD

Participants
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LEARNING OBJECTIVES

1) Learn essential criteria for diagnosis of a normal viable first trimester pregnancy. 2) Learn essential criteria for differentiating an ectopic pregnancy from intrauterine pregnancy, and various ectopic pregnancies. 3) Learn appropriate use of such terms as 'pregnancy of unknown location', findings suspicious for early pregnancy failure', etc as outline by SRU lexicon and criteria.

ABSTRACT

Imaging evaluation of first trimester pregnancy especially in an emergent setting can pose dilemmas since in early pregnancy a gestational sac may not be clearly visible. Differentiating an IUP from an ectopic pregnancy is crucial as the latter requires clinical intervention. There is some overlap of serum BhCG levels with IUP, ectopic pregnancy, and spontaneous pregnancy loss. in 2012, SRU consensus panel published their agreed upon criteria and lexicon for reporting first trimester ultrasound exams. We will review the clinical application of these criteria and the lexicon, and review appearance of various types of ectopic pregnancies.

RC308-07 Dual-energy CT of the Acute Abdomen: Current Status

Tuesday, Dec. 3 10:20AM - 10:50AM Room: S401CD

Participants

Savvas Nicolaou, MD, Vancouver, BC (*Presenter*) Institutional research agreement, Siemens AG; Stockholder, Canada Diagnostic Centres

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LEARNING OBJECTIVES

1) Explain the principles of Dual Energy CT/Spectral imaging. 2) Describe and apply 3-material decomposition. 3) Evaluate application of 3-material decomposition in select cases (organ perfusion in trauma, bowel ischemia, active bleeding, renal stone analysis).

RC308-08 Facilitating Acute Bowel Ischemia Diagnosis: Value of Low-keV Monoenergetic Imaging and Color-Coded Iodine Maps in Dual-Energy CT

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S401CD

Participants

Elina Khasanova, MD, Vancouver, BC (*Presenter*) Nothing to Disclose
Sunghan Jung, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
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Yuhao Wu, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
Gavin M. Sugrue, MBBCh, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
Nicolas Murray, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess the impact of virtual monoenergetic imaging (VMI) and color-coded iodine-overlay images (IOI) on reader confidence and image quality (IQ) in the detection of hypoperfused bowel compared to simulated 120-kVp images (s-120-kVp).

METHOD AND MATERIALS

Institutional review board approval was obtained. Acute bowel ischemia was reported in 80 patients imaged with triphasic CT studies with the portal venous phase acquired with dual energy analysis (90-150 snVp; 3rd generation dual source CT) from 01/02/2016 to 31/12/2018. Of 80 patients, 26 (33%) had bowel ischemia confirmed intra-operatively, 11(14%) deceased within 72 hours, 43 (53%) did not qualify for surgery. S-120-kVp, VMI (40, 50, 60 keV) and IOI (40%, 50%, 60% of iodine overlay color-coded saturation) datasets were created for each patient. Quantitative assessment (HU and CNR) on ischemic bowel, normal bowel, and portal vein was performed only on the surgically proven cases (n=26). Two emergency radiologists independently evaluated subjective image quality (IQ) and diagnostic confidence (DC). Time-to-diagnosis (TTD) was recorded on VMI and IOI datasets with the highest IQ and DC and s-120-kVp dataset. One-way ANOVA and Kruskal-Wallis/Wilcoxon rank sign tests were used for statistical analysis.

RESULTS

There was a significant increase in absolute attenuation difference between normal and ischemic bowel in 40, 50, 60 keV datasets (mean±SD 66±5.3, 62±4.3, 54±5.5 HU) compared to s-120-kVp (38±5.6HU). Both readers deemed 50-keV as the best VMI dataset for subjective IQ including image sharpness and resolution ($p= 0.0017$), DC ($p= 0.0003$). IOI-50% demonstrated subjective IQ ($p= 0.0021$) and DC ($p= 0.0041$). TTD for 50-keV, IOI -50%, and s-120-kvp datasets resulted 37±4 seconds (sec), 39±10 sec, 107±7 sec).

CONCLUSION

Low energy imaging (50-keV) and color-coded IOI (50% saturation) significantly improved bowel wall conspicuity with increased attenuation differences and higher diagnostic confidence between ischemic and non-ischemic bowel compared to simulated 120-kVp. In addition, 50 keV and 50% IOI datasets allowed shorter TTD.

CLINICAL RELEVANCE/APPLICATION

Hypoperfused bowel often goes unrecognized especially for short ischemic segments that blend in with normal bowel loops. Low monoenergetic images and color-coded overlay iodine maps increase bowel wall attenuation differences improving hypoenhanced bowel segments identification.

RC308-09 Dual-Energy CT in Evaluating the Acute Bowel in Emergency: A Real Diagnostic Gain?

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S401CD

Participants
Luca Tarotto, Napoli, Italy (*Presenter*) Nothing to Disclose
Igino Simonetti, MD, Naples, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco Palumbo, MD, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Luigi Palumbo, MD, Pozzuoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Alfonso Ragozzino, Pozzuoli, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Purpose of the study was to retrospectively analyze the processed imaging findings from the Dual Energy CT examinations of patients with acute abdominal symptoms compared with the native axial and multiplanar reconstructions in evaluating the cause of disease.

METHOD AND MATERIALS

A retrospective analysis on 122 patients who underwent DECT examination in emergency for acute abdominal symptoms were considered. All examinations were performed using a dual energy dual source CT 128 detector rows scanner (Drive, Siemens), after administration of i.v. contrast medium (Iomeron 400, Bracco) with mono or double phase acquisition. Native and processed images (i.e. iodine map, fusion series, virtual non contrast) were analysed in evaluation of: mesenteric vessels opacification of major and secundary branches; bowel wall thickening; bowel wall enhancement; abdominal addictional findings (free peritoneal air and fluid, mesenteric stranding, bowel lumen dilatation). Double readers / blinded final diagnosis analysis were performed; a cross-check of imaging and surgical/endoscopic from both native and processed images were made.

RESULTS

In 94/122 patients a correct diagnosis with correlative native imaging findings have been noted. In 39 patients in which the native images were already effective, post processed imaging findings did not add any new informations, whereas among the 28 patients with inconclusive findings at the native scans regarding the final diagnosis, processed images (iodine map) seemed to show altered findings, most of them in inflammatory and ischemic bowel disease.

CONCLUSION

DECT could be of help in case of controversial and not defined imaging findings , but the relative absolu value of the iodine map in evaluating the bowel wall trophism seemed to be reconsidered.

CLINICAL RELEVANCE/APPLICATION

Clinical relevance of this study is mainly pertinent on the DECT in evaluating the bowel wall enhancement in acute conditions

RC308-10 Abdominopelvic Imaging in the Emergency Department of Patients Treated with Immune Checkpoint Inhibitors: A Single Institute 9-Year Experience

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S401CD

Participants
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Daniel A. Smith, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Christopher Hoimes, DO, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate abdominopelvic imaging findings of cancer patients treated with immune checkpoint inhibitors (ICIs) who presented to the emergency department (ED).

METHOD AND MATERIALS

A retrospective database search was performed to identify patients treated with ICIs who presented to the ED and underwent abdominopelvic imaging between January 2010 and November 2018. Images were reviewed to assess tumor burden and to detect immune-related adverse events (irAEs). Clinical indications for imaging and management were documented from medical record.

RESULTS

A hundred patients (62 men, median age: 63 years) with 138 abdominopelvic exams including 123 CT scans, 9 X-rays, 5 US, and 1 HIDA exams were identified. The most common cancer types included lung (40%), melanoma (17%), and kidney (12%). The date of ED visit occurred a median of 70 days after starting ICI (IQR 75-25 139-31). Common imaging indications included abdominal pain (72%), constipation (5%), and hematuria (5%). Forty-nine (35%) ED abdominopelvic scans showed worsening tumor burden at a median of 42 days (IQR 75-25 92-22) following initiation of ICIs. Twenty-five (18%) scans detected a cause of acute abdomen in patients treated with ICIs. In 5 (4%) exams, both an etiology of acute abdomen and worsening tumor burden were identified. Ten (10%) out of 100 patients demonstrated an irAE at a median of 74 days (IQR 75-25 284-42) following initial dose of ICI. irAEs detected on imaging included colitis/enteritis (6/10), pneumatosis coli (2/10), acute hepatitis (1/10), and acute acalculous cholecystitis (1/10). Steroid therapy was started in 2 cases following ICI discontinuation. The other most common causes of acute abdomen included gastrointestinal tract emergencies (10/100), and collections/abscesses (5/100).

CONCLUSION

Thirty-five percent of abdominopelvic imaging of patients on ICI therapy who presented to the ED demonstrated worsening tumor

Thirty-five percent of abdominopelvic imaging of patients on ICI therapy who presented to the ED demonstrated worsening tumor burden. Abdominopelvic irAEs were detected on imaging in 10% of patients and colitis/enteritis was the most common irAE.

CLINICAL RELEVANCE/APPLICATION

Abdominopelvic imaging at the ED detected the etiology of clinical presentation in 57% of patients treated with ICIs.

RC308-11 Clinical Use and Value of Renal Ultrasound for Suspected Urolithiasis in the Emergency Department

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S401CD

Awards
Trainee Research Prize - Medical Student

Participants
Camilo Campo, Boston, MA (*Presenter*) Nothing to Disclose
Jennifer W. Uyeda, MD, Boston, MA (*Abstract Co-Author*) Consultant, Allena Pharmaceuticals, Inc
Aaron D. Sodickson, MD,PhD, Boston, MA (*Abstract Co-Author*) Institutional research agreement, Siemens AG; Speaker, Siemens AG; Speaker, General Electric Company

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PURPOSE

Computed tomography (CT) has the highest sensitivity and specificity for urolithiasis in patients with acute flank pain. However, studies have suggested that ultrasound (US) should be the initial imaging test in the Emergency Department (ED) for acute flank pain. The purpose of this study is to assess the value of renal US in predicting follow-up imaging for patients with acute flank pain and to calculate the additional time required to obtain a renal US prior to CT.

METHOD AND MATERIALS

This was an IRB-approved, HIPAA-compliant retrospective study of all patients that underwent renal US in the ED from March 2018-March 2019 for acute flank pain. Data points collected were: presence of calculi and/or hydronephrosis on US, whether patients underwent follow-up imaging within 24 hours of US, presence of calculi and/or hydronephrosis on follow-up imaging, acute extra-renal findings, need for intervention, and history of urolithiasis. The time interval between US and follow-up CT was recorded based on the time that the tests were ordered.

RESULTS

271 patients underwent renal US in the ED for acute flank pain. 76 of 271 patients (28%) underwent follow-up imaging within 24 hours of initial US: 72 underwent CT abdomen/pelvis and 4 underwent magnetic resonance urogram (MR). Of the initial 271 US, 138 (51%) were positive for calculi and/or hydronephrosis on US. Of the 76 patients who underwent follow-up CT or MR, 40 (52%) had been positive for calculi and/or hydronephrosis on initial US and 36 (47%) had been negative on US. Of the 76 that underwent follow-up imaging, 10 had acute extra-renal findings, and 17 had subsequent intervention. For patients that underwent follow-up CT, the mean time interval between US and CT was 170 min.

CONCLUSION

Few cases of acute flank pain underwent follow-up imaging. Of these, approximately half had a positive US (54%) and half had a negative US (47%). Therefore, it is likely that clinical judgement plays a large role in predicting the need for follow-up imaging. We also found a larger time interval between US and follow-up CT for patients with positive versus negative US, which may reflect that patients with positive US were given the opportunity to pass the stones before follow-up imaging.

CLINICAL RELEVANCE/APPLICATION

Renal US is often the initial test done in the ED for acute flank pain. We evaluate how renal US predicts follow-up imaging and the additional time required to obtain a renal US prior to CT.

RC308-12 Imaging of Renal Emergencies

Tuesday, Dec. 3 11:30AM - 12:00PM Room: S401CD

Participants
John J. Hines JR, MD, Huntington, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify acute and emergent conditions of the kidney, with emphasis on renal obstruction, infection and hemorrhage. 2) Discuss cross-sectional imaging findings typically found with acute kidney disease, with an emphasis on CT. 3) Explain how the radiologist can integrate imaging findings with clinical history in order to help guide management of the patient with acute kidney disease.

RC309

Gastrointestinal Series: Advances in Abdominal Imaging

Tuesday, Dec. 3 8:30AM - 12:00PM Room: S405AB

CT GI

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Amy K. Hara, MD, Scottsdale, AZ (*Moderator*) Nothing to Disclose
George L. Shih, MD, New York, NY (*Moderator*) Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;
Avinash R. Kambadakone, MD, Boston, MA (*Moderator*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV
Benjamin M. Yeh, MD, Hillsborough, CA (*Moderator*) Research Grant, General Electric Company; Consultant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc; Research Grant, Koninklijke Philips NV; Research Grant, Guerbet SA; ;

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Sub-Events

RC309-01 Artificial Intelligence: What You Can Use Now

Tuesday, Dec. 3 8:30AM - 8:50AM Room: S405AB

Participants
George L. Shih, MD, New York, NY (*Presenter*) Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;

RC309-02 Machine-Learning Analysis of Radiomic Features for the Preoperative Assessment of Vascular Involvement in Patients with Pancreatic Ductal Adenocarcinoma

Tuesday, Dec. 3 8:50AM - 9:00AM Room: S405AB

Participants
Francesca Rigiroli, MD, Durham, NC (*Presenter*) Nothing to Disclose
Jocelyn Hoye, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Cai Li, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Mathias Meyer, Mannheim, Germany (*Abstract Co-Author*) Researcher, Siemens AG; Researcher, Bracco Group
Juan Carlos Ramirez-Giraldo, PhD, Cary, NC (*Abstract Co-Author*) Employee, Siemens AG
Peijie Lyu, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Niharika Mettu, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Sabino Zani JR, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Sheng Luo, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Abstract Co-Author*) Research Grant, General Electric Company Research Grant, Siemens AG Advisory Board, medInt Holdings, LLC License agreement, 12 Sigma Technologies License agreement, Gammex, Inc
Daniele Marin, MD, Durham, NC (*Abstract Co-Author*) Research support, General Electric Company

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PURPOSE

To evaluate the performance of radiomic features analysis in the pre-operative assessment of superior mesenteric artery (SMA) involvement in patients with pancreatic ductal adenocarcinoma (PDA).

METHOD AND MATERIALS

104 patients with surgically-proven PDA were identified between 2013 and 2018. 80% of patients underwent neoadjuvant therapy. All patients underwent dedicated preoperative pancreatic CT (range, 3 to 105 days before surgery). As part of the standard of care, images were reviewed by a panel of experts from radiology, surgery, and medical oncology. Patients were categorized as resectable, borderline resectable, or locally advanced according to recent NCCN guidelines. Subsequently, we performed a volumetric segmentation of the primary tumor and the circumferential perivascular tissue surrounding the SMA (2.5 to 4.5-mm in diameter) using a prototype segmentation and radiomic features extraction software (Radiomics, Siemens Healthineers). Extracted features included standard intensity, size, shape, and texture properties. In addition, composite radiomic features were calculated accounting for the spatial relationships and texture features similarities between the primary tumor and the perivascular tissue. A machine learning random forest model based on radiomic features was developed and validated by 100-times cross validation for the prediction of SMA tumor involvement. Pathologic R stage of the SMA margin after surgery was used as the reference standard.

RESULTS

9 standard and 2 composite features were identified as significant predictors of SMA involvement by PDA. The diagnostic

performance of the machine learning model was substantially higher compared to the consensus visual assessment of the expert panel (average area under the curve,AUC: 0.84 vs. 0.66). This improvement was largely related to selecting informative radiomincs features by using machine learning methods (Figure).

CONCLUSION

Our study suggests that machine learning analysis of radiomic features improves the accuracy of preoperative SMA staging in patients with PDA.

CLINICAL RELEVANCE/APPLICATION

Machine learning analysis of radiomic features may provide important information for pre-operative assessment of SMA involvement in patients with PDA, which may imrpove patient selection for surgery.

RC309-03 Low-dose CT Update

Tuesday, Dec. 3 9:00AM - 9:20AM Room: S405AB

Participants
Amy K. Hara, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Recognize opportunities for reducing CT radiation dose (primarily for body imaging). 2) Be familiar with current and cutting edge CT dose reduction techniques.

Active Handout:Amy Kiyo Hara

http://abstract.rsna.org/uploads/2019/19000861/Active RC309-03.pdf

RC309-04 Potential of an Image-Based Frequency-Splitting Multiband Filtration Denoising Algorithm to Reduce Radiation by 50% for Multiphase Liver CT: Impact on Metastasis Detection Potential of Image-Based Frequency-Splitting Multiband Filtration Denoising

Tuesday, Dec. 3 9:20AM - 9:30AM Room: S405AB

Participants
Benjamin Voss, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose
Eric C. Ehman, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Jay P. Heiken, MD, Rochester, MN (*Abstract Co-Author*) Patent agreement, Guerbet SA; Patent agreement, Bayer AG
Nam Ju Lee, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Matthias Baer, DiplPhys, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose
Akitoshi Inoue, MD,PhD, Higashioumi, Japan (*Abstract Co-Author*) Nothing to Disclose
Rogerio Vasconcelos, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Gregory J. Michalak, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Rickey E. Carter, PhD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose
Matthew Johnson, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Yong Lee, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Ahmed Halaweish, PhD, Rochester, MN (*Abstract Co-Author*) Employee, Siemens AG
Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG
Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; Consultant, Medtronic plc; Consultant, Takeda Pharmaceutical Company Limited; Grant, Takeda Pharmaceutical Company Limited; ;

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PURPOSE

Image-based frequency split multiband filtration denoising (FS-MBF) uses images from one phase of enhancement to help reduce CT image noise in other phases. Our purpose is to determine if FS-MBF can be used to reduce image noise for half dose multiphase liver CT without sacrificing the ability to detect subtle hepatic metastases.

METHOD AND MATERIALS

All patients had archived projection CT data from contrast-enhanced multiphase liver CT. Metastases were confirmed with histology, or progression or regression, with benign lesions confirmed with stability. Half dose CT images were created using a validated noise insertion program, then reconstructed with FS-MBF. Anonymized routine or half dose FS-MBF images were evaluated by two radiologists in two sessions, with each patient's exam evaluated once/session. Radiologists reviewed images, noting location of liver lesions, rating confidence in liver metastasis presence on a per lesion and per patient level (0-100 scale), and assigning scores for image quality. A confidence cutoff of 10 was used for sensitivity and specificity comparisons.

RESULTS

48 patients had 141 liver lesions (61 mets [size1.2 cm±0.9 cm], 80 benign lesions). CTDIvol was 20± 8 mGy/phase. Per metastasis sensitivity was similar between routine dose and half dose FS-MBF multiphase CT (R1 - 81% v. 77%, p= 0.3; R2 - 80 v. 77%, p = 0.4). Per patient accuracy was also similar for each radiologist (R1- 67.0% v. 63.0%; R2 - 74.0% v. 77.0%, p=0.098 - 0.34). For patients with metastases, patient level confidence that liver metastases were present was not different for either reader between routine and half dose FS-MBF exams (R1 - mean 74 v. 85; p = 0.26; R2 - mean 69 v. 71, p = 0.65). Patient level confidence scores in patients without metastases were also similar (p = 0.26, 0.65). The mean image quality of half dose FS-MBF images was slightly but significantly lower (SD 4.4 ± 0.7 v. 4.0 ± 0.8, p = 0.0001).

CONCLUSION

Radiologist performance for detection of hepatic metastases using half dose FS-MBF multiphase liver exams was similar to routine dose, providing a new image-based method to reduce image noise for multiphase CT exams.

CLINICAL RELEVANCE/APPLICATION

An image-based method for reducing image noise for multiphase, contrast-enhanced abdominal CT shows promise as a broadly applicable noise reduction method that preserves radiologist performance at half of routine radiation dose.

RC309-05 Effects of Deep Learning Reconstruction (DLR) and Iterative Reconstruction Techniques on Sub-Milli-Sievert Chest and Abdomen-Pelvis CT: Image Quality and Lesion Detection

Tuesday, Dec. 3 9:30AM - 9:40AM Room: S405AB

Participants
Ramandeep Singh, MBBS, Boston, MA (*Presenter*) Nothing to Disclose
Yiemeng Hoi, PhD, Tustin, CA (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation
Erin Angel, PhD, Tustin, CA (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation
Avinash R. Kambadakone, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV
Subba R. Digumarthy, MD, Boston, MA (*Abstract Co-Author*) Speaker, Siemens AG; Research Grant, Lunit Inc; Researcher, Merck & Co, Inc; Researcher, Pfizer Inc; Researcher, Bristol-Myers Squibb Company; Researcher, Novartis AG; Researcher, F. Hoffmann-La Roche Ltd; Researcher, Polaris Pharmaceuticals, Inc; Researcher, Cascadia Healthcare, LLC; Researcher, AbbVie Inc; Researcher, Gradalis, Inc; Researcher, Clinical Bay; Researcher, Zai Lab
Mannudeep K. Kalra, MD, Lexington, MA (*Abstract Co-Author*) Research Grant, Siemens AG; Research Grant, Riverain Technologies, LLC;
Victorine V. Muse, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Michael A. Blake, MBBCh, Milton, MA (*Abstract Co-Author*) Nothing to Disclose
Naruomi Akino, Otawara, Japan (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation

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PURPOSE

To compare image quality and lesion detection of Deep Learning Reconstruction (DLR) and Iterative Reconstruction (IR) on sub-milli-Sievert chest and abdomen-pelvis CT.

METHOD AND MATERIALS

Our study included 59 adult patients (33F:26M; age=65±12 years, BMI=27±5 kg/m2) who underwent routine chest (n=22;16F: 6M) and abdomen (n=37;17F: 20M) CT on a 640-slice MDCT (Aquilion ONE, Canon Medical Systems). All patients gave written informed consent for acquisition of low dose (LD) CT after a clinically indicated standard dose (SD) CT. The SD-CT (120kVp;164-644mAs) were reconstructed with AIDR3D (IR) and the LD-CT (100,120kVp;30-50mAs) were reconstructed with FBP, IR (AIDR3D, FIRST) and DLR. Four sub-specialty trained radiologists (R1, R2-thoracic; R3, R4-abdominal) performed subjective evaluation for chest (2mm; kernel FC18) and abdomen (2mm; kernel FC52) image sets on a four-point scale (1 = unacceptable image quality; 4 = image quality better than SD). Lesions were first detected on LD-FBP. LD (FIRST, AIDR3D, DLR) images were then compared side-by-side to SD (AIDR3D) images in an independent, randomized, and blinded fashion. Descriptive statistics and Wilcoxon sign rank test were performed.

RESULTS

CTDIvol and DLP for LD-CT (2.1±0.8mGy; 49±13mGy-cm) were lower than SD-CT (13±4.4mGy;567±249mGy.cm) ($p<0.0001$). All 31 clinically significant lesions (such as 13 liver lesions, 5 adrenal nodules, 8 retroperitoneal nodes, 3 pancreatic lesions) were detected on SD-CT and LD-DLR. LD-AIDR3D, LD-FIRST and LD-FBP detected 25/31, 18/31, and 7/31 lesions, respectively. For chest CT, 33/39 nodules detected on LD-DLR and SD-CT were missed on LD-FBP. LD-DLR was deemed acceptable for interpretation (median score >=3) in 97% of LD abdomen and 95-100% (R1-R2s scores) of LD chest (p=0.2-0.99). LD-FBP was unacceptable for all patients (59/59) whereas LD-FIRST had unacceptable image quality in 36-39% cases ($p<0.0001$). LD-AIDR3D images were unacceptable in 11-49% abdomen-pelvis CT (4/37-18/37; p<0.04-0.0001) and 41-45% chest CT (9/22-10/22; p=0.002-0.003).

CONCLUSION

At sub-milli-Sievert chest and abdomen-pelvis CT doses, DLR enables superior image quality and lesion detection as compared to commercial IR and FBP images.

CLINICAL RELEVANCE/APPLICATION

Deep Learning based Reconstruction (DLR) in CT outperforms commercial iterative reconstruction techniques and provides acceptable diagnostic quality for routine chest and abdomen-pelvis CT examinations at sub-milli-Sievert radiation dose levels.

RC309-06 Oral Contrast Media Controversies for CT and MR

Tuesday, Dec. 3 9:40AM - 10:00AM Room: S405AB

Participants
Avinash R. Kambadakone, MD, Boston, MA (*Presenter*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV

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LEARNING OBJECTIVES

1) Explain the indications and benefits of oral contrast media in abdomen/pelvis CT. 2) Understand the controversies in the role of

oral contrast media in various clinical settings including ER, oncology and routine abdominal scans. 3) Learn the role of oral contrast media in abdominal MRI, its benefits and controversies. 4) Optimize the use of oral contrast media to improve diagnosis.

RC309-07 New Applications of Dual-energy CT

Tuesday, Dec. 3 10:30AM - 10:50AM Room: S405AB

Participants
Benjamin M. Yeh, MD, Hillsborough, CA (*Presenter*) Research Grant, General Electric Company; Consultant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc; Research Grant, Koninklijike Philips NV; Research Grant, Guerbet SA; ;

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LEARNING OBJECTIVES

1) Describe potential applications of dual energy CT image reconstructions to improve clinical diagnoses. 2) Apply dual energy CT to clarify the cause of ambiguous radiodensities. 3) Examine the methods by which dual energy CT may allow 'invisible' lesions to be better seen. 4) List ways that different dual energy CT image reconstructions can be used to minimize artifacts at CT imaging. 5) Describe potential challenges and benefits of new dual energy CT techniques for clinical decision making.

RC309-08 Value of Dual-Energy CT Imaging for Evaluation of Intestinal Activity and Severity in Crohn's Disease

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S405AB

Participants
Yu Zhang, MS, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Ming Yang, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Xin Li, MD,PhD, Wuhan, China (*Presenter*) Nothing to Disclose
Ping Han, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the clinical value of dual-energy CT imaging in assessing the activity and severity of Crohn's disease compared with the simple endoscopic score (SES).

METHOD AND MATERIALS

60 patients suspected to have Crohn's disease received both colonoscopy and dual-energy computed tomography (DECT) were involved in this study. The interval time between the two examinations was less than one week. All examinations were performed on the same dual-energy DECT scanner (SOMATOM Force, Siemens) with standardized settings for the DECT mode: tube A: 90 kV; tube B: Sn150 kV with tin filter. Dedicated software (syngo.via) with an iodine subtraction algorithm was used to calculate quantitative CT data from portal-venous phase images, including iodine concentration and fat fraction measurements. According to the Simple Endoscopic Score for Crohn's Disease(SES-CD), 60 patients were divided into 4 groups(GroupA:Score=0-2,n=8;GroupB:Score=3-6,n=14;GroupC:Score=7-15,n=22;GroupD:Score>=16,n=16). Each patient's ROI measurements were repeated nine times and mean values were taken into account. Mean values of the iodine concentration of lesions and surrounding adipose tissue, the fat fraction of lesions and surrounding adipose tissue were used for the evaluation.

RESULTS

The iodine concentration of lesions(0.87±0.45, 0.99±0.36, 1.17±0.55, 1.94±0.54), the iodine concentration of surrounding adipose tissue(0.23±0.09, 0.42±0.10,0.66±0.11,1.56±0.29), the fat fraction of lesions(27.34±2.34,25.55±1.33,15.64±2.91,10.36±2.71)and the fat fraction of surrounding adipose tissue(90.52±5.04, 85.31±4.06, 71.35±5.34, 63.74±4.84)of four groups were found statistically significant different ($P<0.01$); the iodine concentration of lesions and surrounding adipose tissue among Group A, Group C and Group D were statistically different($P<0.05$); the fat fraction of lesions and surrounding adipose tissue among Group B,Group C and Group D were statistically different($P<0.05$).

CONCLUSION

The iodine concentration and the fat fraction derived from dual-energy CT imaging can be used to evaluate the activity and severity of Crohn's disease.

CLINICAL RELEVANCE/APPLICATION

dual-energy CT had sensitivity in detecting intestinal activity and severity of CD, which could be an alternative choice in evaluation of CD. The ultimate purpose of this study was to establish the standards of evaluating the activity of Crohn's disease using dual-energy CT in the future.

RC309-09 Role of Dual-Energy Computed Tomography in the Evaluation of Liver Fibrosis in Patients of Chronic Liver Disease

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S405AB

Awards
Trainee Research Prize - Resident

Participants
Uday K. Marri, MBBS,MD, Delhi , India (*Presenter*) Nothing to Disclose
Shalimar Shalimar, MBBS,MD, Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Prasenjit Das, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Deepnarayan Srivastava, Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Raju Sharma, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Madhusudhan Kumble Seetharama, MD, FRCR, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To quantify liver fibrosis in patients of chronic liver disease (CLD) using delayed phase dual-energy computed tomography (DECT) and comparing it with liver elastography and histology.

METHOD AND MATERIALS

107 patients (57 men; 50 women, mean age-35.4yrs) of CLD due to various aetiologies were included in this approved prospective study. 50 voluntary kidney donors undergoing multiphasic CT abdomen were used as controls. All patients underwent Transient elastography (TE), Shear wave elastography (SWE), multiphasic DECT (arterial, portal venous and 5 min delayed) and liver biopsy, whereas multiphasic DECT and SWE were performed in controls. Regions of interest were drawn on both lobes of liver and aorta on the 5-min delayed DECT scan to calculate the normalized iodine concentration (NIC=Iodine concentration in the liver/concentration in the aorta) and slope of the monochromatic spectral curve [(HU at 40keV - HU at 70keV)/30]. These were compared with liver stiffness (LS) on TE and SWE and the pathological METAVIR stage (F0 to F4) and collagen proportionate area (CPA). The accuracy of each parameter in quantifying liver fibrosis was assessed using receiver operating characteristic (ROC) curve.

RESULTS

The NIC of liver in cases showed high positive correlation with METAVIR staging and CPA (r= 0.810 and 0.665 respectively; p<0.0001). Area under ROC curve for NIC with each METAVIR stage ranged between 0.860 and 0.961. The cut-off values (with sensitivity and specificity) of NIC for different fibrosis stages were: >=F1 = 0.243 (85.1%, 83.3%), >=F2 = 0.289 (83.7%, 81.4%), >=F3 = 0.343 (86.9%, 86.8%), =F4 = 0.401 (93.3%, 84.7%), respectively. The mean NIC of liver in controls was 0.233. Spectral curve slope in cases showed poor correlation with histology (r= 0.265, p<0.006). The NIC of right lobe showed moderate agreement with LS measured by TE and SWE (r =0.599 and 0.635 respectively, p<0.0001). The LS on TE and SWE in cases showed good correlation with METAVIR stage [r= 0.704 and 0.736 respectively; p<0.0001].

CONCLUSION

The NIC of the liver on delayed phase DECT is accurate in non-invasive quantification of liver fibrosis and is better than liver elastography.

CLINICAL RELEVANCE/APPLICATION

Biopsy or elastography cannot quantify fibrosis of the entire liver. The delayed phase DECT is promising in assessing liver fibrosis and may become a one-stop shop for evaluating patients with CLD.

RC309-10 Comparison between ROI-Based and Volumetric Measurements of Liver Fibrosis Using MR Elastography in Quantifying Heterogeneity of Liver Stiffness

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S405AB

Participants
Roya Rezvani Habibabadi, Baltimore, MD (*Presenter*) Nothing to Disclose
Pegah Khoshpouri, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Maryam Ghadimi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Mohammadreza Shaghaghi, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Mounes Aliyari Ghasabeh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Sanaz Ameli, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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Ankur Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

To compare ROI-based and volumetric measurements in quantifying heterogeneity of liver stiffness (LS) using MRE.

METHOD AND MATERIALS

In this retrospective, IRB approved study, 128 patients with suspected liver fibrosis and MRE were reviewed between 12/2016 and 12/2017. LS was measured using: 1) the average of 3 Regions of interest (ROI), and 2) volumetric segmentation of the entire liver parenchyma (excluding vessels) using a semi-automatic software. Mean LS (MLS) of the 2 methods was calculated for each patient. Stages of fibrosis were defined using previously tested thresholds. Each patient was assigned to one of the 5 stages of fibrosis (MLS-stage)based on their ROI-MLS. Volumetric measurement of stiffness maps was also used to calculate the full range of LS and percentage involvement of the liver with each stage of fibrosis. Accordingly, specific proportions were defined: 1) above MLS-stage: percentage of the liver that has LS at least one category higher than MLS-stage, and 2) the first and second most predominant stages of fibrosis. Heterogeneous stiffness was defined when the first and second most predominant stages were more than one category apart.

RESULTS

The mean age of patients was 54 ±15 years; 46% were female. The average of MLS was 2.72 ±1.03 kPa for ROI measurements and2.64 ±0.93 kPafor volumetric method (p=0.001).As per MLS-stage,59 (46 %), 19 (15 %), 13 (10 %), 26 (20%) and 11 (8%) patients were assigned to stages F0, F1, F2, F3, and F4.In 58 patients (45%), more than 20% of liver had stiffness at least one stage higher than MLS-stage. Among 59 patients with normal MLS-stage (F0), 31 patients (53%) had >20% of liver volume with abnormal LS (F1-F4). In all 128 patients, an average of 20% of the liver volume had stiffness at least one stage higher than each individuals' MLS-stage. By definition,18 patients (14%) were identified to have heterogeneous stiffness.

CONCLUSION

Heterogeneity of hepatic fibrosis may occur in patients with chronic liver disease. MLS may not represent the entire spectrum of hepatic fibrosis. Failure to detect heterogeneity in its early stage could cause a delay in treatment initiation and progression of fibrosis.

CLINICAL RELEVANCE/APPLICATION

Volumetric segmentation and descriptive reporting of LS can potentially improve the detection of heterogeneous fibrosis in the liver and the accuracy of LS measurement. It helps to establish a more timely and precise management plan for each patient.

RC309-11 Dual-Layer Spectral CT of Pancreatic Adenocarcinoma: Can Virtual Monoenergetic Imaging of Portal Venous Phase Replace Pancreatic Phase?

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S405AB

Participants
Beom Jin Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yeo Eun Han, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Min-Ju Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Na Yeon Han, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Choon Sim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyun Jin Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Deuk Jae Sung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Bum Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate diagnostic performance and optimal keV of virtual monoenergetic imaging (VMI) created from portal venous phase in comparison with conventional 120kVp polychromatic imaging of pancreatic phase on dual-layer spectral CT when assessing pancreatic adenocarcinoma and peripancreatic vasculature.

METHOD AND MATERIALS

In this retrospective study, thirty patients with pancreatic adenocarcinoma who underwent dual-layer spectral CT scan with nonenhanced images, pancreatic phase, and portal venous phase were included. VMIs for 40 keV (VMI40), 55 keV (VMI55), and 70 keV (VMI70) of portal venous phase were created, and each VMI was compared with conventional 120kVp polychromatic imaging of pancreatic phase. In all four images, tumor-to-pancreas contrast-to-noise ratio (CNR) and attenuation difference were compared for tumor conspicuity. CNR and signal-to-noise ratio (SNR) of the celiac trunk, superior mesenteric artery, portal vein, and superior mesenteric vein were compared for peripancreatic vasculature assessment. Effective radiation dose for standard triple-phase and dual-phase without pancreatic phase CT scan were compared.

RESULTS

VMI40 of portal venous phase demonstrated significantly the greatest ($P <0.001$) tumor-to-pancreas CNR and attenuation difference, peripancreatic vascular CNR and SNR than those of conventional pancreatic phase and VMI55, VMI70 of portal venous phase. VMI55 of portal venous phase demonstrated second greatest ($P < 0.001$) results in all measured values. VMI70 of portal phase and conventional pancreatic phase were equivalent in tumor-to-pancreas attenuation difference and CNR of arteries (celiac trunk and superior mesenteric artery). Mean effective dose was 12.8 ± 3.9 mSv and 8.9 ± 2.7 mSv for standard triple-phase CT scan and dual-phase CT scan without pancreatic phase, respectively.

CONCLUSION

For assessing pancreatic adenocarcinoma, VMI40 of portal venous phase obtained on dual-layer spectral CT demonstrated superior tumor conspicuity, higher CNR and SNR for peripancreatic vasculature than those of conventional pancreatic phase.

CLINICAL RELEVANCE/APPLICATION

VMI40 of portal venous phase may replace conventional pancreatic phase with better diagnostic performance and reduced radiation dose. Further study in greater population may be required.

RC309-13 Advances in Molecular Imaging for the Abdomen

Tuesday, Dec. 3 11:40AM - 12:00PM Room: S405AB

Participants
Thomas A. Hope, MD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company; Research Grant, Koninklijke Philips NV; Advisory Board, Ipsen SA; Researcher, Advanced Accelerator Applications SA

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LEARNING OBJECTIVES

1) Identify approved imaging agents for prostate cancer. 2) Describe the role of somatostatin receptor PET agents for staging neuroendocrine tumor. 3) Assess the limitations and opportunities of molecular imaging moving forward.

RC310

Renal Sonography 2019: Update and Controversies

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E451A

GU US

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

FDA Discussions may include off-label uses.

Sub-Events

RC310A Sonography of Renal Masses: Pearls and Pitfalls

Participants
Michael D. Beland, MD, Providence, RI (*Presenter*) Nothing to Disclose

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mbeland@lifespan.org

LEARNING OBJECTIVES

1) Optimize renal ultrasound technique to maximize detection of renal masses. 2) Describe the ultrasound imaging features of a wide variety of renal masses and mass-like conditions and the potential overlap between malignant and non-malignant lesions. 3) Recognize the limitations of ultrasound for renal mass detection and characterization.

RC310B Microbubbles: How to Get Started

Participants
Wui K. Chong, MD, Houston, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review principles of ultrasound contrast agents, regulatory requirements, administration and safety. 2) Learn how to set up a contrast enhanced renal ultrasound service, training and equipment. 3) Review RVUs billing and reimbursement for renal contrast enhanced ultrasound procedures.

Active Handout:Wui Kheong Chong

http://abstract.rsna.org/uploads/2019/19000117/Active RC310B.pdf

RC310C Genitourinary CEUS

Participants
Stefanie Weinstein, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

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Stefanie.Weinstein@ucsf.edu

LEARNING OBJECTIVES

1) Review the range of indications for performing CEUS in the genitourinary tract, including the evolving role of CEUS beyond characterization of cystic renal masses. 2) Discuss methods to optimize performance and avoid pitfalls.

ABSTRACT

N/A

RC310D Sonography of Renal Dysfunction

Participants
Jean-Michel Correas, MD, Paris, France (*Presenter*) Advisory Board, Koninklijke Philips NV Speaker, Bracco Group Investigator, Bracco Group Speaker, SuperSonic Imagine Speaker, General Electric Company

For information about this presentation, contact:

jean-michel.correas@aphp.fr

RC311

Review of Pediatric Nuclear Medicine

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S504CD

GI GU MK NM PD

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

LEARNING OBJECTIVES

1) Review of Pediatric Nuclear medicine, particularly for radiologists and nuclear medicine physicians who may not specialize in pediatric patients, and for resident and fellow trainees.

Sub-Events

RC311A Pediatric Gastrointestinal

Participants
Helen R. Nadel, MD, Palo Alto, CA (*Presenter*) Consultant, ICON plc

For information about this presentation, contact:

hnadel@stanford.edu

LEARNING OBJECTIVES

1) Be able to list indications for GI scintigraphy in children. 2) Be able to describe scintigraphic patterns of disease on GI examinations in children.

RC311B Pediatric Genitourinary

Participants
Neha S. Kwatra, MBBS, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

neha.kwatra@childrens.harvard.edu

LEARNING OBJECTIVES

1) Describe pediatric renal diseases and understand the complementary role of scintigraphy and other imaging modalities. 2) Apply pediatric-specific imaging considerations. 3) Identify important normal variants/pitfalls in interpretation.

RC311C Pediatric Musculoskeletal

Participants
Susan E. Sharp, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Be able to describe the utilization and performance of nuclear medicine imaging for musculoskeletal indications in pediatric patients. 2) Be able to identify musculoskeletal findings on Tc-99m-MDP and F-18-FDG scans.

RC311D Case Presentation/Panel Discussion

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

RC312

Body MR Angiography: 2019 Update

Tuesday, Dec. 3 8:30AM - 10:00AM Room: N229

MR VA

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

FDA Discussions may include off-label uses.

Participants
Maureen N. Hood, PhD,RN, Bethesda, MD (*Moderator*) In-kind support, General Electric Company
Scott B. Reeder, MD,PhD, Madison, WI (*Moderator*) Nothing to Disclose

Sub-Events

RC312A MRA Techniques

Participants
Scott B. Reeder, MD,PhD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the fundamental principles of contrast enhanced MRA. 2) Understand the fundamental principles of non-contrast enhanced MRA. 3) Understand the fundamental principles of phase velocity MRA.

RC312B Thoracic MRA: Clinical Applications

Participants
Robert A. Liotta, MD, Kensington, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

robert.liotta@usuhs.edu

LEARNING OBJECTIVES

1) Identify common clinical applications for thoracic MRA. 2) Describe the role for non-contrast versus contrast-enhanced thoracic MRA.

RC312C Abdominal/Pelvic MRA: Clinical Applications

Participants
Pamela J. Lombardi, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe current contrast enhanced and non contrast MR angiography techniques. 2) Present clinical applications of MR angiography. 3) Introduce future perspectives for MRA.

RC312D MR Safety Concerns in Cardiovascular Patients

Participants
Maureen N. Hood, PhD,RN, Bethesda, MD (*Presenter*) In-kind support, General Electric Company

For information about this presentation, contact:

maureen.hood@usuhs.edu

LEARNING OBJECTIVES

1) Discuss the importance of an MR Safety Program in your institution. 2) Describe safety concerns related passive and active cardiovascular devices. 3) Explain the evaluation MR safety procedures for electronic devices. 4) Discuss contrast agent concerns and safety recommendations in MRA.

ABSTRACT

MR safety is a team effort. Cardiovascular patients often need special care and the use of contrast agents. MRI settings that perform cardiac MR and MRA regularly should have advanced education in MR safety. Staff should be trained annually on MR safety, especially with the growth in the number of patients with implanted active cardiovascular devices. Training and proper selection of staff are required for certain active devices. The off-label use of contrast agent use, both gadolinium and iron will be presented along with adverse events the MR team needs to be prepared for. Teamwork is critical for optimal patient care.

Active Handout:Maureen Nanette Hood

http://abstract.rsna.org/uploads/2019/18002591/RC312D Hood MR Safety Concerns 2019_Handout.pdf

RC313

Pediatric Series: Musculoskeletal Imaging

Tuesday, Dec. 3 8:30AM - 12:00PM Room: N228

MK PD

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

FDA Discussions may include off-label uses.

Participants
Kathleen H. Emery, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose
Andrea S. Doria, MD, Toronto, ON (*Moderator*) Nothing to Disclose
Heike E. Daldrup-Link, MD, Palo Alto, CA (*Moderator*) Nothing to Disclose
Arthur B. Meyers, MD, Orlando, FL (*Moderator*) Author with royalties, Reed Elsevier Editor with royalties, Reed Elsevier

Sub-Events

RC313-01 Imaging of Glenohumeral Dysplasia

Tuesday, Dec. 3 8:30AM - 8:50AM Room: N228

Participants
J. H. Kan, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jhkan@texaschildrens.org

LEARNING OBJECTIVES

1) Review pathophysiology of brachial plexus birth trauma and the development of glenohumeral dysplasia. 2) Review US and MRI technique and findings of glenohumeral dysplasia. 3) Implications in patient care: what does the surgeon need to know from the US and MRI study?

RC313-02 Role of Imaging in Diagnosis of Glenohumeral Deformity Following Obstetric Brachial Plexus Injury

Tuesday, Dec. 3 8:50AM - 9:00AM Room: N228

Participants
Shilpa Vijayasekar, MBBS, Chennai, India (*Presenter*) Nothing to Disclose
Amarnath Chellathurai, MD, FRCR, Chennai, India (*Abstract Co-Author*) Nothing to Disclose
Anand N. Parimalai, MD, Chennai , India (*Abstract Co-Author*) Nothing to Disclose
Anitha Alaguraj, DMRD, Chennai, India (*Abstract Co-Author*) Nothing to Disclose
Murali K. Logudoss, MBBS, MD, Chennai, India (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

amarrd02@yahoo.co.in

PURPOSE

To study the usefulness of CT in the measurement of glenoid version angle, humeral head dislocation or subluxation and to propose a grading for the severity of glenohumeroscapular dysplasia following OBPI.

METHOD AND MATERIALS

It is a prospective study for three years duration. 21 children below the age of 12 years presenting with posterior subluxation/dislocation of shoulder, with past history of OBPI were included in the study. CT of shoulders was done using 128 slice scanner. The functional status of the limb was clinically assessed by Modified Mallet scale and the deformity was graded by Waters classification. Statistical analysis used: Parameteric paired-t-test, Kruskal Walli's test and Linear regression were used.

RESULTS

The difference between affected and normal shoulders of glenoscapular angle, Percentage of humeral head anterior to the scapular line, Scapular height, Scapular Width were statistically significant ($p < 0.05$). The influence of age on GSA and PHH were not statistically significant. We confirmed that higher is the grade of deformity, more difficult will be the shoulder movements and hence, worse scores in Modified Mallet scale. We assessed joint stability and proposed a grading for severity based on the CT parameters and treatment protocol.

CONCLUSION

CT scan clearly identifies the glenohumeroscapular deformities like increased glenoid retroversion, posterior subluxation or dislocation of humeral head, smaller humeral head size and smaller size of the scapula.

CLINICAL RELEVANCE/APPLICATION

Glenohumeroscapular dysplasia and posterior shoulder subluxation are well recognized complications in obstetric brachial plexus

Glenohumeroscapular dysplasia and posterior shoulder subluxation are well recognized complications in obstetric brachial plexus injury (OBPI). Early recognition, categorisation and treatment helps to retain a functioning limb to the child.

RC313-03 Volumetric Quantitative Measurement of Hip Joint Fluid in Healthy Children

Tuesday, Dec. 3 9:00AM - 9:10AM Room: N228

Participants
Vanessa Quinn-Laurin, MD, Quebec City, QC (*Presenter*) Nothing to Disclose
Nancy A. Chauvin, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Timothy G. Brandon, MPH, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Pamela F. Weiss, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Jacob L. Jaremko, MD, PhD, Edmonton, AB (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In our experience, a normal pediatric hip subjectively presents a larger amount of fluid relative to patient size when compared to a normal adult hip. We assessed the feasibility and reliability of a quantitative hip joint fluid measurement in the pediatric population to estimate the normal volume of fluid in a pediatric hip joint.

METHOD AND MATERIALS

Seventy healthy children aged 8-17 years underwent a pelvic MRI including a large field of view coronal T2 FS sequence where hips were entirely imaged. Two musculoskeletal radiologists (one pediatric and one adult) performed volumetric quantitative measurements of hip fluid using semi-automated pixel-based thresholding with custom MATLAB software. The custom software minimized variability by applying Otsu's method to automatically select a pixel inclusion threshold within the user-defined region of interest in each slice.

RESULTS

Mean processing time per hip was 2 min 41 s. The mean amount of fluid in a hip joint was 2.03 mL (range 0.38-5.41 mL), increasing slightly with age from mean 1.7 mL at 8 years to 2.3 mL at 17 years. Intra-observer and inter-observer agreement were high (ICC 0.93 and 0.81 respectively), with mean volume differences of 0.04 mL intra-observer and 0.09 mL inter-observer.

CONCLUSION

A semi-automated pixel-based thresholding approach measured joint fluid feasibly and reliably in pediatric hips and found an average fluid volume of 2 mL, which is slightly less than the 2.7 mL reported by others in asymptomatic adult hips. This can represent a visually substantial quantity of fluid per MRI slice, particularly in small children, and should not be misinterpreted as a joint effusion.

CLINICAL RELEVANCE/APPLICATION

Semi-automated pixel-thresholding measurement of hip fluid is feasible and reliably quantifies fluid volume in healthy pediatric hips, which could help avoid misdiagnosis of hip effusions.

RC313-04 Comparison of Ultrasonographic and Radiographic Findings in Patients with Hemophilic Arthropathy

Tuesday, Dec. 3 9:10AM - 9:20AM Room: N228

Participants
Yoshiko Matsubara, Hiroshima, Japan (*Presenter*) Nothing to Disclose
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation; Research Grant, Hitachi, Ltd; Research Grant, Fujitsu Limited; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd;

PURPOSE

Radiography has been employed to evaluate joint lesions in children with hemophilia and ultra-sound (US) is increasingly used for the assessment of their joints. We compared the usefulness of US- and radiographic images in young hemophiliacs.

METHOD AND MATERIALS

We enrolled 40 hemophiliacs ranging in age from 1 to 18 years (median 9 years) who had undergone US- and radiographic studies of both knees and ankles between 2015 and 2017. Transverse, lateral transverse, and sagittal US images were evaluated on a gray scale using Haemophilia Early Arthropathy Detection with Ultrasound (HEAD-US) criteria. Scores were recorded for the soft-tissue- and the osteochondral domain (scores :0-9 for soft tissue, 0-5 for osteochondral changes; total score 0 - 14) and adjusted to the MRI scale of the International Prophylaxis Study Group (IPSG). Radiographic images were graded on the Pettersson Score (PS) (scores 0-13). Two pediatric radiologists consensually evaluated all images. To compare the incidence of abnormal joint findings on the images we used the McNemar test. The Mann-Whitney U-test was applied to confirm the early detection of abnormal findings on US images.

RESULTS

No abnormalities were detected in 29 patients (age range 1 to 16 years, median 7 years. The other 11 (age range 10 to 18 years, median 16 years) manifested abnormal joints in their knees and/or ankles. Radiography and US detected abnormalities in 6 of the 11 patients. In the other 5, only US provided evidence of anomalies ($p = 0.03$); they were significantly younger than the patients with positive findings on both US and radiographic images ($p = 0.02$).

CONCLUSION

US was superior to radiography for the detection of joint abnormalities in hemophiliacs. It was particularly useful in younger patients.

CLINICAL RELEVANCE/APPLICATION

For the evaluation of joints in patients with hemophilia, US- should be added to radiographic studies.

RC313-05 Participants

Hip Morphology Differs on Post-Reduction MRI Between Hips with and without Residual Dysplasia at Longterm: A Pilot Study with a Minimum 10-Year Follow-Up

Tuesday, Dec. 3 9:20AM - 9:30AM Room: N228

Florian Schmaranzer, MD, Boston, MA (*Presenter*) Nothing to Disclose
Mariana Ferrer, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Jennifer Kallini, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
David Williams, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Young-Jo Kim, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Eduardo Novais, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Although commonly used to assess quality of reduction following open or closed reduction for developmental dysplasia (DDH) of the hip, the value of post-reduction MRI of the hip and it's potential to identify residual DDH at long-term is unknown. We sought to compare the hip morphology on post-reduction MRI scans between hips with and without residual dysplasia at a minimum 10-year follow-up.

METHOD AND MATERIALS

We reviewed the institutional database for hips undergoing an open/closed reduction for DDH and a minimum 10-year follow-up. Out of 64 hips (54 patients) eligible, 40 hips (63%;34 patients) had a complete radiographic followup (mean 13±2 years followup). Hips were allocated to a 'no DDH' (25 hips)- and 'residual DDH' (15 hips) group. Residual DDH was defined as any subsequent surgery or radiographically dysplastic (Severin grade >2). Groups were comparable (all p>0.05) for demographic parameters (sex, time of follow-up, open/closed reduction) except for age (residual DDH:0.4±0.3 years vs no DDH: 0.8±0.5 years; p=0.016). MRI was performed at 1.5 T and included 2D coronal-, axial PD-w spin-echo images. Analysis of hip morphology on MRI was performed by one reader. On axial images: acetabular version, anterior/posterior sector angles, acetabular depth; were measured. On coronal images: osseous/cartilaginous acetabular indices, lateral cartilage thickness; were measured.

RESULTS

On post-reduction MRI, the acetabulum of hips with residual DDH at follow up was more anteverted (25±6° vs 19±7°; p=0.022). While the cartilaginous acetabular index did not differ, the osseous acetabular index was higher in hips with residual dysplasia (39±7° vs 34±6°; p=0.017). The lateral acetabular cartilage anlage was thicker in hips with residual dysplasia compared to the non-dysplastic hips (5.6±1.1mm vs 4.3±1mm; p=0.002).

CONCLUSION

Increased acetabular version, decreased coverage of the femoral head, and lateral cartilage thickness are associated with residual DDH in adolescence. This study may serve as basis for planning of future prognostic- and longitudinal studies using MRI for improved understanding of factors predicting failure of acetabular remodelling after reduction.

CLINICAL RELEVANCE/APPLICATION

Thickening of the lateral cartilage may represent an important factor to differentiate hips that would remodel versus those that will have persistent DDH with growth.

RC313-06 Presence of Globally Decreased Perfusion on Post-Reduction MRI Does Not Reliably Predict Proximal Femoral Growth Disturbance at Midterm Follow-Up in Developmental Dysplasia of the Hip

Tuesday, Dec. 3 9:30AM - 9:40AM Room: N228

Participants
Florian Schmaranzer, MD, Boston, MA (*Presenter*) Nothing to Disclose
Mariana Ferrer, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
David Williams, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Sarah D. Bixby, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Young-Jo Kim, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Eduardo Novais, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Femoral growth disturbance is a negative outcome predictor following open/closed reduction of the hip for developmental dysplasia (DDH). Post-reduction perfusion MRI has been previously introduced to assess femoral head perfusion but its prognostic value is unclear. To determine whether globally decreased femoral head perfusion predicts femoral growth disturbance at minimum 5 years after closed/open reduction for DDH.

METHOD AND MATERIALS

Retrospective analysis of patients undergoing closed/ open reduction for DDH and post-reduction perfusion MRI within 24 hours. Out of 149 hips (131 patients) eligible, 99 hips (87 patients) had a minimum 5-year radiographic followup. Five hips (4 patients) were excluded due to metal artifacts, yielding 94 hips (83 patients, mean 11±4 year followup). Of these 45/49 hips had open/closed reduction. The Kalamchi/MacEwen classification of proximal femoral deformity was used to assess significant femoral deformity (= grade 4; total damage to femoral epiphysis, -physis, -neck) at latest radiographic followup. MRI was performed at 1.5 T and included 2D coronal-, axial PD-w and T1-w turbo spin-echo images, before/ after i.v. contrast injection (0.2 mmol/l Gd-DTPA2-). Femoral head enhancement was graded as: normal/ asymmetric/ focally-/ globally decreased. Multivariate regression analysis was performed including odds-ratio (OR) and diagnostic performance.

RESULTS

At followup, 11 hips (12%) had femoral growth disturbance. Prevalence of globally decreased perfusion was higher (p = 0.016) in hips with- (36%, 4/11) compared to hips without growth disturbance (10%; 8/75) and was independently associated with femoral growth disturbance (OR: 6.2; 95%CI, 2 to 27; p=0.014). While negative predictive value of globally reduced perfusion was high (92%) its positive predictive value was low (36%) in predicting femoral growth disturbance.

CONCLUSION

Globally decreased perfusion on post-reduction MRI does not reliably predict proximal femoral growth disturbance in DDH at mid-term. Etiology of femoral growth disturbance after treatment of DDH is likely a multifactorial problem not solely attributed to decreased femoral head perfusion after closed/ open reduction.

CLINICAL RELEVANCE/APPLICATION

Our findings question the value of adding contrast agent to assess femoral head perfusion to a postreduction MRI as a predictor of proximal femoral growth disturbance.

RC313-07 Shape Regression in Characterizing an Infant's Growing Bony Pelvis

Tuesday, Dec. 3 9:40AM - 9:50AM Room: N228

Participants
Andy Tsai, MD, Boston, MA (*Presenter*) Nothing to Disclose

PURPOSE

Understanding the normal growth pattern of the infant pelvis is essential in recognizing many congenital pelvic abnormalities. Very little data exists on the normal growth of the bony pelvis during infancy. The purpose of this study is to analyze the spatial and temporal anatomical shape changes of the infant pelvis based on cross-sectional radiologic data, thus providing insight into the process of male and female infant pelvic growth.

METHOD AND MATERIALS

Pelvic radiographs from negative skeletal surveys of 247 term-born low-risk-of-abuse infants were reviewed (7/2005-2/2013). Additional exclusion criteria were asymmetry of the bony pelvis (due to rotation and/or tilt) and obscuration of the bony margins (due to overlying bowel gas and soft tissues). The bony margins of the pelvis (ilium, ischium, and pubis) from pelvic radiographs were manually segmented by a pediatric radiologist to form male and female shape databases. These databases were used to compute growth patterns of the normal infant male and female pelvises. Specifically, to capture the shape variations of the pelvises both in space and in time, probability maps were used to encode the segmented shapes, and kernel regression (via the Nadaraya-Watson estimator) was employed to interpolate these probability maps across time. The computed dynamic growth patterns were visually assessed for changes in size and morphology; and compared to one another to assess for gender differences.

RESULTS

One hundred eighteen pelvic radiographs from 68 boys (mean=145; SD=100; range=5-344 days) and 50 girls (mean=168; SD=100; range=10-339 days) met study inclusion criteria. The proposed computational framework generated a data-driven model of continuous pelvic growth that is temporally smooth and biologically plausible. It showed that the overall size of the pelvis grows fastest from birth to 3 months of life, and then steadily declines in growth rate from 3-months to 1-year. Visually, the growth pattern for boys and girls are similar, both in terms of morphology and growth rate.

CONCLUSION

Our study generated growth models for the normal male and female pelvises during infancy that can be used to better understand the dynamic growth of the infant bony pelvis.

CLINICAL RELEVANCE/APPLICATION

Understanding the growth pattern of the infant bony pelvis improves the diagnosis and evaluation of congenital skeletal anomalies.

RC313-08 Imaging of Developmental Hip Dysplasia

Tuesday, Dec. 3 9:50AM - 10:10AM Room: N228

Participants
Lene B. Laborie, Bergen, Norway (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lene.bjerke.laborie@helse-bergen.no

LEARNING OBJECTIVES

At the conclusion of this lecture, participants will be able to: 1) Understand the importance of early detection of Hip Dysplasia and the role of imaging. 2) Know how to perform ultrasound of newborn hip joints. 3) Know about existing newborn screening strategies for hip dysplasia.

ABSTRACT

Developmental hip dysplasia is the most common musculoskeletal disorder in childhood, with a reported prevalence of around 2-3 %. This congenital disorder features a shallow, or dysplastic acetabulum, often accompanied by a dislocatable or dislocated femoral head. Ultrasound has enabled a detailed assessment of both acetabular morphology and neonatal hip stability. Various static and dynamic ultrasound techniques, as well as a combination of the two are currently used. Both selective and universal ultrasound screening strategies exist for hip dysplasia in newborns. Early detection and correct management of hip dysplasia is crucial. The management of late detected cases of severe dysplasia can be very challenging. Unsuccessful management of dysplasia represents potential risks of developing early osteoarthritis from young adulthood and serious functional disability.

RC313-09 The Clavicular Joints in Children

Tuesday, Dec. 3 10:20AM - 10:40AM Room: N228

Participants
Delma Y. Jarrett, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the differences between adult and pediatric acromioclavicular and sternoclavicular joints in: anatomy, radiologic assessment, and patterns of injury.

RC313-10 Evaluation of Physeal Bridges in Children: Correlation with CT and MRI

Tuesday, Dec. 3 10:40AM - 10:50AM Room: N228

Participants
Amarnath Chellathurai, MD, FRCR, Chennai, India (*Abstract Co-Author*) Nothing to Disclose
Anand N. Parimalai, MD, Chennai , India (*Presenter*) Nothing to Disclose
Murali K. Logudoss, MBBS, MD, Chennai, India (*Abstract Co-Author*) Nothing to Disclose
Anitha Alaguraj, DMRD, Chennai, India (*Abstract Co-Author*) Nothing to Disclose
Shilpa Vijayasekar, MBBS, Chennai, India (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

amarrd02@yahoo.co.in

PURPOSE

Physeal bar is a premature interruption in the unfused physis of children by means of ossification or fibrous bridging due to trauma,infection and other causes leading to growth arrest or deformity.This physeal bridge may be fibrous or bony in nature. In this study we compare the CT and MR images of physeal bridging in children and the accuracy of MRI in the characterisation of the physeal bridges.

METHOD AND MATERIALS

We evaluated 60 children in the age group of 1-18 yrs prospectively who presented with growth arrest and /or deformity to look for the presence of physeal bridges during the period of august 2014-december 2018. With the help of CT and MRI we were able to characterise the nature of the bar whether fibrous or bony,depending upon the extent as epiphyseal,transphyseal,submetaphyseal.It is further classified on the basis of the location of the bridge in the bone into 9 physeal quadrants,so that area of involvement of the physis can be calculated.This quadrant mapping analysis is useful for the correlation with deformity and growth arrest.

RESULTS

16 Female and 15 male presented with premature physeal changes .Out of 31 physeal bridges studied,15 were posttraumatic,9 were associated with infection, 5 were associated with blounts disease , 1 was associated with perthes disease and 1 was associated with neglected slipped capital femoral epiphysis .The most common anatomic sites involved were proximal femur (10),distal femur (10), proximal tibia (9), distal radius (2).80.6% of the bridges were bony in posttraumatic cases,19.3% of the bridges were fibrous in postinfectious cases. 67.7% of the bridges were transphyseal in nature.Submetaphyseal type of bridging was common in blounts disease ,epiphyseal type was common in postinfectious cases . 50% of the distal femoral arrests were anterolateral in location whereas 44.4% of the proximal femoral arrests were anteromedial in location. Fibrous type of bridging was common in postinfectious sequalae.

CONCLUSION

MR imaging detects fibrous type of physeal bridging and submetaphyseal bridging more accurately than CT and the accuracy in detection of the bony physeal bars is equal to CT

CLINICAL RELEVANCE/APPLICATION

MR imaging ,exquisitely shows the growth disturbance and associated abnormalities that may follow physeal injury and guides surgical management

RC313-11 Pediatric Long-Bone Fracture Trinomial Subclassification by Convolutional Neural Networks with Two-Stage Decision Model

Tuesday, Dec. 3 10:50AM - 11:00AM Room: N228

Participants
Zbigniew Starosolski, PhD, Houston, TX (*Presenter*) Stockholder, Alzeca Biosciences, LLC
Haithuy N. Nguyen, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Melissa C. Cano, RRA, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Leslie Jones, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Ananth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC; Stockholder, Sensulin, LLC; Stockholder, Abbott Laboratories; Stockholder, Johnson & Johnson; Research Grant, Alzeca Biosciences, LLC
J. H. Kan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

Zbigniew.Starosolski@texaschilderns.org

PURPOSE

The purpose of this study was to evaluate the effect of newly designed CNN architecture utilizing two-stage decision model resulting in the trinomial classification of pediatric long bone radiographs with variable open growth plates.

METHOD AND MATERIALS

An IRB approved dataset obtained at a children's hospital during 2018, that included 3801 pediatric fractures, and 3801 normal radiographs of the appendicular skeleton was used. Fracture locations were labeled as healing or acute with boxes overlaying each fracture location and automatically patched into 512x512 pixels images. Normal radiographs were also automatically patched using the algorithm described in figure 1 A-G. The CNN network consisted of two-stage architecture. The Stage-1 training set consisted of 3001 patches with long bone fractures and the same number showing normal radiographs without fracture. The validation set and test set each had 800 images. Stage 2 CNN training set included 1910 acute and 1891 healing fracture patches, with the latter trained to identify periosteal reaction or callus as evidence of healing. The validation set and test set each had 400 images with class balance 50/50.

RESULTS

The limitation of transfer learning due to low resolution of input images was eliminated using the automated patch approach. The accuracy of classification of the Xception transfer learning network in stage 1 resulted in an accuracy of 89.87%, 60/400 normal radiographs were classified as positive, and 21/400 fracture radiographs were classified as negative, resulting in 379 true positives. In stage 2, the starting set of 379 positive radiographs was tested. Classification failed for 9 of 214 healing fractures, and 26 of 165 acute fractures resulting in stage 2 accuracy of 90.7%. The majority of the false negative and positive exams include casting material, creating the impression of absent periosteum. Combined accuracy for stage 1 and stage 2 was lowered by two stage error propagation to 85.5%.

CONCLUSION

Proposed network architecture allows for successful classification radiographs into three categories: normal, acute fracture and healing fracture.

CLINICAL RELEVANCE/APPLICATION

Trinomial classification of pediatric long bone fractures in the setting of open growth plates is possible using two stage CNN architecture and is able to distinguish normal, acute, and healing fractures.

RC313-12 Pediatric Knee MRI Blind Spots in Patellar Dislocation with Radiologic-Arthroscopic Correlation

Tuesday, Dec. 3 11:00AM - 11:10AM Room: N228

Participants
Oluwafunmiso Fagbongbe, Houston, TX (*Presenter*) Nothing to Disclose
Matthew Ditzler, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Aharon Z. Gladstein, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
J. H. Kan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

MRI is often used in the setting of patellar dislocation to screen for injuries necessitating surgery, such as intra-articular osteochondral bodies and cruciate ligament or meniscal injuries. The purpose of this study was to investigate the frequency of chondral, cruciate, and meniscal injuries in surgical patients after a patellar dislocation event to determine the most commonly missed injuries at imaging and further refine our search patterns.

METHOD AND MATERIALS

Children with both knee MRI and operative intervention for the treatment of acute lateral patellar dislocation were identified retrospectively in our electronic medical record. All MRI exams were interpreted by subspecialty trained pediatric musculoskeletal radiologists and all patients were examined by subspecialty trained pediatric orthopedic surgeons. Derangements including location and number of osteochondral loose bodies, cruciate/meniscal injuries, and location and grade of chondral injuries was recorded. Imaging findings were compared to operative reports, which were used as the reference diagnosis.

RESULTS

30 children (14.2 ± 2.1 years;60% female) with acute lateral patellar dislocation underwent knee MRI followed by surgery and shared a total of 62 surgically significant findings. The MRI discrepancy rate was 26% (16/62) and the false positive rate was 3% (2/62) with reference to surgical findings; both false positives were instances of medial patellar facet chondral injuries not corroborated at surgery. In 10/30 (33%) cases chondral injuries were incorrectly characterized on imaging, most commonly at the lateral tibial plateau. Osteochondral loose bodies were present in 18/30 (60%) patients, but only 13 (72%) were identified at imaging. Missed loose bodies were most common in the medial gutter. 9/30 (33%) had co-existing cruciate or meniscal injuries; of these, 3 were only identified at surgery (2 lateral and 1 medial meniscal tear).

CONCLUSION

Correct identification of surgically significant MRI findings in children with patellar dislocation by pediatric musculoskeletal radiologists is limited with a 26% miss rate. Our most common blind spots included lateral tibial plateau chondral injuries, medial gutter loose bodies, and meniscal injuries.

CLINICAL RELEVANCE/APPLICATION

Radiologists can refine their search patterns for MR knee exams in children with acute lateral patellar dislocation with the knowledge of common imaging blind spots we have described.

RC313-13 Bassett's Ligament Revisited: A Normal Variant or a Sign of Pediatric Ankle Pathology?

Tuesday, Dec. 3 11:10AM - 11:20AM Room: N228

Participants
Matthew Ditzler, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Atul Utturkar, DO, Oklahoma City, OK (*Presenter*) Nothing to Disclose
J. H. Kan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Aharon Z. Gladstein, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Siddharth P. Jadhav, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Erica K. Schallert, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Brian G. Smith, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Bassett's ligament, the accessory fascicle of the anteroinferior tibiofibular ligament (AITFL), is a normal anatomic structure with a high prevalence that is well described in adults, but not in pediatric patients. The ligament can abnormally thicken over time due to chronic anterolateral ankle impingement or a lateral talar dome chondral injury, per adult literature. The purpose of our study was to determine the prevalence of Bassett's ligament, and thickness when present, in pediatric patients with MR findings of anterolateral ankle pathology, compared to pediatric patients with normal ankle MR exams.

METHOD AND MATERIALS

Retrospective review of pediatric ankle MRI exams obtained through our electronic medical record was performed with MRI studies grouped into 2 categories: (1) those with a lateral talar osteochondral lesion (OCL)(13.5±2.9 years) and (2) normal ankle MRIs in children >10 years old(13.8±2.5 years). All examinations were retrospectively reviewed by a pediatric musculoskeletal radiologist for the presence of Bassett's ligament and its axial plane thickness. Frequencies of the ligament and average thickness measurements were calculated per group and analyzed for significant differences.

RESULTS

21 MRI studies were obtained for each group, for a total of 42 examinations. Bassett's ligament was present in 71% (15/21) of ankle MRIs with a lateral talar OCL with an average thickness of 2.04 mm (range 1.6-2.9 mm) and 71% (15/21) of normal ankle MRIs in patients aged >10 years with an average thickness of 1.59 mm (range 1-2.3 mm). Ligament prevalence (p=1) was similar, but thickness (p=0.004) was statistically different between the groups. For all cases with a lateral talar dome OCL, when Basset's ligament was identified it measured greater than 1.6 mm in thickness.

CONCLUSION

Bassett's ligament is a normal developmental anatomic structure present in children and not an acquired lesion related to a remote tear of the AITFL. Our data showed a significant association between thickening of Bassett's ligament and lateral talar dome OCLs in pediatric patients; further investigation is necessitated to delineate if this is causal or contributory.

CLINICAL RELEVANCE/APPLICATION

Bassett's ligament is a common and normal anatomic structure in the anterolateral compartment and should not be reported or implicated as a sign of talar dome chondral injury or anterolateral ankle impingement in pediatric patients unless thickened >1.6 mm.

RC313-14 The Impact of Urgent MRI in Management of First Time: Unexpected Patellar Dislocation Compared with Recurrent Dislocators

Tuesday, Dec. 3 11:20AM - 11:30AM Room: N228

Participants
Matthew Ditzler, MD, Houston, TX (*Presenter*) Nothing to Disclose
Oluwafunmiso Fagbongbe, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Aharon Z. Gladstein, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
J. H. Kan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Children suffering acute patellar dislocation undergo urgent MRI to confirm diagnosis and facilitate management decision support. The purpose of this study was to investigate the role of MRI and how imaging findings may predicate differences in orthopedic management for patients with acute patellar dislocation with or without a history of patellofemoral instability.

METHOD AND MATERIALS

Knee MRI examinations referred from pediatric orthopedic surgeons were selected by a PACS and electronic medical record query to identify subjects with acute patellar dislocation who received urgent MRI assessment. Clinical and surgical findings were used for the reference diagnosis. Subjects with acute lateral patellar dislocation were placed into 2 groups: first-time dislocators and recurrent dislocators. Demographics, frequencies of loose bodies/associated injuries, and average TT-TG distances were calculated per group and analyzed for significant differences.

RESULTS

99 knee MRI examinations performed between 2012-2018 were obtained. 22 patients were classified as first-time dislocators and 77 patients as recurrent dislocators who suffered an acute dislocation event prior to MRI. The groups included 36% female first-time dislocators and 69% female recurrent dislocators (p=0.01); average age (14.1 years vs 13.9 years;p=0.66) and TT-TG distances (14.6 mm vs 16.5 mm;p=0.16) were not significantly different. Osteochondral loose bodies (16/22, 73% vs 22/77, 29%;p<0.01) and cruciate/meniscal injuries (4/22, 18% vs 3/77, 4%;p=0.04) were identified more commonly in first-time dislocators compared to recurrent dislocators. Surgical intervention was similar for both groups (5/22, 22% vs 13/77, 17%;p=0.53). Realignment surgeries were performed in only 2/99 (2%) patients, both of whom were recurrent dislocators.

CONCLUSION

Surgically significant knee injuries occurred more frequently in children with first-time patellar dislocation compared to those with acute events and history of prior dislocation. These differences may reflect that these two populations have different biomechanical predispositions to injury and that ligamentous laxity in children with a history of recurrent dislocation may be protective for internal derangement.

CLINICAL RELEVANCE/APPLICATION

Patellar dislocation in children should routinely undergo urgent MRI investigation to help facilitate optimal surgical decision support.

Patellar dislocation in children should routinely undergo urgent MRI investigation to help facilitate optimal surgical decision support, particularly for first-time events.

RC313-16 Benign Mimics of Pediatric Bone Malignancy

Tuesday, Dec. 3 11:40AM - 12:00PM Room: N228

Participants
Micheal A. Breen, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Identify some of the most common pathologic and developmental processes that can mimic bone malignancy when imaging pediatric patients. 2) Differentiate these entities from malignant tumors based on imaging findings. 3) Recommend more appropriate management for non-malignant diagnoses.

RC314

Interventional Series: Venous Disease

Tuesday, Dec. 3 8:30AM - 12:00PM Room: E352

CH VA IR

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

FDA Discussions may include off-label uses.

Participants
Sanjeeva P. Kalva, MD, Boston, MA (*Moderator*) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Health, CA; Consultant, C. F. Koo Foundation; Consultant, Medtronic plc; Research Grant, AngioDynamics, Inc; Consultant, US Vascular LLC; Consultant, Dova Pharmaceuticals
Kari J. Nelson, MD, North Tustin, CA (*Moderator*) Research support, SillaJen, Inc; Research collaboration, Koninklijke Philips NV; Research collaboration, Teclison Cheery Pharma ;

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LEARNING OBJECTIVES

1) Describe current management of pulmonary embolism, including interventional techniques. 2) List rationale for venous thrombolysis. 3) Describe the current state of practice surrounding inferior vena cava filters. 4) Learn about techniques for endovascular management of chronic venous occlusions

ABSTRACT

n/a

Sub-Events

RC314-01 New Endovascular Devices for PE

Tuesday, Dec. 3 8:30AM - 8:45AM Room: E352

Participants
Akhilesh K. Sista, MD, New York, NY (*Presenter*) Research Grant, Penumbra, Inc; Scientific Advisory Board, Thrombolex; Scientific Advisory Board, Vascular Medicure

LEARNING OBJECTIVES

1) Describe the different mechanical options for thrombus maceration and/or removal. 2) Describe the risks and benefits of these devices. 3) Identify which patients may benefit the most from these devices. 4) Describe the state of the data for these mechanical devices.

ABSTRACT

n/a

RC314-02 PE Treatment Options and Pulmonary Embolism Response Team

Tuesday, Dec. 3 8:45AM - 9:00AM Room: E352

Participants
Ketan Y. Shah, MD, Chicago, IL (*Presenter*) Nothing to Disclose

RC314-03 Safety and Feasibility of Pulmonary Artery Mechanical Thrombectomy Using the FlowTriever System: Real World Experience with a New Device

Tuesday, Dec. 3 9:00AM - 9:10AM Room: E352

Participants
Nariman Nezami, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Jeffrey S. Pollak, MD, Woodbridge, CT (*Abstract Co-Author*) Nothing to Disclose
Igor Latich, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Juan Carlos Perez Lozada, MD, Fairfield, CT (*Abstract Co-Author*) Nothing to Disclose
Angelo G. Marino, DO, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Todd Schlachter, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA
Hamid R. Mojibian, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Catheter-directed and assisted therapies have revolutionized the management of higher-risk pulmonary embolism (PE) by means of chemical dissolution or mechanical disruption of clots. This is the first study reporting the safety, feasibility, and early outcome of the FDA approved pulmonary artery mechanical thrombectomy (MT) device, the Inari FlowTriever System.

METHOD AND MATERIALS

This was a retrospective analysis of 14 consecutive patients with acute massive or submassive PE, who underwent MT with the Inari FlowTriever System from Dec 2018 to Feb 2019. One patient underwent repeated MT 2 days after the initial one. The patient's demographic data, imaging findings, procedural details, outcomes, and complications were analyzed. Successful placement of the system and initiation of MT was considered technical success. Stabilization of hemodynamic parameters was defined clinical success. Outcome of the procedure, complications, and survival till hospital discharge was assessed for 30 days.

RESULTS

The procedure was technically and clinically successful in all 13 patients. One patient was excluded as she had no pre or post imaging assessment. Tachycardia, dyspnea, and dizziness were resolved in all patients. Systemic and diastolic blood pressures, and need for oxygen were corrected in all patients. Troponin trended down in all patients. The main pulmonary pressure was decreased 30% after MT (pre vs. post). 30 days survival was 100% and no procedure related complication occurred.

CONCLUSION

The Inari FlowTriever System is safe and feasible for mechanical thrombectomy of pulmonary artery in patients with acute massive or submassive PE.

CLINICAL RELEVANCE/APPLICATION

The Inari FlowTriever System can be safely used for mechanical thrombectomy of pulmonary arteries in patients with acute massive or submassive PE.

RC314-04 Chronic Venous Recanalization

Tuesday, Dec. 3 9:10AM - 9:25AM Room: E352

Participants
Kari J. Nelson, MD, North Tustin, CA (*Presenter*) Research support, SillaJen, Inc; Research collaboration, Koninklijke Philips NV; Research collaboration, Teclison Cheery Pharma ;

LEARNING OBJECTIVES

1) Describe indications for chronic venous recanalization. 2) Define patient work-up and follow-up. 3) Explain procedural tools and techniques. 4) Review outcomes of chronic venous recanalization.

RC314-05 Gianturco Z-Stent Placement for the Treatment of Chronic Central Venous Occlusive Disease: Implantation of 208 Stents in 137 Symptomatic Patients

Tuesday, Dec. 3 9:25AM - 9:35AM Room: E352

Participants
Jacob J. Bundy, MD, MPH, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Joseph McDevitt, MD , Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Daryl T. Goldman, MD , New York , NY (*Abstract Co-Author*) Nothing to Disclose
Anthony N. Hage, MD, Ada, MI (*Abstract Co-Author*) Nothing to Disclose
Joseph J. Gemmete, MD, Northville, MI (*Abstract Co-Author*) Consultant, Terumo Corporation; Stockholder, Ablative Solutions, Inc; Stockholder, Innovative Cardiovascular Solutions; Stockholder, InNeuro; Stockholder, FlexDex, Inc; Stockholder, Kalypso LP
Ravi N. Srinivasa, MD, Agoura Hills, CA (*Abstract Co-Author*) Nothing to Disclose
Jeffrey F. Chick, MD, MPH, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To report the technical success, adverse events, and long-term stent patencies of Gianturco Z-Stent placement for management of chronic central venous occlusive disease.

METHOD AND MATERIALS

137 patients, with mean age 49 ± 16 years (range: 16-89 years), underwent placement of Gianturco Z-Stents for chronic central venous occlusion. Presenting symptoms included: lower extremity edema (n=66; 48%), superior vena cava syndrome (n=30; 22%), unilateral upper extremity swelling (n=20; 15%), hemodialysis fistula or catheter dysfunction (n=11; 8.0%), ascites (n=8; 5.8%), and both ascites and lower extremity edema (n=2; 1.5%). Most common etiologies of central venous occlusion were: prior central venous access placement (n=58; 42%), extrinsic compression (n=29; 21%), and post-surgical anastomotic stenosis (n=27; 20%). Number of stents placed, stent implantation location, stent sizes, technical success, adverse events, need for re-intervention, follow-up evaluation, stent patencies, and mortality were recorded. Technical success was defined as recanalization and stent reconstruction with restoration of in-line venous flow. Primary and primary-assisted stent patencies were analyzed using Kaplan-Meier analysis.

RESULTS

208 total Z-Stents were placed. The three most common placement sites were the inferior vena cava (n=124; 60%), superior vena cava (n=44; 21%), and brachiocephalic veins (n=27; 13%). Technical success was achieved in 133 (97%) patients. There were two (1.5%) severe adverse events (two cases of stent migration to the right atrium), one (0.7%) moderate adverse event, and one (0.7%) mild adverse event. Mean follow-up was 44 months. Estimated 1-, 3-, and 5-year primary stent patency was 84%, 84%, and 82%, respectively. Estimated 1-, 3-, and 5-year primary-assisted patency was 92%, 89%, and 89%, respectively. 30- and 60- day mortality rates were 2.9% (n=4) and 5.1% (n=7), none of which were directly attributable to Z-Stent placement.

CONCLUSION

This study, which is the largest to date and with the longest follow-up evaluation, demonstrates the efficacy and safety of Gianturco Z-Stent placement for the treatment for chronic central venous occlusive disease.

CLINICAL RELEVANCE/APPLICATION

Gianturco Z-Stent placement is safe and effective for the treatment for chronic central venous occlusive disease with durable short- and long-term patencies.

RC314-06 Short-Term Outcomes and Predictive Factors of Primary Patency of Stent Placement for Central Venous Occlusion Disease (CVOD) in Hemodialysis Patients

Tuesday, Dec. 3 9:35AM - 9:45AM Room: E352

Participants
Bin Chen, Guangzhou, China (*Presenter*) Nothing to Disclose
Yonghui Huang, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Run Lin, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the outcomes and the predictive factors of primary patency of endoprothesis for central venous occlusive disease (CVOD) in hemodialysis patients.

METHOD AND MATERIALS

This study was approved by the institutional ethics committee. Data of consecutive 110 CVOD patients who underwent endovascular treatment in our department, include all clinical evaluation: demographic, clinical, and multi-slice spiral computed tomography venography(MSCTV) characteristics, from January 2012 to December 2017 were recorded and analyzed. The primary patency of stenting patients and the correlative factors were investigated. The data of patients who were treated with stents and followed up successfully was analyzed in the study.

RESULTS

Percutaneous recanalization was technically successful in 93 of the 102 patients (91%). Seventy-eight of the 93 patients (84%) were treated with stent placement. 71 case successful followed up were enrolled in the study. Procedure-related adverse events occurred in 17 patients (21.8%), and 4 events (5.1%) required medical intervention. No life-threaten complications occurred. The median primary patency was 16±2.2 month. The cumulative 3-, 6-, 9- and 12- month primary patency rates of stents were 93%, 72%, 55%, and 51%, respectively. Independent positive predictive factors of primary patency included vessel diameter >12mm, covered stents and non-calcification. Median primary patency of covered stents group was 21 months,significant better than that of bare stent group,which was 10 months (P<0.001). The primary patency rates of 1-, 3-, 6-, and 12-month in the covered stents group were 100%, 86.4%, 77.3% and 59.1%, respectively. In the bare stents group, the primary patency rates were 100%, 93.9%, 67.3% and 44.9%, respectively.

CONCLUSION

According to primary patency, percutaneous stent placement is promising treatment in Chinese CVOD patients. Characteristics of occlusive lesions including vessel diameter stent type and calcification are key factors of the primary patency. Covered stents demonstrated as a factor to improve the outcoming of CVOD treatment.

CLINICAL RELEVANCE/APPLICATION

These results can be useful to help us to select optimal intervention as the first choice to treat CVOD in hemodialysis patients.

RC314-07 Biology of Pulmonary Embolism

Tuesday, Dec. 3 9:45AM - 10:00AM Room: E352

Participants
Akhilesh K. Sista, MD, New York, NY (*Presenter*) Research Grant, Penumbra, Inc; Scientific Advisory Board, Thrombolex; Scientific Advisory Board, Vascular Medicure

LEARNING OBJECTIVES

1) Define the post-PE syndrome. 2) Identify gaps in knowledge of the pathophysiology of PE. 3) Identify future areas of research for interventional and non-interventional management of PE. 4) Describe the pathophysiology of massive and submassive PE.

ABSTRACT

n/a

RC314-08 Compressive Venous Syndromes

Tuesday, Dec. 3 10:15AM - 10:30AM Room: E352

Participants
Sanjeeva P. Kalva, MD, Boston, MA (*Presenter*) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Health, CA; Consultant, C. F. Koo Foundation; Consultant, Medtronic plc; Research Grant, AngioDynamics, Inc; Consultant, US Vascular LLC; Consultant, Dova Pharmaceuticals

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LEARNING OBJECTIVES

1) To review the pathophysiology, clinical symptoms and imaging diagnosis of common venous compression syndromes including May Thurner, Paget Schrotter, Nut cracker and popliteal venous compression syndromes. 2) To discuss the current role of endovascular therapy, endovascular treatment options and their results.

RC314-09 MR-Venography in the Diagnosis of Post-Thrombotic Iliac Vein Obstruction and Extravascular Compression

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E352

Participants
Vladimir Shebryakov, PhD, Moscow , Russia (*Presenter*) Nothing to Disclose
Oleg Karpov, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose
Yuriy Stoyko, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose
Oleg Bronov, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose
Maxim Yashkin, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose
Danata Lutarevich, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Evaluate value of non-contrast MRI in the diagnosis of post-thrombotic iliac vein obstruction and extravascular compression.

METHOD AND MATERIALS

The study included 168 patients with CVD (clinical class C3-C6 according to the CEAP classification), including 80 males and 98 females. The average age of the patients was 43.6±11.6 years. All patients underwent ultrasound angioscanning veins of the lower extremities and MRI of the iliac veins and inferior vena cava. Studies were performed on MRI using a special protocol non-contrast sequences: 1. BH TRUFI/FIESTA 3D using Valsalva maneuver; 2. INHANCE 3D using free breathing technique, with subsequent 3D reconstruction.

RESULTS

87 patients have been diagnosed with stenosis of the left common iliac vein due to compression of the right common iliac artery (May-Thurner syndrome). 55 patients underwent stenting of left common iliac vein with the May-Turner syndrome. Two patients underwent stenting of the left external and common iliac veins with post-thrombotic obstruction. 30 post-thrombotic deep vein changes have been revealed.

CONCLUSION

MR-venography is the most optimal method in the diagnosis of the causes of extra and intravenous pathology of the IVC and its basin. There is no radiation exposure, no use of contrast agent and short time relation. 3D-reconstruction of the IVC and iliac veins can be used for planning corrective treatment and reconstructive operations.

CLINICAL RELEVANCE/APPLICATION

MR-venography is equal to contrast angiographic methods in detecting extravasal compression and is recommended in the initial evaluation of suspected May-Thurner syndrome and post-thrombotic iliac vein obstructions.

RC314-10 IVC Filters: Evidence and Ongoing Trials

Tuesday, Dec. 3 10:40AM - 10:55AM Room: E352

Participants
Nima Kokabi, MD, Atlanta, GA (*Presenter*) Research support, Sirtex Medical Ltd

LEARNING OBJECTIVES

1. Learn the most up-to-date guidelines for placment of IVC filters. 2. Learn the highest level of evidence regarding IVC filter efficacy for various indications. 3. Learn highest level of evidence regarding IVC filter retrieval.

RC314-11 DVT Lysis: An Update

Tuesday, Dec. 3 10:55AM - 11:10AM Room: E352

Participants
Kush R. Desai, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Consultant, Cook Group Incorporated; Consultant, Koninklijke Philips NV; Consultant, The Spectranetics Corporation; Consultant, AngioDynamics, Inc; Consultant, Boston Scientific Corporation; Consultant, W. L. Gore & Associates, Inc

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LEARNING OBJECTIVES

1) To review the data governing thrombolysis of lower extremity DVT, with an emphasis on patient selection and procedural outcomes. 2) To review current technologies available for endovascular DVT treatment.

RC314-12 IVC Filters: Past, Present, and Future

Tuesday, Dec. 3 11:10AM - 11:25AM Room: E352

Participants
Sundeep Punamiya, MD, Singapore , Singapore (*Presenter*) Speakers Bureau, C. R. Bard, Inc

RC314-13 In-Vitro Comparison of the Clot Capturing Efficiency of Commercially Available Retrievable Inferior Vena Cava Filters

Tuesday, Dec. 3 11:25AM - 11:35AM Room: E352

Participants
He Zhao, Beijing, China (*Presenter*) Nothing to Disclose
Jiaywei Tsauo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Xiao Li, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare the clot capturing efficiency (CCE) of commercially available retrievable inferior vena cava (IVC) filters.

METHOD AND MATERIALS

Aliquots of blood were collected from domestic pigs and was coagulated for 30 minutes at room temperature and matured for 24 hours at 4?. The thrombi were cut into different sized cylindrical fragments ranging from 2.5×10mm to 7×20mm, and a venous flow simulator apparatus was used to test the CCE of four commercially available retrievable IVC filters [i.e. Denali (Bard, AZ), Option (Argon, TX), Celect (Cook, IN) and Optease (Cordis, NJ)].

RESULTS

The CCE of the Denali, Option, Celect, and Optease filter for sized 2.5×10mm, 3×10mm, and >= 4×10mm thrombi was 70%, 85%, and 100%, 80%, 95%, and 100%, 95%, 100%, and 100%, and 100%, 100%, and 100%, respectively. The CCE of all four filters for >= 4×10mm sized thrombi were not significantly different ($P > 0.99$). The CCE of the Denali filter for sized 2.5×10mm thrombi was significantly lower than the Optease filter ($P < 0.05$) and the Option filter ($P < 0.05$). The CCE of the Denali filter for sized 3×10mm thrombi was significantly lower than the Optease filter ($P < 0.05$).

CONCLUSION

The CCE of commercially available retrievable IVC filters for large and medium sized thrombi is similar. However, the Denali filter showed inferior CCE to the Optease and Option filter for small sized thrombi.

CLINICAL RELEVANCE/APPLICATION

The CCE of commercially available retrievable IVC filters for large and medium sized thrombi is similar, however, the Denali filter showed inferior CCE to the Optease and Option filter for small sized thrombi.

RC314-14 Single-Center 10-Year Clinical Experience with SVC Filters in the Era of Retrievable Filters

Tuesday, Dec. 3 11:35AM - 11:45AM Room: E352

Participants
Jorge E. Lopera, MD, San Antonio, TX (*Presenter*) Shareholder, Tecnostent SA; Advisor, Boston Scientific Corporation ; Proctor, Teleflex Incorporated

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PURPOSE

To report a 10 -year clinical experience with SVC filters with emphasis in complications and filter retrieval rates.

METHOD AND MATERIALS

A retrospective review of the images and electronic medical records of patients with Superior Vena Cava (SVC) filters was performed between 2008 and 2018 in a single tertiary medical center. Patient demographics, indications for filter placement, type of filter placed and clinical evolution were recorded. Complications during placement and retrieval were also determined. Contrast enhanced computed tomography images after the procedure were reviewed if available, to study filter migration and leg penetration .

RESULTS

Fifty patients with ages ranging from 17 to 89 years (average 54) underwent SVC retrievable filter placement. Main indication for SVC filter placement was deep venous thrombosis (DVT) of the major upper extremity and/or neck veins with contraindications to anticoagulation. Twenty -one patients had major neurological conditions, 16 had advanced cancers and 13 patients had other severe life- threatening comorbidities. Complications during placement included: filter malposition into the right brachycephalic vein in two patients, another patient had a leg of the filter entrapped in the tip of a hemodialysis catheter that required filter reposition and line exchange. Twelve patients had attempted filter removal. Eleven filters were successfully removed 3 - 14 months after placement (mean 5.8 m) with one technical failure . During removal one filter had a leg retained that required additional retrieval. Follow- up CT scans of the chest were available in 15 patients 1- 1920 days after filter placement (mean 493 days). Leg penetration into the mediastinum was seen in three patients , in one patient as early as 10 days after placement, no symptoms were oberved in these patients. No pericardial or pleural related to filter perforation was noted.

CONCLUSION

The use of retrievable SVC filters in patients with upper extremity DVT although highly controversial is safe with minimal complications. Most filters can be safely retrieved. Retrieval rates are modest.

CLINICAL RELEVANCE/APPLICATION

The use of retrievable SVC filters in patients with upper extremity DVT is safe with minimal complications . The majority of filters can be safely retrieved. The mortalty in this group of patients is very high and the use of SVC filters is highly controversial .

RC314-15 Advanced Filter Retrieval Techniques

Tuesday, Dec. 3 11:45AM - 12:00PM Room: E352

Participants
Thuong G. van Ha, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Advanced techniques for difficult filter retrieval will be discussed in details.

Printed on: 10/29/20

RC315

Breast Series: Emerging Technologies (The In-Person Presentation is Supported by an Unrestricted Educational Grant from Hologic, Inc)

Tuesday, Dec. 3 8:30AM - 12:00PM Room: Arie Crown Theater

AI BR

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

FDA Discussions may include off-label uses.

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Research Grant, Hologic, Inc; Research Grant, General Electric Company ; Research Consultant, Alphabet Inc; Research support, Bayer AG; Research collaboration, Volpara Health Technologies Limited
Shandong Wu, PhD, MSc, Philadelphia, PA (*Moderator*) Nothing to Disclose
Despina Kontos, PhD, Philadelphia, PA (*Moderator*) Research Grant, Hologic, Inc
John M. Lewin, MD, Denver, CO (*Moderator*) Nothing to Disclose

Sub-Events

RC315-01 Emerging Technologies: Part 1

Participants
Shandong Wu, PhD, MSc, Philadelphia, PA (*Moderator*) Nothing to Disclose
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Research Grant, Hologic, Inc; Research Grant, General Electric Company ; Research Consultant, Alphabet Inc; Research support, Bayer AG; Research collaboration, Volpara Health Technologies Limited
Despina Kontos, PhD, Philadelphia, PA (*Moderator*) Research Grant, Hologic, Inc

RC315-02 Lessons Learned from CAD and AI

Tuesday, Dec. 3 8:30AM - 8:55AM Room: Arie Crown Theater

Participants
Linda Moy, MD, New York, NY (*Presenter*) Grant, Siemens AG; Support, Lunit Inc ; Support, iCad, Inc; Support, FAIR Facebook; Advisory Board, Lunit Inc; Advisory Board, iCad, Inc

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LEARNING OBJECTIVES

1) To compare traditional CAD for mammography versus machine learning-based platforms. 2) To discuss the status of AI and screening mammography. 3) To discuss the potential roles for AI and mammography beyond improved diagnosis, assessment of breast density, and potential triaging of normal screening mammograms.

ABSTRACT

Breakthroughs in computer processing, data storage and algorithm design have led to development of AI tools for screening mammography. These new systems may improve clinical care throughout the breast care continuum. However, the promise of these AI tools is tempered by lessons learned with traditional CAD systems. This talk will underscore the limitations of traditional CAD and highlight potential solutions with AI systems.

RC315-03 Comparison of the Diagnostic Performance of Abbreviated MRI and Full Diagnostic MRI with CAD System in Patients with a Personal History of Breast Cancer: The Effect of CAD-Generated Kinetic Features on Reader Performance

Tuesday, Dec. 3 8:55AM - 9:05AM Room: Arie Crown Theater

Participants
Taeyang Ha, MD, Suwon, Korea, Republic Of (*Presenter*) Nothing to Disclose
Taehee Kim, MD, PhD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Doo Kyoung Kang, MD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purposes of our study were to compare the diagnostic performance of abbreviated MRI and full diagnostic MRI with CAD system in patients with a personal history of breast cancer and to evaluate how the kinetic features affect the performance of two radiologists.

METHOD AND MATERIALS

Between 1, 2014 and December 31, 2017, 3834 breast MR examinations in 2310 patients with a personal history of breast cancer composed our study population. MR images were retrospectively reviewed by two radiologists with 8 and 15 years of experience. First, two radiologists independently reviewed T1-weighted images scanned at 90s after the contrast injection and T2-weighted images. After 6 months, the two readers reviewed contrast enhanced T1-weighted images with 5 consecutive delayed images using CAD. We compared the diagnostic performance of abbreviated- and full-sequence MRI.

RESULTS

Fifty one intramammary recurrences were detected with breast MRI in 47 patients. Of fifty one tumor recurrences, 36 (70.6%) lesions occurred at more than 3 years after initial cancer surgery and 7 (13.7%) lesions at less than 2 years after initial surgery. The sensitivity and specificity were 98% and 97.6%-98.6% on the abbreviated sequence and 94.1%-98% and 97.9%-98.3% on full diagnostic MRI showing no significant differences. Of 51 malignant lesions, 6 showed delayed persistent pattern, of which 3 lesions were non-mass enhancement and 3 lesions were small enhancing masses less than 1cm. There were 6 false negative cases in both MRI. On abbreviated MRI, the reasons of false negative were moderate background parenchymal enhancement causing the masking of non-mass enhancement in one case and small size and margin in the other case. Four cases were missed in the full-diagnostic MIR and the reasons were delayed persistent kinetic curve in all cases.

CONCLUSION

Overall diagnostic performances of abbreviated MRI and full diagnostic MRI were similar in both readers. The semi-quantitative kinetic features from CAD system could affect the reader performance and the sensitivity could be improved or the specificity improved according to the readers.

CLINICAL RELEVANCE/APPLICATION

Postoperative MRI screening is useful especially in patients who have undergone surgery for more than 2 years. Using MR-CAD system could increase the sensitivity or specificity according to the readers.

RC315-04 Are Your AI Diagnosis Models Safe Under Attack of Manipulated Images?

Tuesday, Dec. 3 9:05AM - 9:15AM Room: Arie Crown Theater

Participants
Qianwei Zhou, PhD, Hangzhou, China (*Presenter*) Nothing to Disclose
Guo Yuan, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Lu Yang, Chongqing , China (*Abstract Co-Author*) Nothing to Disclose
Giacomo Nebbia, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Shandong Wu, PhD, MSc, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Promising performance has been shown in deep learning-based artificial intelligence (AI) models for Computer-Aided Diagnosis. In implementing deep learning diagnosis tools in clinical workflow, safety issues of such AI models emerge but little research has been done. We performed a study to investigate the effects of a Full Field Digital Mammography (FFDM)-based deep learning diagnosis model under attack of manipulated images.

METHOD AND MATERIALS

In a breast cancer diagnosis setting, we trained a customized VGG network using 853 positive FFDM images (biopsy-proven malignancy) and 2374 negative images (benign or negative findings) for classification. Then, we trained two generative models by the Generative Adversarial Networks (GANs) using the training set of the full data; one model is to generate a fake positive-looking image from a given real negative image and the other is to generate a fake negative-looking image from a given real positive image. The GAN-generated fake images are input to the classification model to test whether it would be fooled. Furthermore, we tested whether or to what extent the fake images may possibly fool human radiologists. Two certified breast imaging radiologists (12 [Reader 1] and 11 [Reader 2] years of experience) were given a set of 322 mixed real and fake images to assess as "real", "fake", or "unsure". An education process is applied by having them read 100 pairs of real and the corresponding GAN-generated fake images to understand the manipulations made by the GAN models and after that, a different set of 324 mixed real and fake images were given to them for assessment. Both readers assess all images independently without knowledge on the GAN models.

RESULTS

The classification model's AUC is 0.86 on 10% unseen testing data and its AUC is 0.82 when tested on the same amount of GAN-generated fake images. Reader 1 and 2 recognized 39% and 69% fake images initially and then 54% and 75% after the education process, respectively.

CONCLUSION

GAN-generated fake images largely fool a deep learning-trained diagnosis model and to a much less extent the experienced radiologists, who can recognize most fake images, where an education intervention can improve their performance.

CLINICAL RELEVANCE/APPLICATION

Defending considerations against intentionally-generated fake images to attack AI diagnosis models are needed in their clinical deployment, where human-AI model interactions may be a key solution.

RC315-05 Masking Risk Index by Deep Learning for a Stratified Screening Program

Tuesday, Dec. 3 9:15AM - 9:25AM Room: Arie Crown Theater

Participants
Theo S. Cleland, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
James G. Mainprize, PhD, Toronto, ON (*Presenter*) Institutional research agreement, General Electric Company
Olivier Alonzo-Proulx, Toronto, ON (*Abstract Co-Author*) Institutional research agreement, General Electric Company

Jennifer A. Harvey, MD, Charlottesville, VA (*Abstract Co-Author*) Stockholder, Hologic, Inc Research Grant, Volpara Health Technologies Limited Stockholder, Volpara Health Technologies Limited
Martin J. Yaffe, PhD, Toronto, ON (*Abstract Co-Author*) Research collaboration, General Electric Company Shareholder, Volpara Health Technologies Limited Co-founder, Mammographic Physics Inc Research Consultant, BHR Pharma LLC

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PURPOSE

Masking in mammography is the reduction of lesion conspicuity by surrounding and overlying dense tissue. Women at risk of masking will likely benefit from other screening methods (e.g. ultrasound). The FDA is proposing that all mammography facilities in the US report on breast density to allow for women with dense breasts to receive supplemental screening. Since ~50% of screening-age women have dense breasts, the cost of supplemental screening could be substantial. We propose a masking risk index (MI) that uses a convolutional neural network (CNN) that is efficient in stratifying women at risk of masking and can potentially lower the cost of a supplemental screening program (SSP).

METHOD AND MATERIALS

A study population of 224 cancer cases (461 mammograms) was used to train an InceptionV3 model pre-trained on ImageNet in a 7 cross-fold validated approach to distinguish mammograms associated with interval or screen-detected cancers. We simulate an SSP by testing the model's ability to identify high masking risk subjects within a simulated population of 100,000 women with 60 interval cancers. The efficiency of the model is estimated as the number of women needed to undergo supplemental screening to find one additional interval cancer (labelled the screening cost, 'SC'). An MI is more efficient if the SC is lower. We compare MI estimates from the CNN to other candidate MIs such as BI-RADS density and volumetric breast density (VBD) in terms of the concordance statistic (C-stat), SC and the capture fraction of interval cancers.

RESULTS

Stratification by the CNN, VBD and BIRADS density MIs yields C-stats of 0.76 [0.67-0.81], 0.66 [0.57-0.74] and 0.63 [0.56-0.69] respectively (95% CI in brackets). As reference, stratification by BI-RADS density in an SSP for all 'dense breasts' would capture 63% (38/60) of missed cancers at a cost of 42645 extra screens out of 100000 (SC=1117). At the same operating point, an MI by VBD would require 40118 extra screens (SC=1051) and by CNN, would require only 22826 extra screens (SC=598).

CONCLUSION

The CNN model has been shown to outperform the BI-RADS and VBD metrics in identifying high masking risk patients and may be more efficient in guiding an SSP.

CLINICAL RELEVANCE/APPLICATION

Individualized breast cancer screening requires an efficient decision tool to identify women who would benefit the most from supplemental screening while minimizing unnecessary extra exams.

RC315-06 Retrospective Detection of Breast Malignancies with Deep Learning in Clinically Negative, Prior Screening Mammograms

Tuesday, Dec. 3 9:25AM - 9:35AM Room: Arie Crown Theater

Participants
Abdul Rahman Diab, Cambridge, MA (*Presenter*) Employee, DeepHealth, Inc
Jiye G. Kim, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, DeepHealth, Inc
Mack K. Bandler, MD, Medford, OR (*Abstract Co-Author*) Nothing to Disclose
A. Gregory Sorensen, MD, Belmont, MA (*Abstract Co-Author*) Employee, DeepHealth, Inc Board member, IMRIS Inc Board member, Siemens AG Board member, Fusion Healthcare Staffing Board member, DFB Healthcare Acqusitions, Inc Board member, inviCRO, LLC
William Lotter, PhD, Cambridge, MA (*Abstract Co-Author*) Officer, DeepHealth Inc

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PURPOSE

To evaluate the ability of a deep learning model to detect breast cancer in clinically negative, prior screening mammograms of breast cancer patients.

METHOD AND MATERIALS

Screening FFDM x-ray mammograms from 2011 to 2017 were retrospectively collected under an IRB-approved protocol. Women who had a malignancy on either screening or diagnostic x-ray mammography were identified, and their previous screening mammograms, which were interpreted as normal (BI-RADS 1 or 2) and performed 9 months to 3 years prior to the index cancer diagnosis, were collected. These 'prior' screening mammograms were assigned the label 'malignant'. In addition, a set of screening exams interpreted as BI-RADS 1 or 2, each of which was followed by at least one additional screening exam also interpreted as BI-RADS 1 or 2, was assigned the label 'normal'. The resulting full set consisted of 328 'malignant' cases and 13540 'normal' cases. For evaluation on this dataset, we used a top-scoring deep learning model from the Digital Mammography DREAM Challenge which was not trained on data from this institution. The receiver operating characteristic (ROC) and the corresponding area under the curve (AUC) were quantified.

RESULTS

The model achieved an AUC of 0.70 (+/- 0.03). At an operating point of 88.9% specificity - the mean radiologist level according to the Breast Cancer Surveillance Consortium - the model achieved a sensitivity of 35%. Thus, at a recall rate consistent with clinical practice, the model detected 35% of cancer cases using the prior exams. Using this threshold, the earliest cancer detected was in a screening exam 730 days prior to the index diagnosis.

CONCLUSION

A deep learning model successfully detected malignancies in a significant number of clinically negative prior screening exams of women diagnosed with breast cancer.

CLINICAL RELEVANCE/APPLICATION

AI-assisted screening mammography has the potential to help physicians detect breast malignancies earlier, which could ultimately improve prognosis.

RC315-07 What Is the Future of AI in Breast Imaging?

Tuesday, Dec. 3 9:35AM - 10:00AM Room: Arie Crown Theater

Participants
Geraldine B. McGinty, MD, MBA, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the potential for AI to impact breast imaging. 2) Learn about innovations in breast imaging research and practice related to AI tools. 3) Understand the ethical considerations related to data sharing and patient privacy as well as navigating relationships with industry.

RC315-08 Emerging Technologies: Part 2

Participants
John M. Lewin, MD, Denver, CO (*Moderator*) Nothing to Disclose
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Research Grant, Hologic, Inc; Research Grant, General Electric Company ; Research Consultant, Alphabet Inc; Research support, Bayer AG; Research collaboration, Volpara Health Technologies Limited

RC315-09 Artificial Intelligence for Digital Breast Tomosynthesis Imaging

Tuesday, Dec. 3 10:20AM - 10:45AM Room: Arie Crown Theater

Participants
Ioannis Sechopoulos, PhD, Atlanta, GA (*Presenter*) Research Grant, Siemens AG; Research Grant, Canon Medical Systems Corporation; Speakers Bureau, Siemens AG; Scientific Advisory Board, Fischer Medical

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LEARNING OBJECTIVES

1) List and explain the features of current artificial intelligence (AI)-based systems for digital mammography and digital breast tomosynthesis (DBT) image interpretation. 2) Describe the current performance capabilities of these AI systems. 3) Describe the current and future potential uses for AI systems in mammography and DBT imaging.

RC315-10 Improved Machine Learning-Based Evaluation of Digital Breast Tomosynthesis Screening Mammography through Customized Synthetic 2D Image Creation

Tuesday, Dec. 3 10:45AM - 10:55AM Room: Arie Crown Theater

Participants
William Lotter, PhD, Cambridge, MA (*Presenter*) Officer, DeepHealth Inc
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PURPOSE

Synthetic 2D images constructed from digital breast tomosynthesis (DBT) data are a useful tool for summarizing the information across the DBT planes. However, the default synthetic 2D images included in many systems may not summarize the most important information for cancer detection. We use machine learning (ML) to construct optimized 2D images from DBT slices, and subsequently used these images for additional ML training and testing.

METHOD AND MATERIALS

The data used consisted of three sets: Set A - 12000 2D FFDM cases (4500 proven cancers) from two sites; Set B - 22000 DBT cases (300 proven cancers) with default synthetic 2D from a site in Rhode Island; Set C - 1000 screening DBT cases (100 proven cancers) with default synthetic 2D from a site in Oregon. First, a 2D deep learning model was trained on Set A, then used to create ROI-optimized 2D images using a proprietary method on the DBT cases in Set B. The 2D model was then fine-tuned on these novel synthetic images in Set B, as well as also being separately fine-tuned on the default synthetic 2D images in this set. Finally, we tested the resulting models on Set C, where the ROI-optimized 2D images were created in the same manner as those created in Set B. Importantly, neither the model used to create the optimized images nor the model trained to classify these images were trained on data from Set C. Performance on the task of determining the presence or absence of proven cancer was quantified using the AUROC.

RESULTS

The model trained and tested on the ROI-optimized 2D images obtained a significantly higher AUROC than the model trained and tested on the default synthetic 2D images (0.93 vs. 0.90, p<0.05). Combining the predictions of both models resulted in an even greater performance of 0.95 AUROC (p<0.05), corresponding to a sensitivity of 91% at 89% specificity.

CONCLUSION

Using deep learning to create a ROI-optimized 2D image from DBT images can lead to a higher performance in AI-based classification than the default synthetic 2D image. The images are complementary: combining predictions on both versions leads to even higher performance.

CLINICAL RELEVANCE/APPLICATION

AI has the potential to improve screening mammography performance, especially for DBT. These results suggest that creating optimized 2D images from DBT using ML can be an effective strategy for ML-based classification. Future work will investigate if these optimized synthetics are useful for human readers.

RC315-11 Machine Learning in Multi-Parametric Magnetic Resonance Imaging of Women with Extremely Dense Breasts to Reduce Referral for Benign BI-RADS 3 and 4 Lesions

Tuesday, Dec. 3 10:55AM - 11:05AM Room: Arie Crown Theater

Participants
Erik Verburg, Utrecht, Netherlands (*Presenter*) Nothing to Disclose
Wouter B. Veldhuis, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Marije F. Bakker, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Grant, Bayer AG; Software support, Volpara Health Technologies Limited
Ruud Pijnappel, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Carla H. van Gils, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Software support, Volpara Health Technologies Limited
Kenneth G. Gilhuijs, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of this study was to demonstrate feasibility of reducing follow-up on benign BI-RADS-3 and 4 lesions in the DENSE trial, involving MRI screening of asymptomatic women with extremely dense breasts.

METHOD AND MATERIALS

Asymptomatic women with extremely dense breasts participated in a randomized controlled MRI screening trial using multi-parametric MRI, after normal screening mammography. In total, 4783 women (49.5-75.2 years) were screened in 8 hospitals between 22-dec-2011 and 22-jan-2016. In total 526 lesions (445 benign and 81 malignant) in 454 women were given a BI-RADS 3, 4 or 5 score. Five different MRI sequences were used: T1-weighted imaging without fat suppression, diffusion weighted imaging, T1-weighted DCE with high spatial resolution, T1-weighted DCE with high temporal resolution and T2-weighted imaging. A machine learning algorithm was developed to reduce the number of referrals for BI-RADS 3 (155 benign, 6 malignant) and BI-RADS 4 (248 benign, 59 malignant) lesions without reducing sensitivity. The algorithm consists of feature extraction and feature classification. After semi-automated segmentation, 49 features were candidate predictors in a radiomic model, 46 were automatically calculated from the MR images supplemented with 3 clinical features; age, BMI and BI-RADS score. To avoid overfitting, a Ridge regression model was developed using 10-fold cross validation. Model performance was analyzed using decision curve analyses and ROC analysis. To simulate impact of an abbreviated MRI protocol, we repeated classification without using any of the 5 features related to the high-resolution DCE series.

RESULTS

The model correctly classified 51.4%±4.2% (mean±1std) of all BI-RADS 3 lesions and 20.1%±2.7% of all BI-RADS 4 lesions as benign, without missing a malignant lesion. The simulated abbreviated protocol resulted in correct classification of 26.0%±3.7% and 14.8%±2.4% of the lesions as benign, respectively, with a fixed sensitivity of 100%.

CONCLUSION

Dedicated multi-parametric machine learning of breast MRI for BI-RADS-3 and 4 lesions in screening of women with extremely dense breasts has promising potential to reduce referral of benign lesions.

CLINICAL RELEVANCE/APPLICATION

The reduction of false-positive referral could be beneficial for women to reduce psychosocial distress associated with such referrals, and for hospital workflow.

RC315-12 Effect of Harmonization on Machine Learning Classification Performance of DCE-MRI Radiomic Features of 2,235 Breast Lesions from Two Populations

Tuesday, Dec. 3 11:05AM - 11:15AM Room: Arie Crown Theater

Participants
Heather Whitney, PhD, Wheaton, IL (*Presenter*) Nothing to Disclose
Hui Li, PHD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Yu Ji, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Alexandra V. Edwards, Chicago, IL (*Abstract Co-Author*) Research Consultant, QView Medical, Inc Research Consultant, Quantitative Insights, Inc
John Papaioannou, MSc, Chicago, IL (*Abstract Co-Author*) Research Consultant, QView Medical, Inc
Peifang Liu, MD, PhD, Tianjin, China (*Abstract Co-Author*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Advisor, Qlarity Imaging; Stockholder, Hologic, Inc; Shareholder, 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, Canon Medical Systems Corporation

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PURPOSE

To assess the impact of harmonization on classification performance of radiomic features extracted from dynamic contrast-enhanced magnetic resonance (DCE-MR) images of breast lesions in two populations.

METHOD AND MATERIALS

DCE-MR images of 2,235 breast lesions were retrospectively collected under IRB/HIPAA compliance from two populations, one in the United States (211 benign, 475 cancers) and one in China (481 benign, 1068 cancers). Lesions were segmented using a fuzzy c-means method and thirty-eight radiomic features were extracted. ComBat harmonization was used to standardize radiomic features with three covariates: benign or cancer, pre- or post-biopsy, and field strength (1.5T or 3.0T). Pre- and post-harmonization, t-distributed stochastic neighbor embedding (t-SNE) methods were used to reduce the feature space. Degree of clustering by lesion type between populations before/after harmonization was measured using the Davies-Bouldin index. Performance in the task of classification of lesions as benign or cancer was determined using the t-SNE outputs in ROC analysis, with linear discriminant analysis and ten-fold cross-validation in three scenarios: (1) lesions imaged in the United States, (2) lesions imaged in China, and (3) all lesions together. The area under the ROC curve (AUC) served as figure of merit. Superiority ($p < 0.05$) and similarity testing (equivalence margin identified retrospectively) were used to compare classification performance pre- and post-harmonization.

RESULTS

For benign lesions and for cancers, the Davies-Bouldin index increased 82% and 97% respectively, indicating that the harmonization process increased the similarity of the lesion types between the two populations. When comparing pre- and post-harmonization, classification performance was either statistically equivalent (US database) or demonstrated statistically significant improvement (China and combined databases).

CONCLUSION

In the mixed population dataset, harmonization of radiomic features of breast lesions in two populations yielded statistically significant improvement in classification performance as compared to pre-harmonization.

CLINICAL RELEVANCE/APPLICATION

Harmonization methods can improve the classification performance of radiomic features extracted from combined populations of breast lesions imaged with dynamic contrast-enhanced magnetic resonance.

RC315-13 Combining Deep Learning and Radiomic Classifiers within the Tumor and Tumor Environment Enables Enhanced Prediction of Neo-Adjuvant Chemotherapy Response from Pre-Treatment Breast DCE-MRI

Tuesday, Dec. 3 11:15AM - 11:25AM Room: Arie Crown Theater

Awards
Trainee Research Prize - Medical Student

Participants
Jeffrey E. Eben, Cleveland, OH (*Presenter*) Nothing to Disclose
Nathaniel Braman, Cleveland, OH (*Abstract Co-Author*) Intern, IBM Corporation
Maryam Etesami, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Jame Abraham, MD, Morgantown, WV (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Hologic, Inc
Anant Madabhushi, PhD, Cleveland, OH (*Abstract Co-Author*) Stockholder, Elucid Bioimaging Inc; Stockholder, Inspirata Inc; Consultant, Inspirata Inc; Scientific Advisory Board, Inspirata Inc; Scientific Advisory Board, AstraZeneca PLC; Scientific Advisory Board, Merck & Co, Inc; Researcher, Koninklijke Philips NV; Researcher, Inspirata Inc; License agreement, Elucid Bioimaging Inc; License agreement, Inspirata Inc; Grant, PathCore Inc; Grant, Inspirata Inc

PURPOSE

Radiomics, the extraction and analysis of quantitative imaging features, and deep learning (DL), the training of a neural network for feature extraction and prediction, have individually shown promise in predicting response to neoadjuvant chemotherapy (NAC) from pre-treatment breast DCE-MRI. Additionally, previous work has shown that employing these approaches separately within subregions of the tumor habitat can further enhance response prediction. In this work, we present a novel approach for combining radiomic and DL-based response classifiers localized in the tumor and its surrounding environment.

METHOD AND MATERIALS

1.5 or 3T pre-treatment breast DCE-MRI scans of 114 patients receiving NAC, supplemented with HER2-targeted agents for HER2+ patients (n=27), were retrospectively analyzed. Patients were randomly divided into training (N=80) and testing (N=34) sets. The scans were segmented into an intratumoral region (IT) consisting of the tumor itself and a peritumoral region (PT) consisting of the annular band 0-3mm surrounding the tumor. IT and PT were separately analyzed in the training set via 3-fold cross-validation using DL and radiomics, with the DL classifier trained on the segmented volume and the radiomic classifier trained on image texture features extracted within the segmented volume. The 4 individual classifiers were fused using a logistic regression classifier based on their predictions in the training set. Ensemble performance was compared against that of the individual classifiers in the held-out testing set by area under the receiver operating characteristic curve (AUC).

RESULTS

The fusion model predominantly incorporated predictions from the IT DL classifier and the IT and PT radiomics classifiers to identify pCR with AUC=0.793, which outperformed individual radiomic and DL classifiers. Non-pCR was characterized by elevated expression of radiomic features quantifying enhancement heterogeneity, while the neural network emphasized IT regions near the tumor's border in tumors that had pCR.

CONCLUSION

An ensemble of classifiers oriented spatially in the tumor habitat better identified pCR on baseline DCE-MRI than approaches incorporating radiomics or DL alone.

CLINICAL RELEVANCE/APPLICATION

A combination of radiomics and DL based on their relative and regional strengths represents a promising approach to identify NAC responders prior to NAC.

RC315-14 Radiomics in Transmission Ultrasound Improve Differentiation between Benign and Malignant Breast Masses

Tuesday, Dec. 3 11:25AM - 11:35AM Room: Arie Crown Theater

Participants
Rajni Natesan, MD, MBA, Houston, TX (*Presenter*) Officer, QT Ultrasound Labs
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Diane Navarro, Novato, CA (*Abstract Co-Author*) Employee, QT Ultrasound LLC
Christopher Anaje, Novato, CA (*Abstract Co-Author*) Employee, QT Ultrasound LLC
Bilal Malik, PhD, Novato, CA (*Abstract Co-Author*) Employee, QT Ultrasound Labs

PURPOSE

Over the past decade, radiomic features have proved to be helpful in characterizing tumor biology in vivo by correlating imaging with ground truth pathology. In this study, we identified and utilized such features applied to transmission ultrasound (TU). An abundance of imaging biomarkers are encoded in the TU speed-of-sound maps of breast tissue, which can be used to characterize breast masses. The purpose of this study was to evaluate the efficacy of using these radiomic features to differentiate benign from malignant breast masses.

METHOD AND MATERIALS

We randomly selected 90 pathology-proven cases with space-occupying breast masses (49 benign and 41 malignant) from our imaging database. Masses were included in the study if they were able to be segmented using our segmentation algorithm. Radiomic features, including mass irregularity, circularity, and first-order statistics of the pixel distribution, were calculated. T-tests were used to evaluate each feature in its ability to characterize a mass as benign or malignant ($p<0.05$ considered significant). These features were used in machine learning-based classifiers to differentiate benign from malignant masses.

RESULTS

Both irregularity and circularity proved to be significantly different when comparing benign and malignant masses. Irregularity was measured to be 0.202 ± 0.014 for benign masses and 0.402 ± 0.019 for malignant masses. Similarly, circularity was measured to be 0.788 ± 0.013 and 0.719 ± 0.017, respectively, demonstrating that fundamental morphological features typically used to differentiate benign from malignant masses can also be derived meaningfully from TU imaging. The mode, median and average speed of sound values showed significant differences for benign and malignant mases. Using the two morphological features along with the speed of sound, our algorithm testing found that K-nearest neighbor method with 10-fold cross-validation provided the highest accuracy of 86.7% (ROC-AUC of 0.85).

CONCLUSION

Our study shows that a range of radiomic features derived from TU can differentiate benign from malignant breast masses. These features may serve as important tools when developing artificial-intelligence-based and computer-aided diagnosis tools for TU.

CLINICAL RELEVANCE/APPLICATION

Radiomics in transmission ultrasound may contribute to decision support to increase precision in the diagnosis and treatment of breast cancer.

RC315-15 AI For Breast Ultrasound and MRI

Tuesday, Dec. 3 11:35AM - 12:00PM Room: Arie Crown Theater

Participants
Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Advisor, Qlarity Imaging; Stockholder, Hologic, Inc; Shareholder, 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, Canon Medical Systems Corporation

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LEARNING OBJECTIVES

1) Appreciate the motivation and scientific premise of AI for breast ultrasound and MRI for various clinical tasks. 2) Learn about the role of AI in computer-aided diagnosis using computer-extracted hand-engineered radiomic features and methods in deep learning in 2D and 3D. 3) Understand the role of AI beyond breast cancer detection and diagnosis, in which data extracted from breast images could be used to inform multi-omics cancer discovery studies and virtual biopsies.

RC316

Becoming a Leader in Non-clinical Professional Roles in Radiology and Medicine (Sponsored by the RSNA Professionalism Committee)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S404AB

LM

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

FDA Discussions may include off-label uses.

Participants
Stephen Chan, MD, Closter, NJ (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe different non-clinical professional roles of the radiologist and the various kinds of training and experience required to develop expertise in these roles. 2) Develop their appreciation of the role of business and leadership skills in representing the radiology profession within various healthcare organizations and within governmental bodies, panels and agencies both inside and outside the healthcare arena. 3) Deepen their understanding of specific professional roles - such as radiology informatics expert and entrepreneur - where radiologists bring specific subspecialty expertise into non-clinical professional domains.

ABSTRACT

All radiologists have undergone many years of training in clinical radiology, with most individuals having also participated in research and educational activities during their postgraduate training and post-residency careers. By virtue of the importance of radiology in modern medicine, as well as of the clinical, academic, and scientific expertise that every radiologist develops as a result of his or her years of training and experience, many individuals in the field of radiology are called upon to participate in professional activities for which he or she has not typically received formal training of similar intensity and duration.The performance of such non-clinical activities at a suitable professional level is important for promoting and enhancing the careers of individual radiologists. In the aggregate, pursuit of these non-clinical activities is also essential for enhancing the overall image of all radiologists as relevant, connected, and integral to the practice of modern medicine, and for demonstrating radiologists to be contributing, functional members of society. However, these non-clinical roles require a different type of expertise and bring a new set of expectations. This course aims to answer these two broad questions: what are these important non-clinical professional roles, and how does a radiologist develop the acumen to act as a leader in a non-clinical professional role?

Sub-Events

RC316A Developing the Skills to Become a Leader in Organized Radiology

Participants
Stephen Chan, MD, Closter, NJ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how volunteering for committees in professional societies is professionally rewarding, and also serves the greater good. 2) Develop an appreciation of the role of business and leadership skills in representing the radiology profession within various healthcare organizations. 3) Learn the value of networking, and the need to practice leadership skills.

RC316B Leadership Differences Outside of Radiology: Federal and State Levels of Government

Participants
Suresh K. Mukherji, MD, Carmel, IN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the traditional leadership roles within radiology and academic medicine. 2) Discuss leadership roles at the federal and state levels. 3) Explain how you can become more involved in these important opportunities.

RC316C Developing Expertise and Skills in Radiology Informatics

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Speaker, RadPartners AI; Speaker, AIMed Radiology

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LEARNING OBJECTIVES

1) To discuss the steps needed to develop the expertise and skills to become an expert on imaging informatics and manage the rapidly-changing data sources and systems in radiology.

RC316D Developing Expertise and Skills in Entrepreneurship

Participants

Srini Tridandapani, MD, PhD, Birmingham, AL (*Presenter*) Co-founder, CameRad Technologies, LLC; Spouse, Co-founder, CameRad Technologies, LLC; Officer, CameRad Technologies, LLC; Spouse, Officer, CameRad Technologies, LLC

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LEARNING OBJECTIVES

1) Identify and enumerate the funding mechanisms that may be pursued to support entrepreneurial activities as an academic radiologist. 2) Understand the value of customer/stakeholder discovery. 3) Understand how to identify compelling needs and impactful solutions.

Printed on: 10/29/20

RC317

Emerging Technologies: Prostate Cancer Imaging & Management - Update 2019

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S505AB

GU MI MR NM

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

FDA Discussions may include off-label uses.

Participants

Peter L. Choyke, MD, Rockville, MD (*Moderator*) License agreement, Koninklijke Philips NV; Researcher, Koninklijke Philips NV; License agreement, ScanMed; License agreement, Rakuten Medical; Researcher, Rakuten Medical; Researcher, General Electric Company; Researcher, Progenics Pharmaceuticals, Inc; Researcher, Novartis AG; ; ; ; ;

For information about this presentation, contact:

pchoyke@mail.nih.gov

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 technolgies in prostate cancer imaging and management.

Sub-Events

RC317A Introduction to Imaging in Prostate Cancer

Participants

Peter L. Choyke, MD, Rockville, MD (*Presenter*) License agreement, Koninklijke Philips NV; Researcher, Koninklijke Philips NV; License agreement, ScanMed; License agreement, Rakuten Medical; Researcher, Rakuten Medical; Researcher, General Electric Company; Researcher, Progenics Pharmaceuticals, Inc; Researcher, Novartis AG; ; ; ; ;

For information about this presentation, contact:

pchoyke@mail.nih.gov

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 provide an overview regarding the major issues of imaging in prostate cancer including screening and detection, initial staging, biochemical recurrence and metastatic disease. Recent trends in the management of prostate cancer from active surveillance to first and second line androgen deprivation, radium and chemotherapy/immunotherapy will be briefly discussed. The role of imaging in prostate cancer is becoming much more central than it was a decade ago and this talk will set the stage for other talks in the session that will provide new details regarding novel imaging methods.

RC317B Next Generation Prostate MRI

Participants

Baris Turkbey, MD, Bethesda, MD (*Presenter*) Research support, Koninklijke Philips NV; Royalties, Invivo Corporation; Investigator, NVIDIA Corporation

For information about this presentation, contact:

turkbeyi@mail.nih.gov

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*) Research Grant, Progenics Pharmaceuticals, Inc; Royalties, Progenics Pharmaceuticals, Inc

For information about this presentation, contact:

mpomper@jhmi.edu

LEARNING OBJECTIVES

1) To compare and contrast the imaging characteristics of present and emerging molecular imaging agents for prostate cancer. 2) To describe how emerging molecular imaging agents for prostate cancer are being integrated into clinical practice. 3) To focus on PET agents targeting the prostate-specific membrane antigen (PSMA) with respect to a new structured reporting system proposed to enhance clinical management.

ABSTRACT

n/a

RC317D 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

1) To describe the basic principles and techniques used in hyperpolarized carbon-13 MRI. 2) Understand the cellular metabolic reprogramming that occurs in prostate cancer. 3) Demonstrate the changes in pyruvate to lactate conversion that are observed in prostate cancer and differences with cancer aggressiveness and response to therapy.

RC317E Radionuclide Therapy for Prostate Cancer

Participants
Frank I. Lin, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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RC318

An Integrated Approach to Tumor Heterogeneity Using Imaging

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S502AB

OI

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

Participants
Evis Sala, MD, PhD, Cambridge, United Kingdom (*Moderator*) Co-founder, Cambridge AI Health; Speakers Bureau, GlaxoSmithKline plc

LEARNING OBJECTIVES

1) Review the results of the massively parallel sequencing studies of human cancers. 2) Assess the inter- and intra-tumor genetic heterogeneity found in human cancers. 3) Define the implications of genetic heterogeneity on tumor evolution and treatment. 4) Identify potential multi-omics data sets in medicine 5) Identify and compare different integration strategies 3) identify challenges of multi-omics data integration. 6) Explain the basic concepts of Radiomics. 7) Describe methods, challenges, and solutions on small data sets. 8) Discuss early clinical results in Oncologic Imaging with a critical eye.

Sub-Events

RC318A Genetic Heterogeneity in Cancer: Overview and Implications

Participants
Britta Weigelt, New York, NY (*Presenter*) Spouse, Advisor, Goldman Sachs; Spouse, Scientific Advisory Board, VolitionRx; Spouse, Scientific Advisory Board, Page.AI; Spouse, Scientific Advisory Board, Grail; Spouse, Scientific Advisory Board, F. Hoffmann-La Roche Ltd; Spouse, Scientific Advisory Board, inviCRO, LLC; ;

LEARNING OBJECTIVES

1) Review the results of the massively parallel sequencing studies of human cancers. 2) Assess the inter- and intra-tumor genetic heterogeneity found in human cancers. 3) Define the implications of genetic heterogeneity on tumor evolution and treatment.

RC318B Integrating Multiomics: New Frontiers Ahead

Participants
Ramona Woitek, MD, Vienna, Austria (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rw585@cam.ac.uk

LEARNING OBJECTIVES

1) Identify potential multi-omics data sets in medicine 2) Identify and compare different integration strategies 3) identify challenges of multi-omics data integration

RC318C Radiomics on Small Datasets: Techniques and Strategies to Enhance Performance

Participants
Nickolas Papanikolaou, PhD, Lisbon, Portugal (*Presenter*) Stockholder, MRIcons LTD; Stockholder, Advantis Medical Imaging

For information about this presentation, contact:

nickolas.papanikolaou@research.fchampalimaud.org

LEARNING OBJECTIVES

1) Explain the basic concepts of Radiomics. 2) Describe methods, challenges, and solutions on small data sets. 3) Focus on the critical appraisal of radiomics in Oncologic Imaging

Printed on: 10/29/20

RC320

Radiogenomics of GBM

Tuesday, Dec. 3 8:30AM - 10:00AM Room: N230B

BQ NR RO

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

Participants
Christina I. Tsien, MD, Washington, DC (*Moderator*) Advisory Board, Blue Earth Diagnostics Ltd; Advisory Board, NovoCure Ltd; Speakers Bureau, Varian, Inc; Speakers Bureau, Merck & Co, Inc

Sub-Events

RC320A Machine Learning Approaches: Radiomics in Brain Tumors

Participants
Olivier Gevaert, PhD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) On overview of brain tumor segmentation as a prerequisite to radiomics analysis of brain tumors. 2) How to extract robust quantitative image signatures from multi-modal MR data. 3) Using machine learning for quantitative image analysis of glioblastoma and linking with clinical histopathological and molecular phenotypes. 4) An introduction in deep learning and convolutional neural networks as applied to brain tumor imaging.

RC320B Molecular Classification of GBM

Participants
Daniel J. Brat, MD, PhD, Chicago , IL (*Presenter*) Nothing to Disclose

RC320C Response Assessment in GBM

Participants
Christina I. Tsien, MD, Washington, DC (*Presenter*) Advisory Board, Blue Earth Diagnostics Ltd; Advisory Board, NovoCure Ltd; Speakers Bureau, Varian, Inc; Speakers Bureau, Merck & Co, Inc

RC320D Radiogenomics for GBM

Participants
Rivka R. Colen, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rrcolen@gmail.com

LEARNING OBJECTIVES

1) Understand the basic concepts of radiomics and radiogenomics in GBM. 2) Learn the process of linkage between imaging and genomic information. 3) Review the recent studies on radiogenomics in GBM. 4) Review the process of validation in radiogenomics studies.

Printed on: 10/29/20

RC321

Innovations in MR

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S102CD

MR PH

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

FDA Discussions may include off-label uses.

Participants
Matthew A. Bernstein, PhD, Rochester, MN (*Coordinator*) Former Employee, General Electric Company; Intellectual property, General Electric Company

LEARNING OBJECTIVES

1) Review newer techniques that can be used to accelerate MR including simultaneous multislice (SMS), compressed sensing, and MR fingerprinting. 2) Review the basic principles of chemical exchange saturating transfer, and discuss its emerging applications. 3) Review recent advances in novel MR systems, including low cryogen magnets, dedicated and compact systems.

Sub-Events

RC321A New Directions in Fast MR

Participants
Kawin Setsompop, Charlestown, MA (*Presenter*) Research Grant, Siemens AG; Royalties, General Electric Company; Royalties, Koninklijke Philips NV; Scientific Advisory Board, Kineticor;

LEARNING OBJECTIVES

1) Describe emerging MR acquisition approaches and their ability to provide faster and higher quality imaging. 2) Identify the most suitable acquisition approach for improving the quality of various imaging sequences/clinical applications.

RC321B New Directions in CEST

Participants
Peter C. van Zijl, PhD, Baltimore , MD (*Presenter*) Research support, Koninklijke Philips NV; Patent agreement, Koninklijke Philips NV; Speakers Bureau, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Understand the basics of CEST, endogenous and exogenous contrast. 2) Be aware of latest applications of CEST in the clinic. 3) Understand interpretation of Amide Proton Transfer weighted (APTw) MRI for assessing brain tumors, including for separating high/low grade, separating progression/pseudoprogression, relationship to IDH status. 4) Be aware of possible contrast agents for CEST MRI.

ABSTRACT

Chemical Exchange Saturation Transfer (CEST) is a relatively new field of magnetic resonance (MR) that combines principles of MR spectroscopy (MRS, chemical selectivity of proton pools) and MRI (imaging of water protons with high sensitivity). It is based on magnetization transfer, especially exploiting the interaction of the exchangeable protons of probe molecules with the water protons to achieve large sensitivity enhancements (several orders of magnitude) for the imaging of molecular information with MRI sensitivity. CEST MRI can be done both using paramagnetic and diamagnetic probes, but the ultimate strength and hope for fast clinical translation lies in the presence of endogenous contrast (e.g. cellular proteins and tissue metabolites, such as glutamate) and in the use of diamagnetic agents, expected to have lower toxicity and to be more applicable for regulatory approval and patient acceptance.After an introduction of the basic principles of CEST MRI to provide insight into the type of molecules that can be studied and the sensitivity of this approach, I will explain the main contributions to the in vivo saturation spectrum (Z-spectrum) and its relationship to the proton MR spectrum. Several application examples will be presented to illustrate the potential of using these signals for clinical diagnosis and prognosis.1) imaging of endogenous proteins, especially the use of amide proton transfer weighted (APTw) MRI for brain tumor diagnosis, including separation of high and low grade, judging progression versus pseudoprogression and the effect of IDH status. 2) Imaging of glutamate.3) Use of simple diamagnetic probes such as D-Glucose and its polymers for imaging tissue perfusion, membrane permeability and metabolism.4) Novel approaches for the future.These examples are only early illustrations of this relatively new field, which has great potential due to the presence of exchangeable protons in most molecular agents.Literature:1) van Zijl PC, Yadav NN. Chemical exchange saturation transfer (CEST): what is in a name and what isn't? Magn Reson Med. 2011 Apr;65(4):927-48. 2) Zhou J, Heo HY, Knutsson L, van Zijl PCM, Jiang S. APT-weighted MRI: Techniques, current neuro applications, and challenging issues. J Magn Reson Imaging. 2019 Jan 20. doi: 10.1002/jmri.26645. [Epub ahead of print] Review. 3) Jones KM, Pollard AC, Pagel MD. Clinical applications of chemical exchange saturation transfer (CEST) MRI. J Magn Reson Imaging. 2018 Jan;47(1):11-27

RC321C New Directions in MR Scanners

Participants
Yunhong Shu, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

shu.yunhong@mayo.edu

LEARNING OBJECTIVES

1) List a variety of emerging technologies for MRI scanner design. 2) Understand major driving forces for these technology advancements. 3) Identify the advantages and suitable applications for specific MR scanners.

Active Handout:Yunhong Shu

http://abstract.rsna.org/uploads/2019/19001802/Active RC321C.pdf

Printed on: 10/29/20

RC322

Advances in Cone Beam CT Acquisition and Reconstruction in Radiotherapy

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S503AB

CT PH RO

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

Participants

Douglas Moseley, PhD, Toronto, ON (*Moderator*) License agreement, Modus Medical Devices Inc

Sub-Events

RC322A State of the Art in Advanced CBCT Acquisition and Reconstruction

Participants
Wojciech Zbijewski, PhD, Baltimore, MD (*Presenter*) Research Grant, Carestream Health, Inc; Research Grant, Siemens AG

For information about this presentation, contact:

wzbijewski@jhu.edu

LEARNING OBJECTIVES

1) Identify key challenges to image quality in CBCT. 2) Discuss latest developments in CBCT instrumentation. 3) Describe recent advances in reconstruction algorithms and artifact correction methods for CBCT. 4) Compare CBCT image quality achievable on their systems to state-of-the-art.

RC322B Clinical Need for Advanced CBCT Imaging in Radiotherapy

Participants
Tianyu Zhao, PhD, St. Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Gain greater understanding on the clinical need of CBCT in radiotherapy in the following applications: a) Image-Guided Radiotherapy (IGRT) with more precise tumor localization and better patient setup, b) 4D CBCT in managing respiratory motion, and c) adaptive radiotherapy (ART).

RC322C Technical Challenges in the Integration of CBCT Imaging into Radiotherapy

Participants
Douglas Moseley, PhD, Toronto, ON (*Presenter*) License agreement, Modus Medical Devices Inc

LEARNING OBJECTIVES

1) Identify the technical challenges when using CBCT imaging for image-guided radiation therapy. 2) Discuss strategies for commissioning and QA of the IGRT workflow in the clinic. 3) Describe the future direction of in-room image guidance.

ABSTRACT

The Scan-Plan-Treat paradigm is becoming too simplistic to do describe the workflow in the modern radiation therapy clinic. Multiple CBCT scans are performed during the treatment delivery that may trigger, re-Scans and re-Plans. This presents several challenges.

Active Handout:Douglas Moseley

http://abstract.rsna.org/uploads/2019/18001993/Active RC322C.pdf

Printed on: 10/29/20

RC323

Advanced Ultrasound Technology and Applications

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S104B

PH US

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

FDA Discussions may include off-label uses.

Participants
William F. Sensakovic, PhD, Scottsdale, AZ (*Coordinator*) Founder, Telerad Physics Teaching, LLC
Thaddeus A. Wilson, PhD, Madison, WI (*Coordinator*) Nothing to Disclose

For information about this presentation, contact:

wfsensak@gmail.com

LEARNING OBJECTIVES

1) Understand the role of contrast agents in ultrasound. 2) Explain the science and technology behind strain imaging. 3) Implement strain imaging and ultrasound contrast in clinical practice.

Sub-Events

RC323A Contrast Agents

Participants
Peter N. Burns, PhD, Toronto, ON (*Presenter*) Research collaboration, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Understand the physical composition of microbubble contrast agents and how they interact with an ultrasound field. 2) Describe the principles of contrast specific imaging modes found on modern ultrasound scanners. 3) Review the characteristics of contrast images and flow measurements as the basis for their interpretation in a clinic setting.

RC323B Elasticity Imaging

Participants
Stephen McAleavey, PhD, Rochester, NY (*Presenter*) Research collaboration, Siemens AG; Research Grant, Carestream Health, Inc;

LEARNING OBJECTIVES

1) Explain the physical principles of several elasticity imaging methods in clinical use. 2) Understand capabilities and limitations of elasticity methods. 3) Describe current and emerging clinical applications of elasticity imaging.

RC323C Practical Clinical Advice on the Use of Contrast and Strain Imaging

Participants
Richard G. Barr, MD, PhD, Campbell, OH (*Presenter*) Consultant, Siemens AG; Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, SuperSonic Imagine; Speakers Bureau, Koninklijke Philips NV; Research Grant, Bracco Group; Speakers Bureau, Siemens AG; Consultant, Canon Medical Systems Corporation; Research Grant, Esaote SpA; Research Grant, BK Ultrasound; Research Grant, Hitachi, Ltd

LEARNING OBJECTIVES

1) To review appropriate use of ultrasound contrast in the clinical setting. 2) Discuss which patients would benefit from a contrast enhanced ultrasound. 3) Review the requirements for performing a contrast enhanced ultrasound. 4) Review which applications are appropriate for elastography. 5) Discuss how elastography can help in diagnosis.

RC324

CT Dose Monitoring: Nuts, Bolts, and Tools... and What We Need to Build

Tuesday, Dec. 3 8:30AM - 10:00AM Room: N226

CT PD SQ

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

Participants
Donald P. Frush, MD, Menlo Park, CA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

dfrush@stanford.edu

laurabancroftmd@gmail.com

LEARNING OBJECTIVES

1) To learn fundamental elements of a CT dose monitoring program. 2) To review current programs (products) and resources available. 3) To understand current status, including challenges of dose monitoring in adults. 4) To be able to describe current status, including challenges of dose monitoring in children. 5) To be able to discuss potential advances in dose monitoring.

Sub-Events

RC324A Fundamentals (Nuts and Bolts) and Current Products (Tools)

Participants
Sarah E. McKenney, PhD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Evaluate clinical needs for radiation dose monitoring within their institution. 2) Identify resources necessary to ensure a successful monitoring program. 3) Classify the different features of dose monitoring software.

RC324B CT Dose Monitoring Status in Adults (Including Diagnostic Reference Levels)

Participants
Kalpana M. Kanal, PhD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss CT dose monitoring for adults. 2) To learn about diagnostic reference levels in CT. 3) To understand how to implement dose monitoring and diagnostic reference levels in practice.

RC324C CT Dose Monitoring Status in Children (Including Diagnostic Reference Levels)

Participants
Donald P. Frush, MD, Menlo Park, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the unique considerations in CT dose monitoring program for children. 2) To learn challenges and obstacles in CT dose monitoring programs in children. 3) To be able to discuss future opportunities for CT dose monitoring program in children.

RC324D Designing the Program of the Future

Participants
Ehsan Samei, PhD, Durham, NC (*Presenter*) Research Grant, General Electric Company Research Grant, Siemens AG Advisory Board, medInt Holdings, LLC License agreement, 12 Sigma Technologies License agreement, Gammex, Inc

LEARNING OBJECTIVES

1) To understand the importance of analytics in extracting meaningful and actionable knowledge from performance data. 2) To understand the role and components of image quality characterization based on patient images. 3) To understand performance monitoring as the overarching objective of dose monitoring.

RC325

Quantitative Imaging: Modality Independent Issues

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S403B

BQ 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

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To learn the role that physical phantoms can play in quantitative imaging, especially in understanding and quantifying sources of bias and variance. 2) To explain why digital reference objects (DROs) are useful for evaluation of software packages used to derive quantitative imaging biomarkers. 3) To understand quantitative image analysis methods such as tumor segmentation and feature extraction and the roles that these tools have in quantitative imaging. 4) To understand the role that these modality independent methods have in the standardization of imaging acquisition and image quantification techniques.

ABSTRACT

In Quantitative Imaging, there are some issues that are independent of the imaging modality. Therefore, tools and processes may be developed that are modality independent.

Sub-Events

RC325A The Role of Physical Phantoms in Quantitative Imaging

Participants
William D. Erwin, MS, Houston, TX (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Alfasigma S.p.A.; Research Grant, Oncosil Medical, Ltd.; Research Grant, Ipsen SA; Research Grant, Advanced Accelerator Applications SA; Research Grant, Y-mAbs Therapeutics;

For information about this presentation, contact:

werwin@mdanderson.org

LEARNING OBJECTIVES

1) Explain definitions of and requirements for quantitative medical imaging. 2) Describe the role of phantoms and tradeoffs in comparison with simulations and patient studies. 3) Differentiate between classes of phantoms available: commercial, experimental and virtual (digital reference objects).

Active Handout:William Daniel Erwin

http://abstract.rsna.org/uploads/2019/19001543/Active RC325A.pdf

RC325B Digital Reference Objects

Participants
Daniel P. Barboriak, MD, Durham, NC (*Presenter*) Advisory Board, General Electric Company; Medical Advisory Board, Blue Earth Diagnostics Ltd

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daniel.barboriak@duke.edu

LEARNING OBJECTIVES

1) Explain why digital reference objects are useful for evaluation of software packages used to derive quantitative imaging biomarkers. 2) Understand the difference between aggregated and disaggregated metrics of software performance.

ABSTRACT

This lecture will familiarize the audience with digital reference objects (DROs) and their place in the development of quantitative imaging biomarkers (QIBs). To determine whether a quantitative imaging study is measuring a pathological or physiological process in an unbiased way, the quantitative imaging result would need to be compared to an independently ascertained unbiased measurement in the imaged subject or animal. Unfortunately, obtaining a precise and unbiased measurement (also known as ground truth) is generally impractical or impossible. Frequently there may be several software packages available that can be used to create maps reflecting the spatial distribution of the QIB. Because different software packages often give different quantitative results, the choice of software contributes to the variability of the result. Without ground truth data, it can be difficult to determine which softwares calculate the underlying biomarker with sufficient precision and lack of bias to be applicable for a particular use case. DROs are synthetic images whose pixel values are most often either partially or completely determined by

mathematical equations. Although these images may be designed to mimic real imaging data, their content is ultimately determined by mathematical models. Even though DROs do not perfectly simulate real data, they are useful because they are created assuming particular underlying parameter values, which can be regarded as ground truth for these objects. DROs can be particularly valuable for evaluation of software packages. Because they are created using known ground truth, they can be used to determine whether a particular image analysis strategy introduces biases when used to extract a QIB. (This is not possible with real data if the ground truth is not known). Assuming that realistic image noise and/or artifact can be included in the DRO, they can also be used to estimate how precisely a software package is deriving quantitative metrics in real images. This lecture will describe how DROs are used in the RSNA Quantitative Imaging Biomarker Alliance (QIBA) process. Topics that will be discussed include: 1) the variety of metrics that can be used to evaluate software performance with DROs; 2) the differences between aggregated and disaggregated measures of performance, and the relevance of this for determining whether software complies with a standard; and 3) best practices for creation of DROs.

RC325C Radiomic Analysis and Sources of Variation

Participants

Binsheng Zhao, DSc, New York, NY (*Presenter*) Royalties, Varian Medical Systems, Inc; License agreement, Keosys SAS; License agreement, Hinacom Software and Technology, Ltd;

For information about this presentation, contact:

bz2166@cumc.columbia.edu

LEARNING OBJECTIVES

1) To familiarize the audience with tumor imaging phenotype characterization and its applications in oncology (e.g., cancer diagnosis, patient stratification). 2) To discuss sources of variation in tumor characterization, using both phantom and in vivo image data. 3) To raise awareness of the need for reproducible and robust radiomic features / prediction models via harmonization of imaging acquisition parameters and tumor quantification techniques.

Printed on: 10/29/20

RC327

Basic Principles of Cost-effectiveness Analysis in Imaging

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S104A

HP

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

Participants

Stella Kang, MD,MSc, New York, NY (*Moderator*) Royalties, Wolters Kluwer nv
Pari V. Pandharipande, MD, MPH, Chestnut Hill, MA (*Moderator*) Research Grant, Medical Imaging & Technology Alliance

For information about this presentation, contact:

stella.kang@nyumc.org

pari@mgh-ita.org

Sub-Events

RC327A Introduction to Cost-effectiveness Analysis

Participants
Pari V. Pandharipande, MD, MPH, Chestnut Hill, MA (*Presenter*) Research Grant, Medical Imaging & Technology Alliance

For information about this presentation, contact:

pari@mgh-ita.org

LEARNING OBJECTIVES

1) To define how the long-term costs, effectiveness, and cost-effectiveness of imaging can be measured. 2) To understand how policymakers utilize data from cost-effectiveness analyses. 3) To gain insight into the strengths and drawbacks of cost-effectiveness analysis as a means for judging value.

RC327B Using Cancer Simulation Models to Identify Cost-effective Breast Cancer Screening Strategies

Participants
Kathryn Lowry, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company

RC327C Recent Applications of Cost-effectiveness Analysis in Diagnostic Imaging

Participants
Stella Kang, MD,MSc, New York, NY (*Presenter*) Royalties, Wolters Kluwer nv

For information about this presentation, contact:

stella.kang@nyulangone.org

LEARNING OBJECTIVES

1) Understand how to approach the question of whether a diagnostic imaging strategy is cost effective. 2) Apply methods of cost effectiveness analysis to recent areas of interest: imaging innovation, optimization, and clinical decision making. 3) Evaluate the clinical and research implications of results from cost effectiveness analysis through examples in radiology.

RC327D Beyond Cost: Bringing Value to Patients and Health Systems in Radiology

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

For information about this presentation, contact:

rosena23@nyumc.org

LEARNING OBJECTIVES

1) Understand the importance of considering the value of imaging beyond cost considerations. 2) Recognize challenges in measuring value in radiology. 3) Describe current approaches for assessing the value of radiology and radiologists.

RC329

Liver MRI Essentials (Interactive Session)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: N227B

GI MR

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

Sub-Events

RC329A HCC: Typical and Atypical Appearances

Participants
Kathryn J. Fowler, MD, San Diego, CA (*Presenter*) Consultant, 12 Sigma Technologies; Researcher, Nuance Communications, Inc; Contractor, Midamerica Transplant Services; ;

For information about this presentation, contact:

k1fowler@ucsd.edu

LEARNING OBJECTIVES

1) Review pathological sub-types of HCC. 2) Gain knowledge of the imaging appearance of atypical HCC. 3) Understand impact on management.

RC329B Intrahepatic Cholangiocarcinoma

Participants
Sara Lewis, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the risk factors and clinical features of intrahepatic cholangiocarcinoma (ICC). 2) Examine the cross-sectional typical and atypical imaging characteristics of ICC, with emphasis on CT and MRI. 3) Identify imaging and clinical features that aid in accurate diagnosis of ICC compared to other malignant and benign hepatic lesions.

RC329C Hilar/Perihilar Cholangiocarcinoma

Participants
Koenraad J. Mortele, MD, Boston, MA (*Presenter*) Nothing to Disclose

RC329D FNH and Hepatocellular Adenomas

Participants
Maxime Ronot, MD, Clichy, France (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

maxime.ronot@aphp.fr

LEARNING OBJECTIVES

1) To be able to recognize and non-invasively diagnose typical forms of FNH. 2) To understand the pathomolecular classification of hepatic adenomas. 3) To know how to differentiate FNH from adenomas on imaging. 4) To understand the value and pitfalls of liver-specific contrast agents.

RC329E Liver Metastases

Participants
Frank H. Miller, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To be able to identify findings to identify and characterize liver lesions as metastases. 2) To use a variety of MR sequences to detect and distinguish metastases from other benign lesions such as hemangiomas.

RC331

Percutaneous Thoracic Interventions

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S403A

CA CT HN VA

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

FDA Discussions may include off-label uses.

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

For information about this presentation, contact:

christopher.lee.1@med.usc.edu

LEARNING OBJECTIVES

1) Evaluate the role of percutaneous lung biopsy in the molecular profiling era. 2) Utilize various techniques during percutaneous lung biopsy to maximize the chances of success and limit complications. 3) Apply strategies to prevent and manage a post-biopsy pneumothorax.

Sub-Events

RC331A Percutaneous Lung Biopsy

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

For information about this presentation, contact:

christopher.lee.1@med.usc.edu

LEARNING OBJECTIVES

1) Evaluate the role of percutaneous lung biopsy in the molecular profiling era. 2) Utilize various techniques during percutaneous lung biopsy to maximize the chances of success and limit complications. 3) Apply strategies to prevent and manage a post-biopsy pneumothorax.

RC331B Percutaneous Lung Nodule Localization

Participants
Amita Sharma, MD,MBBS, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

asharma2@mgh.harvard.edu

LEARNING OBJECTIVES

1) Explain how percutaneous localization aids nodule resection during minimally invasive surgery. 2) Compare different techniques used for percutaneous nodule localization. 3) Identify complications that may occur during percutaneous nodule localization.

RC331C Percutaneous Lung Ablation

Participants
Fereidoun G. Abtin, MD, Los Angeles, CA (*Presenter*) Speaker, Johnson & Johnson; Speaker, HealthTronics, Inc; Consultant, BTG International Ltd

For information about this presentation, contact:

fabtin@mednet.ucla.edu

LEARNING OBJECTIVES

1) Describe the current indications for lung ablation and compare the ablation results with competing modalities. 2) Review the criteria affecting the choice of various ablative modalities in particular RFA, Microwave and cryoablation. 3) Technical considerations to optimize the ablation results and to avoid or reduce complication. 4) Brief outline of Interventional Oncology out patient clinic and post ablation follow up recommendations.

RC332

Burnout of a Radiology Physician Workforce

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E353A

LM

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

Participants
Achala S. Vagal, MD, Mason, OH (*Moderator*) Research Grant, Cerovenus

LEARNING OBJECTIVES

1) Define burnout and discuss its prevalence and potential causes in radiologists. 2) Discuss burnout among radiologist trainees and its potential effects on their education. 3) Describe approaches to mitigating burnout in the radiologist's workplace.

Sub-Events

RC332A Burnout in Radiology

Participants
Felix S. Chew, MD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

fchew@uw.edu

RC332B How to Address Radiology Trainees' Burnout

Participants
Stacy E. Smith, MD, Weston, MA (*Presenter*) Nothing to Disclose

RC332C Remedies to Mitigate Burnout in the Workplace

Participants
Claire E. Bender, MD, Rochester, MN (*Presenter*) Nothing to Disclose

Printed on: 10/29/20

RC350

Contrast Reaction Management: Hands-on Simulation (Hands-on)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E260

SQ

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

Participants

Carolyn L. Wang, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company
Carina W. Yang, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Erik Soloff, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company
Ryan O'Malley, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company
Stephen C. O'Connor, MD, Boston, MA (*Presenter*) Nothing to Disclose
Patrick W. Eiken, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Richard H. Cohan, MD, Ann Arbor, MI (*Presenter*) Co-author, Wolters Kluwer nv
Senta M. Berggruen, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Anup J. Alexander, MD, Maywood, IL (*Presenter*) Nothing to Disclose
James H. Ellis, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Rishi Agrawal, MD, Chicago, IL (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbH
William Masch, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Kirk G. Banerian, MD, Bloomfield Hills, MI (*Presenter*) Nothing to Disclose
Rekha N. Mody, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Oren Johnson, MD, Springfield, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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rcohan@med.umich.edu

Special Information

New! Flipped classroom format. Please watch this 16 minute video on contrast reaction management prior to attending the hands-on simulation course to maximize your time engaging in the simulation training. https://youtu.be/iJdPpv5QEkM

LEARNING OBJECTIVES

1) Recognize various types of contrast reactions and the proper management of various types of contrast reactions through simulation-based training. 2) Learn with hands-on practice the proper administration of various routes of epinephrine as well as other medications to treat the more common allergic-like contrast reactions. 3) Recognize and manage a contrast reaction in a sedated patient. 4) Recognize and practice team communication skills necessarily for high stress infrequent scenarios using simulation-based training.

Printed on: 10/29/20

RC352

Live Ultrasound Interventional Procedures: Thermal Ablation, Cyst Aspiration, Abscess Drainage, Vascular Access, Core Biopsy, Foreign Body Removal (Hands-on)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: E264

US IR

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

Participants

Veronica J. Rooks, MD, Honolulu, HI (*Moderator*) Nothing to Disclose
Leah E. Braswell, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Carmen Gallego, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Mabel Garcia-Hidalgo Alonso, MD, Majadahonda, Spain (*Presenter*) Nothing to Disclose
Hollins P. Clark, MD, Winston Salem, NC (*Presenter*) Reviewer, Galil Medical Ltd
Njogu Njuguna, MD, Springfield, MA (*Presenter*) Nothing to Disclose
Sara E. Zhao, MD, Cambridge, MA (*Presenter*) Nothing to Disclose
Jeremiah J. Sabado, MD, Wilmington , DE (*Presenter*) Consultant, BioClinica, Inc
John D. Lane, MD, Bayside, WI (*Presenter*) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose
William W. Mayo-Smith, MD, Boston, MA (*Presenter*) Nothing to Disclose
Linda J. Warren, MD, Vancouver, BC (*Presenter*) Shareholder, Hologic, Inc
Kathleen M. Boyer, DO, Aiea, HI (*Presenter*) Nothing to Disclose
Michael A. Mahlon, DO, Tacoma, WA (*Presenter*) Nothing to Disclose
Robert M. Marks, MD, San Diego, CA (*Presenter*) Nothing to Disclose
Ulises Barajas, MD, Juarez, Mexico (*Presenter*) Nothing to Disclose
Patrick Warren, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Kara D. Gaetke-Udager, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Yassine Kanaan, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Kal Dulaimy, MD, Springfield, MA (*Presenter*) Nothing to Disclose
Christian I. Carlson, MD, MS, Jbsa Ft Sam Houston, TX (*Presenter*) Nothing to Disclose
Jaren Meldrum, MD, Honolulu, HI (*Presenter*) Nothing to Disclose
Remy Ngwanyam, MD, Boston, MA (*Presenter*) Nothing to Disclose
Michael E. Click, MD, Olympia, WA (*Presenter*) Nothing to Disclose
Kristin M. Dittmar, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Peter L. Cooperberg, MD, Vancouver, BC (*Presenter*) Nothing to Disclose
Eva M. Smietana, MD, Portland, OR (*Presenter*) Nothing to Disclose
Paolo Minafra, MD, Pavia, Italy (*Presenter*) Nothing to Disclose
Paula B. Gordon, MD, Vancouver, BC (*Presenter*) Stockholder, OncoGenex Pharmaceuticals, Inc ; Stockholder, Volpara Health Technologies Limited; Scientific Advisory Board, Real Imaging Ltd; Scientific Advisory Board, DenseBreast-info, Inc; Scientific Advisor, Dense Breasts Canada
Andrew B. Wallace, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Ronirooks@gmail.com

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.

Printed on: 10/29/20

RC353

Enterprise Imaging for the Practicing Radiologist

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S504AB

IN

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

Participants
Christopher J. Roth, MD, Raleigh, 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. 4) Learn methods of objectively evaluating your organization's maturity with enterprise imaging.

Sub-Events

RC353A Clinical Challenges in Enterprise Imaging

Participants
Alex Towbin, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Cystic Fibrosis Foundation; Consultant, Reed Elsevier; Advisory Board, IBM Corporation; Advisory Board, KLAS Enterprises LLC;

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.

RC353B Technical Challenges in Enterprise Imaging

Participants
David A. Clunie, MBBS, Bangor, PA (*Presenter*) Owner, PixelMed Publishing LLC; Consultant, Carestream Health, Inc; Consultant, MDDX Research & Informatics; Consultant, BK Medical; Consultant, Canfield Scientific; Consultant, Imago; Consultant, Lunit Inc;

RC353C Finance and Governance Challenges in Enterprise Imaging

Participants
Christopher J. Roth, MD, Raleigh, 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.

RC353D Using the HIMSS Digital Imaging Adoption Model to Advance Your Imaging Strategy

Participants
Kimberley Garriott, Indianapolis, IN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kim.garriott@us.logicalis.com

LEARNING OBJECTIVES

1) Understand what the HIMSS Analytics Digital Imaging Adoption Model (DIAM) is. 2) Discuss how the DIAM can be used to guide

an organization's enterprise imaging journey. 3) Recognize the components necessary to achieve enterprise imaging maturity.

Printed on: 10/29/20

RC354

How Did I Miss That? Perceptual and Attentional Roots of Medical Errors

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S404CD

IN SQ

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

Participants
Jeremy M. Wolfe, PhD, Cambridge, MA (*Presenter*) Research collaboration, Koninklijke Philips NV; Pending research, General Electric Company

For information about this presentation, contact:

jwolfe@bwh.harvard.edu

LEARNING OBJECTIVES

1) Attendees will learn some of the basic perceptual limitations on the analysis of medical images and potential solutions. 2) Attendees will understand some of the attentional limits on visual search (having seen a series of examples) and how these limits can impact search in radiologic images. 3) Attendees will be updated on recent research in medical image perception. 4) Finally, participants will learn about efforts to make humans and AI collaborate more effectively.

ABSTRACT

Perceptual decisions can be hard. Images are often ambiguous, but we still need to make a diagnostic decision (e.g., is this cell abnormal or not?). We cannot simultaneously recognize every object in our field of view. As a result, even if a breast mass or a lung nodule might be clear enough when you find it, the process of finding it involves deploying attention from object to object or place to place, searching for the target. This is true whether we are looking for the cat in the bedroom or those nodules in a stack of CT images. Becoming an expert does not cause you to develop a new search engine. You become an expert on using the standard human search engine on a specific set of stimuli. Unfortunately, our search engine does not work perfectly and we sometimes fail to find what we seek. At other times, we find things that are not really there. I will give a quick tour of the basics of perceptual decision making and then we will illustrate and discuss three classes of error that occur in medical image perception: - Search errors in which the observer never looks in the right spot. - Recognition errors where the observer looks at the target but fails to code it as potentially significant. - Decision errors where the target is scrutinized but the wrong conclusion is reached. This last class of errors can be subdivided into Perceptual decision errors and Cognitive decision errors in which the observer thinks about the problem in a way that leads to the wrong answer. In some cases, these errors arise from 'cognitive heuristics', mental shortcuts can be very useful, but can sometimes lead to errors, medical and other.

RCA31

Creating Patient-Specific Anatomical Models for 3D Printing and AR/VR (Hands-on)

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S401AB

IN

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

Participants
Nicole Wake, PhD, Bronx, NY (*Presenter*) In-kind support, Stratasys, Ltd; Consultant, General Electric Company
Amy E. Alexander, MSc, Rochester, MN (*Presenter*) Nothing to Disclose
Andy Christensen, BS, Littleton, CO (*Presenter*) Consultant, Integrum AB; Board Member, Integrum AB; Stockholder, Somaden LLC
Peter C. Liacouras, PhD, North Potomac, MD (*Presenter*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Todd Pietila, MBA, Plymouth, MI (*Presenter*) Employee, Materialise NV
Adnan M. Sheikh, MD, Ottawa, ON (*Presenter*) Speaker, Siemens AG

For information about this presentation, contact:

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nwake@montefiore.org

LEARNING OBJECTIVES

1) Explain the workflow to create patient-specific 3D anatomic models from DICOM data. 2) Identify and apply image segmentation techniques used to create 3D anatomical models, including thresholding, region growing, and manual editing. 3) Describe and apply image post-processing techniques and 3D design principles. 4) Understand common file formats required for 3D printing and AR/VR (i.e. STL, OBJ). 5) Interface with 3D printing software or AR/VR devices.

ABSTRACT

Advanced image data visualization in the form of 3D printing and AR/VR continues to expand in clinical settings. In order to generate patient-specific models for 3D printing or AR/VR, image data must first be segmented and converted to virtual 3D models which represent the intended anatomy of interest. The RSNA 3D Printing Special Interest Group has adopted a position statement reflecting the FDA recommendation that FDA-cleared software is used when 3D models are created for clinical applications. This course covers the use of industry-standard FDA-cleared software (Mimics InPrint, Materialise, NV) for the design and fabrication of patient-specific 3D models. Case examples will be reviewed. Once the virtual 3D models have been created, users will learn how to prepare these files for 3D printing and AR/VR. In order to aid with the hands-on course, 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.

Active Handout:Nicole Wake

http://abstract.rsna.org/uploads/2019/18020316/Active RCA31.pdf

Printed on: 10/29/20

RCC31

Advanced Cybersecurity for Imaging Departments and Imagers: Threats, Vulnerabilities, and Best Practices

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S501ABC

HP IN

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

Participants
Debra Bruemmer, BS,MBA, Rochester, MN (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe common imaging device vulnerabilities. 2) Explain possible patient safety impacts of cyber attacks. 3) Explain the possible institutional impacts of cyber attacks. 4) List the technical, environmental and cultural barriers in improving the cyber security of imaging devices. 5) Contrast the items in the C-I-A triad. 6) List high value cybersecurity remediation and mitigations. 7) List the steps to creating an imaging device cybersecurity program. 8) Identify available cybersecurity resources.

Sub-Events

RCC31A Medical Device Cybersecurity and the FDA

Participants
Aftin Ross, PhD, Silver Spring, MD (*Presenter*) Nothing to Disclose

RCC31B Defending the Impossible: Internet of Medical Things

Participants
Janine Medina, MS, Brooklyn, NY (*Presenter*) Nothing to Disclose

RCC31C Medical Device Security in a Connected World

Participants
Debra Bruemmer, BS,MBA, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identity the common cybersecurity threat actors. 2) Describe the state of cybersecurity in healthcare. 3) List common categories of security vulnerabilities. 4) Describe cybersecurity challenges with medical devices.

Printed on: 10/29/20

MSAS32

Emerging Imaging Trends (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S105AB

CA NR

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

Participants
Kristen Welch, RT, New Berlin, WI (*Moderator*) Employee, Siemens AG
Steven P. Decolle, Edmonton, AB (*Moderator*) Nothing to Disclose

Sub-Events

MSAS32A Advanced Combination Imaging Procedures

Participants
Osmanuddin Ahmed, MD, Northbrook, IL (*Presenter*) Speaker, C. R. Bard, Inc; Speaker, Cardiva Medical; Speaker, Penumbra, Inc; Advisory Board, AbbVie Inc; Advisory Board, BTG International Ltd

For information about this presentation, contact:

oahmed@radiology.bsd.uchicago.edu

LEARNING OBJECTIVES

1) Describe set up and workflow for combination imaging in interventional radiology (IR). 2) Highlight potential applications of hybrid CT-Fluroscopy systems in IR. 3) Define methods of improved efficiency gained with combination imaging.

ABSTRACT

This talk will discuss the utilization of hybrid CT-fluoroscopy for basic and advanced intervnetions in interventional radiology.

MSAS32B Integrated 3D Imaging: The Future of Cardiac Imaging

Participants
Joseph Vettukattil, MD,MBBS, Grand Rapids, MI (*Presenter*) Proctor, Occlutech AFR device; Patent holder, Occlutech AFR device

LEARNING OBJECTIVES

1) To learn about the spectrum of complex congenital heart defects and role and impact of advanced imaging techniques in their management.

MSAS32C Neuroimaging in the Era of AI: Past, Present, and Future

Participants
Narayan Viswanadhan, MD, Tampa, FL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

narayan.viswanadhan@gmail.com

LEARNING OBJECTIVES

1) Develop a basic understanding of Artificial Intelligence/Machine Learning from a clinical perspective and assess relevant applications to Neuroimaging. 2) Examine various AI applications and target areas within Neuroimaging which would provide the greatest impact on patient care. 3) Identify challenges in developing AI healthcare applications. 4) Identify the unique opportunities for clinicians in AI, and consider emerging trends.

MSCC32

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

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E450B

CH CT NM

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

Participants
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Moderator*) Nothing to Disclose

Sub-Events

MSCC32A Lung Diseases

Participants
David M. Naeger, MD, Aurora, CO (*Presenter*) Consultant, Ebix Inc; Consultant, Oakstone Publishing, LLC

For information about this presentation, contact:

david.naeger@dhha.org

LEARNING OBJECTIVES

1) List the various guidelines used to determine follow up recommendations for pulmonary nodules. 2) Analyze clinical scenarios as to which nodule follow up guideline is most appropriate. 3) Describe how FDG PET can be used to guide pulmonary nodule management.

ABSTRACT

This review course lecture will guide radiologists in the imaging management of pulmonary nodules. We will review the various guidelines used to determine pulmonary nodule follow up and the clinical scenarios for when each is appropriate. Finally, we will review how FDG PET can be used to guide pulmonary nodule management

MSCC32B PET/CT for Breast Cancer: Where is the Clinical Impact?

Participants
Gary A. Ulaner, MD,PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd; Research support, Novartis AG; Research support and Consultant, sanofi-aventis Group; Research support, sanofi-aventis Group

For information about this presentation, contact:

ulanerg@mskcc.org

LEARNING OBJECTIVES

1) Review the strengths and weaknesses of FDG PET/CT for evaluation of a primary breast malignancy, axillary and extra-axillary nodal metastases, and distant metastases. 2) Review the utility of FDG PET/CT for measuring breast cancer treatment response. 3) Understand that not all breast cancers are the same; there is recent data that breast histology may influence imaging interpretation.

ABSTRACT

FDG PET/CT impacts the management of patients with breast cancer in multiple settings, including initial staging, treatment response, and evaluation of suspected recurrence. This lecture reviews the strengths and weaknesses of FDG PET/CT for staging of the primary breast malignancy, axillary and extra-axillary nodal metastases, and distant metastases. The utility of FDG PET/CT for measuring breast cancer treatment response is appraised. The role tumor histology may have on PET/CT interpretation is discussed. National Comprehensive Cancer Network (NCCN) guidelines for patients with breast cnacer are reviewed. Emphasis is given where FDG PET/CT has demonstrated clinical impact.

MSES32

Essentials of Chest Imaging

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S100AB

CH

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

Sub-Events

MSES32A CT Diagnosis of Acute Pulmonary Embolism

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

LEARNING OBJECTIVES

1) Review the imaging findings of acute thromboembolic pulmonary embolism. 2) Discuss artifacts which can limit diagnosis. 3) Identify limitations of PE protocol examinations. 4) Explore other pulmonary embolic or thrombotic conditions.

MSES32B Metabolic and Depositional Lung Diseases

Participants
Tomas C. Franquet, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

tfranquet@santpau.cat

LEARNING OBJECTIVES

1) To recognize the HRCT findings of various metabolic and depositional lung diseases. 2) To understand the CT findings throughout a radiologic-pathologic correlation. 3) To narrow the differential diagnoses towards a specific diagnosis in the right clinical setting.

ABSTRACT

Metabolic and depositional lung disease refers to a heterogeneous group of pulmonary diseases, the pathogenetic mechanism of which is accepted or suspected to be an underlying biochemical abnormality. These include pulmonary alveolar proteinosis (PAP), pulmonary amyloidosis, pulmonary calcification and ossification, pulmonary alveolar microlithiasis, Niemann-Pick disease, Gaucher disease and Hermansky-Pudlak syndrome. Theses diseases are rare and often associated with no or only mild clinical and functional abnormalities. Although the typical radiologic findings of above diseases are well known, the disease may manifest diverse radiologic findings. Some metabolic and storage diseases have characteristic HRCT appearances, helping narrow the differential diagnosis. Correlation of the radiological and histopathological findings of this group of diseases has also helped improve understand- ing of these disorders.

MSES32C Large and Small Airway Diseases

Participants
Andetta R. Hunsaker, MD, Sudbury, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ahunsaker@bwh.harvard.edu

LEARNING OBJECTIVES

1) Describe the many pathologies which affect the airways. 2) Identify neoplastic entities which affect the large airways. 3) Explain the work up of small airways diseases. 4) Classify the structural abnormalities in the airways which result in lung parenchymal findings.

ABSTRACT

Small And Large Airways Diseases The large airways are defined as the trachea down to the segmental bronchi with a diameter > 3mm. Small airways are defined as those between 2-3 mm. Many processes can involve the airways including Congenital, infiltrative diseases, infections, neoplasms, ans airway wall abnormalities. Imaging is important in correctly identifying etiology and management and includes static or dynamic expiratory imaging for small airways diseases depending on the suspected abnormality and HRCT imaging for most processes. Contrast may be helpful for larger airway diseases.

MSES32D Pulmonary Hypertension: The Role of the Radiologist

Participants
Shaunagh McDermott, FFR(RCSI), Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mcdermott.shaunagh@mgh.harvard.edu

LEARNING OBJECTIVES

1) To classify the causes of pulmonary hypertension. 2) To develop a systematic approach to patients with unsuspected, suspected or known pulmonary hypertension. 3) To help guide the management of patients with pulmonary hypertension.

ABSTRACT

Symptoms and signs of pulmonary hypertension are nonspecific and patients may undergo extensive diagnostic testing including imaging in the work up of their symptoms. In this presentation we will discuss the role of the radiologist in raising the suspicion of pulmonary hypertension, in suggesting the cause of pulmonary hypertension and in helping guide the management of patients with pulmonary hypertension.

MSQI32

Quality Improvement Symposium: Patient-centered Care

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S402AB

IN SQ

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

Participants
Bettina Siewert, MD, Boston, MA (*Moderator*) Editor, Wolters Kluwer nv; Reviewer, Wolters Kluwer nv;

For information about this presentation, contact:

bsiewert@bidmc.harvard.edu

Sub-Events

MSQI32A Patient-targeted Reports

Participants
Nadja Kadom, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

nkpiano@gmail.com

LEARNING OBJECTIVES

1) Identify opportunities for patient centered result reporting. 2) Develop patient-centered reporting initiatives.

ABSTRACT

n/a

MSQI32B Translating Reports to Lay Language

Participants
Hanna M. Zafar, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

hanna.zafar@uphs.upenn.edu

LEARNING OBJECTIVES

1) Identify three patient barriers to radiology report access. 2) List three methods to improve patient comprehension of radiology reports. 3) Describe the goals, potential benefits and implementation challenges of PA Act 112.

MSQI32C Patient's Portal: Two-way Street?

Participants
Morgan P. McBee, MD, Charleston, SC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mcbeem@musc.edu

LEARNING OBJECTIVES

1) Understand what patient portals are and their potential for increasing patient engagement. 2) Describe what qualities are necessary for a communication tool to be an effective means for patients to communicate directly with radiologists.

MSQI32D Closing the Loop on Follow-up Recommendations

Participants
Ben C. Wandtke, MD,MS, Rochester , NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ben_wandtke@urmc.rochester.edu

LEARNING OBJECTIVES

1) Identify measures of value achieved through recommendation tracking. 2) Describe medical informatics tools used in efficient recommendation management systems.

MSQI32E Improving Care for Vulnerable Populations

Participants
Hannah Perry, MD, Charlotte, VT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand which patient groups may be considered diverse, marginalized, and vulnerable. 2) Gain familiarity with the spectrum of knowledge necessary to provide respectful and effective care to diverse, marginalized, and vulnerable patient populations.

MSQI32F Q&A

MSRO32

BOOST: Genitourinary-Anatomy and Treatment Planning (Interactive Session)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S103AB

GU OI RO

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

Participants
Rohit Mehra, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Tristan Barrett, MBBS, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Nicole Curci, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn current data on effectiveness of prostate MRI. 2) Understand inter-rater challenges with prostate MRI. 3) Gain awareness of how analytics can be used to improve quality of care.

Printed on: 10/29/20

MSRO36

BOOST: Lung, Mediastinum, Pleura-Anatomy and Treatment Planning (Interactive Session)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S103CD

CH OI RO

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

FDA Discussions may include off-label uses.

Participants
Meng X. Welliver, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Mizuki Nishino, MD, Newton, MA (*Presenter*) Institutional Research Grant, Merck & Co, Inc; Institutional Research Grant, Canon Medical Systems Corporation; Institutional Research Grant, AstraZeneca PLC; Consultant, DAIICHI SANKYO Group; Research Grant, DAIICHI SANKYO Group; Consultant, AstraZeneca PLC
Alexander Louie, MD, FRCPC, Toronto, ON (*Presenter*) Speaker, AstraZeneca PLC; Speaker, Varian Medical Systems, Inc;
Subba R. Digumarthy, MD, Boston, MA (*Presenter*) Speaker, Siemens AG; Research Grant, Lunit Inc; Researcher, Merck & Co, Inc; Researcher, Pfizer Inc; Researcher, Bristol-Myers Squibb Company; Researcher, Novartis AG; Researcher, F. Hoffmann-La Roche Ltd; Researcher, Polaris Pharmaceuticals, Inc; Researcher, Cascadia Healthcare, LLC; Researcher, AbbVie Inc; Researcher, Gradalis, Inc; Researcher, Clinical Bay; Researcher, Zai Lab
Melin J. Khandekar, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the lung, mediastinal, and pleural anatomy on imaging for treatment planning and monitoring for thoracic malignancy, with a focus on lung cancer, thymic tumors, and mesothelioma. 2) Discuss the cutting-edge strategies and pitfalls for treatment planning and disease surveillance for lung cancer, thymic tumors, and mesothelioma. 3) Understand the importance of multidisciplinary approaches to thoracic malignancy involving lung, mediastinum, and pleura.

ABSTRACT

The purpose of this course is to provide attendees with a practical knowledge of the lung, mediastinal, and pleural anatomy and the understanding of the treatment planning strategies and pitfalls for thoracic malignancy with a focus on lung cancer, thymic tumors, and mesothelioma, highlighting the importance of multidisciplinary approaches to these tumors.

PS31

Tuesday Morning Plenary Session

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E451B

PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.25

Participants
Valerie P. Jackson, MD, Tucson, AZ (*Presenter*) Nothing to Disclose
Cynthia H. McCollough, PhD, Rochester, MN (*Introduction*) Research Grant, Siemens AG

Sub-Events

PS31A RSNA/AAPM Symposium: Integrated Diagnostics: Why Does it Matter and How Do We Get There?

Participants
Paul E. Kinahan, PhD, Seattle, WA (*Moderator*) Research Grant, General Electric Company Co-founder, PET/X LLC

LEARNING OBJECTIVES

1) To become familiar with the concept of Integrated Diagnosis, which combines Radiology, Pathology and Genomics seeking to improve outcomes. 2) To understand how the modern computational and concepts provide a basis for the cross-disciplinary implementation of integrated diagnosis. 3) To learn the potential of new methods to combine imaging and other data from multiple diagnostic approaches.

PS31B The Path to Integrated Diagnostics

Participants
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Presenter*) Research Grant, Siemens AG

PS31C Radio-Patho-Genomics: Computationally Integrating Disease Specific Features across Scales

Participants
Anant Madabhushi, PhD, Cleveland, OH (*Presenter*) Stockholder, Elucid Bioimaging Inc; Stockholder, Inspirata Inc; Consultant, Inspirata Inc; Scientific Advisory Board, Inspirata Inc; Scientific Advisory Board, AstraZeneca PLC; Scientific Advisory Board, Merck & Co, Inc; Researcher, Koninklijke Philips NV; Researcher, Inspirata Inc; License agreement, Elucid Bioimaging Inc; License agreement, Inspirata Inc; Grant, PathCore Inc; Grant, Inspirata Inc

RCA32

Understanding Anorectal and Cloacal Malformations with 3D Printed Models (Hands-on)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S401AB

GI IN

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

Participants

Jayanthi Parthasarathy, BDS, PhD, Columbus, OH (*Moderator*) Nothing to Disclose
Jayanthi Parthasarathy, BDS, PhD, Columbus, OH (*Presenter*) Nothing to Disclose
Benjamin P. Thompson, DO, Columbus, OH (*Presenter*) Nothing to Disclose
D. Gregory Bates, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Mark J. Hogan, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Marc Levitt, Columbus, OH (*Presenter*) Nothing to Disclose
Devin R. Halleran, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Hira Ahmad, Columbus, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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hira.ahmad@nationwidechildrens.org

LEARNING OBJECTIVES

1) Understand imaging protocol for anorectal and cloacal malformations for creating precise 3D models. 2) Learn the process of creating patient specific 3D anatomic models of anorectal and cloacal malformations. 3) Understand the various types of anorectal and cloacal malformations using 3D Printed models and their clinical implication in surgical planning.

ABSTRACT

Anorectal and cloacal malformations are rare birth defetcs occurring 1 in 20,000 live births. Understanding the underlying pathologic anatomy in the region of interest is challenging due to varying nature of the anatomy, the complexity of the structures and their relationships, and a wide spectrum of defects. Surgical planning and prognosis depends on precise emasurements of the common channel and urethra. Precise models can be made only with protocols developed for 3D modleing. The presentation will delve in detail into the imaging procedures targeted to 3D modleing processes, for creating 3D virtual models and 3D pritning of anorectal and cloacal malformations. 3D printed models of anorecctal malformations will be used to demonstrate their utiliyy in understanding the underlying pathologic anatomy in surgical decision-making. Experts in interventional radiologists and 3D modleing and pritning will conduct the course and be available for any questions during the presentation

Printed on: 10/29/20

RCC32

Radiology Informatics Mistakes and War Stories from the Physician Front Lines

Tuesday, Dec. 3 10:30AM - 12:00PM Room: N226

IN

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

Participants
Peter B. Sachs, MD, Denver, CO (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

peter.sachs@ucdenver.edu

LEARNING OBJECTIVES

1) Provide attendees with an informative and often humorous look at challenging situations that have faced leading imaging informaticists over their careers. 2) To share some of our most significant mistakes in the hopes of helping others to avoid them and grow as informatics providers and leaders.

ABSTRACT

N/A

Sub-Events

RCC32A 'And Yes, I AM Yelling at You!'

Participants
Peter B. Sachs, MD, Denver, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

peter.sachs@ucdenver.edu

LEARNING OBJECTIVES

1) Discuss the complexities of functioning as an imaging informaticist in a department, hospital and large health system. 2) Review some basic do's and don'ts of communication as a physician informaticist in a management/leadership role.

RCC32B I Almost Got Fired as the Enterprise IT Doc

Participants
Christopher J. Roth, MD, Raleigh, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the importance of communication and outreach in informatics project success. 2) Reinforce the value of calling reference sites for how applications are used and by whom it is being used. 3) Appreciate that professional activity and burnout have significant influences on personal life.

RCC32C System Upgrades Can Be Downgrades

Participants
Safwan Halabi, MD, Stanford, CA (*Presenter*) Officer, Interfierce; Stockholder, DNAFeed; Advisor, Bunker Hill

RCC32D Hope is Not a Downtime Solution

Participants
James Whitfill, MD, Scottsdale, AZ (*Presenter*) President, Lumetis LLC; Spouse, Shareholder, Radiology Partners

LEARNING OBJECTIVES

1) Understand the impact of a prolonged downtime on a radiology practice. 2) Review the steps to implementing a formal downtime solution. 3) Review common points of failure leading to need for a downtime solution.

RCC32E When CTRL-ALT-DEL Won't Work

Participants
Nabile M. Safdar, MD, Milton, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

nmsafda@emory.edu

LEARNING OBJECTIVES

1) To understand the most common reasons for major failures of clinical imaging informatics efforts. 2) To gain exposure to techniques to recover from leadership failures and manage expectations. 3) To explore resources available to help avoid catastrophic failures in informatics leadership.

ABSTRACT

Any informaticist leading major efforts and projects in healthcare will eventually fail miserably. In this session, we'll explore the nature of these failures, how to recover from them, and how to avoid them in the first place when possible.

RCC32F The Go Live Gone Wrong

Participants
Alex Towbin, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Cystic Fibrosis Foundation; Consultant, Reed Elsevier; Advisory Board, IBM Corporation; Advisory Board, KLAS Enterprises LLC;

For information about this presentation, contact:

alexander.towbin@cchmc.org

LEARNING OBJECTIVES

1) Describe the conditions that lead to a failed go-live. 2) Describe 3 strategies to mitigate a failure. 3) Describe how to communicate during a system failure.

SPAI31

RSNA AI Deep Learning Lab: Generative Adversarial Networks (GANs)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: AI Showcase, North Building, Level 2, Booth 10342

AI CT MR NM

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

Participants

Bradley J. Erickson, MD, PhD, Rochester, MN (*Presenter*) Board of Directors, VoiceIt Technologies, LLC; Stockholder, VoiceIt Technologies, LLC; Board of Directors, FlowSigma, LLC; Officer, FlowSigma, LLC ; Stockholder, FlowSigma, LLC

Special Information

In order to get the best experience for this session, it is highly recommended that attendees bring a laptop with a keyboard, a decent-sized screen, and the latest version of Google Chrome. Additionally, it is recommended that attendees have a basic knowledge of deep learning programming and some experience running a Google CoLab notebook. Having a Gmail account is also helpful. Here are instructions for creating and deleting a Gmail account.

ABSTRACT

This course describes a more recent advance in deep learning known as Generative Adversarial Networks (GANs). GANs are a deep learning technology in which a computer is trained to create images that look very 'real' even though they are completely synthetic. Getting 'large enough' data sets is a problem for most deep learning applications, and this is particularly true in medical imaging. This may be one way to address the 'data shortage' problem in medicine. GANs have also been created that can convert MRIs to CTs (e.g. for attenuation correction with MR/PET).

Printed on: 10/29/20

SPCP31

Egypt Presents: Radiology in Egypt-Case-based Approach

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E353C

OT

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

FDA Discussions may include off-label uses.

Sub-Events

SPCP31A Introduction

Participants
Tarek A. El-Diasty, MD, El Mansoura, Egypt (*Presenter*) Nothing to Disclose

Active Handout:Tarek A. El-Diasty

http://abstract.rsna.org/uploads/2019/19002568/Active SPCP31A.pdf

SPCP31B Case 1: Image the Past, See the Future!

Participants
Sahar Saleem, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

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saharsaleem1@gmail.com

LEARNING OBJECTIVES

1) Identifying paleoradiology as a radiology subspecialty where medical imaging methods are used to investigate non-invasively ancient objects: skeletons/mummies and artefacts such as statues and coffins. 2) Recognise the tools and knowledge a radiologist needs to practice paleoradiology. 3) Appreciate how the advances in CT technology (2D & 3D reconstruction of CT images, and 3D printing) can be applied in investigating ancient mummies and objects. 4) Recognise that the data provided by CT study of an ancient Egyptian mummy can provide wealth of information about age, cause of death, ancient diseases, cause of death and add knowledge about ancient culture, funerary and ritual procedures.

ABSTRACT

Mummies and ancient antiquities have been always the pride of Egypt. At RSNA 2017 & RANA 2018, we introduced Paleoradiology as a subspeciality where medical radiographic methods are used to investigate safely and non-invasively ancient mummies, and artefacts. We capture the artefacts within its context at archaeological field. We provide information that rewrites history, helps museums conserve and display ancient artifacts, as well as 3D print replica for visitors with visual challenges or as touristic souvenirs. Paleoradiology supports cultural activities and helps in attraction of tourism, one of the most important national income resources.

SPCP31C Case 2: Interventional Radiology in Challenging Cases (HCC with PVT & Post Bariatric Leakage)

Participants
Mohamed Hosni Kamel Abdelmaksoud, MD, Stanford, CA (*Presenter*) Proctor, Sirtex Medical Ltd; Clinical Advisory Board, Merit Medical Systems, Inc ; Consultant, Merit Medical Systems, Inc;

For information about this presentation, contact:

mohamedh@stanford.edu

LEARNING OBJECTIVES

1) To understand the role of interventional technique in treatment of advanced HCC stage with portal vein thrombosis. 2) To review the different interventional techniques available for HCC management. 3) To review the patients' outcomes associated with interventional treatment of HCC.

SPCP31D Case 3: Cardiovascular Imaging...Challenging Cases

Participants
Ahmed S. Ibrahim, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

asibrahima@gmail.com

LEARNING OBJECTIVES

1) Highlight the importance of cardiovascular CT imaging in assessment of coronary vascular anomalies. 2) Highlight the role of cardiac MRI in better assessment of pericardial and myocardial pathologies.

ABSTRACT

Multi-detector row CT (MDCT) scanners with high spatial and temporal resolutions are now available and are increasingly used for non-invasive assessment of vascular disease, including coronary arteries and coronary artery bypass grafts (CABG). With CTA, proportion of non assessable coronary segments has significantly decreased. MDCT angiography still remains a robust multipurpose technique for patients with acute non-specific chest pain. Thanks to the continuous technical evolution of the CT scanners, it is now possible to scan the heart and the full anatomic extent of grafts with sub-millimeter slice-thickness within a single breath-hold.. The advantages of CT, however, are that it is noninvasive, vein graft disease can be diagnosed at an early stage, and complementary evaluation of extracardiac anatomic features provides useful information before coronary artery bypass grafting is redone. CT coronary angiography can identify coronary stenoses, directly image the atherosclerotic lesions and characterize the plaque components as well as detection of coronary artery anomalies. Cardiac MRI (cMRI) is one of the rising MRI techniques, cMRI is now considered as the gold standard technique for assessment of myocardial pathologies. cMRI can easily allow to distinguish irreversible myocardial infarction from reversible dysfunction with high degrees of accuracy. At present, MRI is one of the best techniques for studying non-ischemic myocardial diseases and cMRI also remains the ultimate technique to assess and differentiate all types of cardiomyopathies and rule out rare diseases as arrythmogenic cardiomyopathy (ACM) and left ventricular non-compaction (LVNC). Unfortunately IHD will continue to increase & WHO estimate that it will be the leading cause of morbidity and mortality in 2020 that is why new emerging technique are being settled every day to upsurge accuracy of diagnosis of different myocardial pathologies. Native T1 and T2 mapping, post contrast T1 mapping (ECV), cMRI diffusion tensor imaging, cardiac spectroscopy and 4 dimensional flow imaging are new upcoming very promising techniques.

SPCP31E Case 4: Most Prevalent Chest Problems in Egypt

Participants
Marian Fayek Farid Kolta, Cairo, Egypt (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To know the most prevalent chest pathologies in Egypt. 2) To properly think of the differential diagnosis. 3) To chose the best modality for diagnosis.

ABSTRACT

N/A

SPCP31F Case 5: Advanced MR Imaging of Head and Neck Cancer: Egyptian Experience

Participants
Ahmed Abdel Razek, MD, Mansoura, Egypt (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review principles and techniques of advanced functional MR imaging of head and neck squamous cell carcinoma (HNSCC). 2) To illustrate the clinical applications of advanced functional MR imaging in HNSCC. 3) To identify the role of functional MR imaging to differentiate recurrent HNSCC from post treatment changes and monitoring after therapy.

ABSTRACT

1-Role of advanced MR imaging in differentiation HNSCC from simulating lesions 2-Imaging appearance and biomarkers of advanced MR imaging in HNSCC 3-Role of advanced MR imaging in nodal staging of HNSCC 4-Role of whole body diffusion weighted MR imaging in metastatic staging of HNSCC 5-Correlation of advanced MR imaging biomarkers with grading and prognostic parameters of HNSCC 6-Role of advanced MR imaging biomarkers in prediction treatment response 7-Role of advanced MR imaging in differentiation of recurrent/residual HNSCC from post treatment changes and in monitoring patients after therapy 8- Merits and limitations of different MR imaging sequences 9- Summary and future prospective

SPCP31G Case 6: Use of MR Tractography & Perfusion to Differentiate Cervical Cord Tumors from Inflammatory Lesions

Participants
Mohamed-Ihab S. Reda, MD, Alexandria, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ihabsreda@hotmail.com

LEARNING OBJECTIVES

1) To use the MR dynamic susceptibility perfusion in cervical cord and illustrate the normal time intensity curve of the cervical cord. 2) To use the DTI in cervical cord and illustrate the normal cervical tractogram. 3) How to differentiate between cervical cord inflammatory and neoplastic lesions using Susceptibility Perfusion and Tractography.

ABSTRACT

Differentiation between cervical cord inflammatory & neoplastic lesions can be performed by using dynamic susceptibility perfusion MR sequence, in addition to the DTI sequence to get a tractography for the affected cord. Inflammatory lesions are hypo perfused in relation to the normal cord segment ; & show No fibers displacement in the performed tractogram.On the other hand; the neoplastic cord lesions are hyper perfused in relation to the adjacent normal cervical cord segment; & typically will show displaced fibers in the performed tractography.

SPCP31H Case 7: Challenging Cases

Participants
Salwa M. Ismail, Giza, Egypt (*Presenter*) Nothing to Disclose

SPCP31I Case 8: Caudal Duplication Syndrome

Participants
Mohamed Eltomey, MD, Tanta, Egypt (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the various imaging findings in Caudal Duplication Syndrome. 2) To explain some of the imaging challenges in evaluation of these cases.

ABSTRACT

Caudal Duplication Syndrome Caudal Duplication Syndrome is a rare condition showing a wide spectrum of spinal, genitourinary and distal gut anomalies. Each case presents with its own unique collection of findings and poses a management challenge.

SPCP31J Case 9: MRI of Pelvic Floor Dysfunction: Egypt Unique Experience

Participants
Rania F. Elsayed, MD,PhD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rania729.re@gmail.com

LEARNING OBJECTIVES

1) To illustrate representative cases of patient with pelvic floor dysfunction. 2) To explain how it was possible based on top-notch original researches in the "Genito-urinary and Pelvic Floor Unit, Radiology department , Cairo university" we were able to provide road mapping and critical radiological information to the surgeons that was able to change their surgical decision in 40 % of patient with PFD.

ABSTRACT

Several clinicians who specialize in the field of PFD have stated that a "wide variety of surgical procedures have been used, with several based on weak scientific evidence". In addition they highlighted that the optimal approach to treatment must be individualized for each patient on the basis of both the symptom complex and the specific structural abnormalities. What had long been missing was a tool for accurately defining the anatomical and structural abnormalities in each patient. Improved imaging of anatomical structures with MRI has allowed superior soft-tissue resolution and consequently provided a more realistic glimpse of the structural relationships in vivo. With changing concepts, it is necessary to reexamine and redefine the underlying anatomy. On the basis of the new three- part pelvic supporting system classification developed in my institution, we were able to create a correlative analytical approach that can provide better data for treatment planning. This approach provides the necessary scientific evidence on which best clinical practice can be based, and the data-reporting system used for analysis provides a tool for accurately planning reconstructive surgery, reducing the risk of surgical failure and dysfunction recurrence. Hence, we believe that this approach enhances collaboration and interaction between radiologist and clinician, to the benefit of the patient, as it provides a common language through which the radiologist can effectively communicate imaging findings.

SPCP31K Case 10: Practical Approach to Rim Enhancing Breast Lesions

Participants
Dorria S. Salem, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dorriasalem@yahoo.com

LEARNING OBJECTIVES

1) To differentiate between various rim enhancing lesions, with emphasis on inflammatory and malignant breast abnormalities.2) To choose the proper recommendation for further evaluation of the patient. 3) To make use of the merits of each imaging modality to reach a diagnosis.

SPCP31L Case 11: Contrast-enhanced Spectral Mammography: Expect the Unexpected

Participants
Norran H. Said, MD, FRCR, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Classify the different imaging characteristics by contrast enhanced mammography. 2) Apply contrast enhanced mammography as a problem solving tool in the diagnostic and screening setting. 3) Assess their skills in interpretation of abnormalities detected by contrast enhanced mammography.

SPCP31M Case 12: Venous Approach for Embolization of Cerebral AVMs

Participants
Ahmed B. Elserwi, Cairo, Egypt (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

To demonstrate the technique of venous approach in embolization of cerebral AVMs that were thought before to be not adapted for endovascular treatment due to the inaccessebility of their arterial supply.

SPCP31N Case 13: Non-surgical Breast Lesion Excision

Participants
Naglaa Abdel Razek, MD, Cairo , Egypt (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Show an example of a common MSK dilemma in Egypt. 2) Discuss the different radiological modalities and learn to chose the optimum technique. 3) Learn critical appraisal and how to prioritize from a list of differential diagnosis.

ABSTRACT

a complicated musculoskeletal quiz case

SPCP31O Case 14: Ablation of Lung Tumors: Case Presentation

Participants
Wahid H. Tantawy, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

tantawyw@yahoo.com

LEARNING OBJECTIVES

1) Show the technique of lung ablation we adopt in Egypt and give some tips and tricks about. 2) Discuss how we can optimize results.

ABSTRACT

Present some interesting cases about the subject

SPCP31P Case 15: The Identification of Queen Hatshepsut's Mummy... Mission Impossible

Participants
Ashraf Selim, MD, Mohandessin, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

a_selim@yahoo.com

LEARNING OBJECTIVES

1) Define the basics of mummification technique of royal Egyptian mummies during the 18th and 19th Dynasty. 2) Apply combined radiology, Egyptology and forensic knowledge in identifying the mummy of Queen Hatshepsut, assessing her general health and identifying her cause of death.

SPCP31Q Closing Remarks

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

SSG01

Breast Imaging (CESM, DBT)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S102CD

BR

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

FDA Discussions may include off-label uses.

Participants
Catherine S. Giess, MD, Wellesley, MA (*Moderator*) Nothing to Disclose
Despina Kontos, PhD, Philadelphia, PA (*Moderator*) Research Grant, Hologic, Inc
Thomas H. Helbich, MD, Vienna, Austria (*Moderator*) Research Grant, Medicor, Inc ; Research Grant, Siemens AG ; Research Grant, C. R. Bard, Inc; Research Grant, Guerbet SA; Research Grant, Novomed GmbH

Sub-Events

SSG01-01 Weakly Supervised Deep Learning Modeling on Sub-Volumes for Pre Assessment of Digital Breast Tomosynthesis

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S102CD

Participants
Emine Doganay, PhD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
Puchen Li, Shenyang City, China (*Abstract Co-Author*) Nothing to Disclose
Yahong Luo, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose
Wendie A. Berg, MD, PhD, Gibsonia, PA (*Abstract Co-Author*) Nothing to Disclose
Shandong Wu, PhD, MSc, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

wus3@upmc.edu

PURPOSE

Digital breast tomosynthesis (DBT) is a quasi-3D imaging modality which can increase cancer detection and reduce false recalls. It, however, entails a much larger volume of imaging data to read, decreasing the time-efficiency of radiologists. In this study, we leverage a weakly supervised approach to build deep learning models to improve radiologists' reading, where the model performs a pre-reading to DBTs to identify potential examinations that are more likely to have malignancy or be breast cancer free.

METHOD AND MATERIALS

This retrospective study includes 546 patients (205 malignant and 341 benign cases, all confirmed by pathology), each having a DBT acquired between 2017-2018 at the same institution. Considering the 3D nature of DBT and the varying length of slice numbers (ranging 31 to 111) per breast across the patients, we proposed a sub-volume (i.e., 11 consecutive slices)-based scheme for 3D-based classification. A total of 1005 and 1753 sub-volumes were generated from the malignant and benign cases, respectively, for multi-sub-volume-based analysis. No lesion segmentation/labeling was performed in any slices; instead, only a weak label of 'malignancy' or 'benign' was given to each sub-volume. We constructed 3D convolutional neural network models using the shallow VGG-19 to perform three binary-classification tasks: (1) malignant vs. all benign, (2) malignant vs. BI-RADS 2&3 benign (109 cases), and (3) malignant vs. BI-RADS 4a&4b&4c benign (168 cases). Patient-wise 10-fold validation was performed, using AUC and sensitivity/specificity to measure model performance.

RESULTS

Average AUC was 0.72 (range 0.70-0.74) when using all benign cases in task 1. For the sub-group analysis, we observe an increased AUC of 0.74 (range 0.72-0.77) in task 2 and a decreased AUC of 0.60 (range 0.50-0.69) in task 3. In particular, a high specificity (0.89) is observed for task 1 and high sensitivity (0.91) is observed for task 2. The ROC curves are given in the attached figure.

CONCLUSION

Without the need of lesion segmentation and labeling, our deep learning method can effectively identify potential concerning DBT scans of reader's interests (more likely to have malignancy or be normal).

CLINICAL RELEVANCE/APPLICATION

Volumetric deep learning models can be a helpful tool to pre-read DBT scans for radiologists, with the promise to optimize reading priority, shorten reading time, and reduce unnecessary biopsy.

SSG01-02 Contrast-Enhanced Spectral Mammography (CESM) for Diagnostic Work-Up of MR-BI-RADS 4 Lesions Detected on Contrast-Enhanced Breast MRI

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S102CD

Participants

Simone Schrading, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Claudia Kurtz, MD, Lucerne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Timm Dirrichs, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Julia Vinnenberg, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christiane K. Kuhl, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

CESM has been proposed as an alternate to MRI for screening as well as staging of breast cancer. Recent studies suggest that CESM offers a similar sensitivity, yet a significantly higher specificity and PPV compared with MRI. Therefore, we investigated whether one can exploit the superior diagnostic accuracy of CESM for work-up of suspicious findings made on breast MRI.

METHOD AND MATERIALS

This prospective bi-center study included 53 asymptomatic patients with 53 contrast-enhancing lesions detected on breast MRI, and categorized as MR-BIRADS-4. All women underwent standard CESM (Selenia 3D Dimensions). MRI and CESM studies were read independently from each other by four breast radiologists. Thereafter, MR and CESM images were read in consensus side-by-side in order to correlate respective imaging findings. All findings were clarified by MR-guided vacuum biopsy.

RESULTS

Of the 53 findings suspicious on MRI, 25 (47.2%) were finally proven to be malignant (11 DCIS, 14 invasive cancers), and 28 (52.8%) benign. CESM suggested presence of breast cancer in 45/53 patients, and absence in 8/53. Of the 25 patients with final diagnosis of a malignant lesion, CESM was positive in 19, and negative in 6. Of the 28 women with final diagnosis of a benign lesion, CESM was positive in 26, and negative in 2. Accordingly, CESM would have caused a correct down-categorization in 2/28 false-positive (benign) MR-BIRADS-4 lesions (7%), but would have caused an incorrect down-categorization of 6/25 true-positive (malignant) MR-BIRADS-4 lesions (24%). No additional breast cancers were found by CESM, but 5 (9%; 5/53) additional false-positive findings. PPV of CESM was lower than that of MRI (47.2% [25/53] vs. 42.2% [19/45]).

CONCLUSION

CESM is not suitable for the non-invasive work up of MR-BI-RADS-4 lesions, because false-positive findings on MRI do mostly also enhance on CESM, with only a minimal reduction of false-positive diagnoses (-7%). Yet even this (low) rate of down-categorization cannot be exploited in clinical practice because it would be associated with cancers going undiagnosed in one out of four cases (24%).

CLINICAL RELEVANCE/APPLICATION

This study does not confirm the reported high sensitivity and superior specificity of CESM. CESM is not suitable for non-invasive work up of MR-BRADS-4 findings.

SSG01-04 Wide versus Narrow Angle Tomosynthesis: What's the Difference?

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S102CD

Participants
Anastasia Plaunova, MD, Stony Brook, NY (*Presenter*) Nothing to Disclose
Hailiang Huang, MS, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Kim Rinaldi, RT, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
David A. Scaduto, PhD, Pittsfield, ME (*Abstract Co-Author*) Research Grant, Siemens AG
Wei Zhao, PhD, Stony Brook, NY (*Abstract Co-Author*) Research support, Siemens AG
Paul R. Fisher, MD, East Setauket, NY (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

Today, digital breast tomosynthesis (DBT) is quickly becoming the standard of care for practices across the US and worldwide. While benefits of tomosynthesis are widely known - e.g., increased cancer detection rate and fewer callbacks - performance differences in DBT systems are unclear. Since the inception of DBT, discussion of optimal angular range and reconstruction algorithms has been at the forefront of the evolving 'ideal tomosynthesis' package. To our knowledge, this pilot study is the first to compare two clinical DBT units of differing angular ranges (AR) side by side.

METHOD AND MATERIALS

In this prospective study, patients coming to diagnostic follow-up (BIRADS 0) were recruited and imaged with both narrow-angle (Hologic Selenia Dimensions, AR = 15°) and wide-angle (Siemens MAMMOMAT Inspiration, AR = 50°) DBT. A total of 60 patients were included to yield 39 mass, 23 asymmetry/focal asymmetry, 4 architectural distortion, and 19 calcification comparison pairs for evaluation. Each abnormality was rated on a five-point scale for conspicuity (-2: lesion much better seen on narrow-angle DBT, to +2: lesion much better seen on wide-angle DBT).

RESULTS

Mass conspicuity was superior on wide-angle DBT compared to narrow-angle (mean score 0.97; 95% confidence interval (CI): 0.68, 1.27), as with asymmetry/focal asymmetry (0.96; CI: 0.56, 1.36). Architectural distortion was equivocal (0.50; CI: -0.42, 1.42), while narrow-angle showed calcifications better (-0.79; CI: -1.23, -0.35). Six cases were excluded from comparison because an asymmetry or mass was only seen on narrow-angle DBT, with that area demonstrating overlapping tissue on wide-angle (final work-up confirmatory). In one case, an asymmetry was a single view finding on narrow-angle DBT (CC view), while it was identified on both wide-angle views.

CONCLUSION

Wide-angle DBT makes it easier to identify masses and asymmetries when compared to narrow-angle DBT. The former can be used to reduce callbacks, reduce false positives, and perhaps identify a true finding faster with less imaging. Narrow-angle DBT performs better for calcifications and remains an Achilles heel for wide-angle DBT. Future endeavors include improving visualization of calcifications through reconstruction techniques.

CLINICAL RELEVANCE/APPLICATION

Wide-Angle DBT can be used to reduce callbacks, reduce false positives, and potentially identify a true finding faster with less imaging.

SSG01-05 Evaluation of Response to Neoadjuvant Chemotherapy by Contrast-Enhanced Mammography in Different Biological Subtypes of Breast Cancer

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S102CD

Participants
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PURPOSE

To assess how the molecular biomarker status of breast cancer affects the accuracy of Contrast Enhanced Spectral Mammography (CESM) in the assessment of residual disease extent after Neoadjuvant Chemotherapy (NAC).

METHOD AND MATERIALS

This study was approved by the institutional review board. 81 patients (age range, 27-77 years) receiving NAC were monitored with CESM. All patients had 2 CESM examinations; prior to and post NAC (maximum 10 days prior to surgery). The longest dimension of the residual cancer was measured at the post-NAC CESM and correlated with the post-operative pathologic findings. Patients were further divided into subgroups on the basis of HER2, hormone receptor, and Ki-67 status. The Pearson correlation was used to correlate CESM and pathologic tumor size, and the unpaired t test was used to compare CESM-pathologic size discrepancies.

RESULTS

Of the 81 patients; 41 had Luminal A tumors, 18 had triple-negative tumors, 16 had HER2-enriched tumors and 6 patients had Luminal B tumors. A strong correlation was found between the size of residual lesions on CESM and histopathology specimens in the total 81 patients ($r=0.921$, $P<0.001$). The overall mean size discrepancy was 0.85 cm +/- 1.04 SD. The HER2-enriched tumors showed the highest correlation with the histologic diameter ($r=0.988$, $P<0.001$), followed by the triple negative tumors ($r=0.932$, $P<0.001$) and then the Luminal A tumors ($r=0.834$, $P<0.001$), while the Luminal B tumors had the weakest correlation with histologic size ($r=0.840$, $P=0.036$). The mean CESM-pathologic size discrepancy was the smallest in the triple negative tumors and HER2-enriched tumors; 0.44 cm +/- 0.5 SD and 0.56 cm +/- 0.7 SD respectively, while the greatest mean size discrepancy was seen with the Luminal A and B tumors; 1.13 cm +/- 1.2 SD and 1.17 cm +/- 0.8 SD respectively.

CONCLUSION

CESM showed overall high diagnostic accuracy in the assessment of residual disease extent, achieving better correlation with pathologic size and smaller size discrepancy with the triple-negative and HER2-enriched tumors.

CLINICAL RELEVANCE/APPLICATION

Accurate assessment of residual disease extent after NAC is crucial for optimum surgical planning. Understanding the impact of the biological subtype of breast cancer on the diagnostic accuracy of a certain imaging modality leads to making sound decisions when it comes to surgical planning, eventually leading to better surgical outcome with tumor free margin.

SSG01-06 Use of Contrast-Enhanced Digital Mammography (CEDM) for Monitoring the Effects of Neoadjuvant Chemotherapy: Results from the "NEO-CEDM Trento Trial"

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S102CD

Participants
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PURPOSE

To report the results of a trial on the comparison between CEDM and Magnetic Resonance (MR) for assessing the size of the residual tumor during and after neoadjuvant chemotherapy (NAC) and estimating the response to therapy

METHOD AND MATERIALS

Between May 2015 and April 2018, 63 women who underwent NAC for breast cancer, were enrolled in this propective study approved by institutional review board. Exclusion criteria were: pregnancy, breastfeeding and contraindications to CEDM and/or MR. Women had contrast examinations before starting (PRE), during (MID) and at the end of NAC (POST). Two experienced radiologists blindly looked at MR, two others looked at CEDM and then reported, for each exam and NAC step, the largest diameter of the target lesion. The response to therapy was finally classified using RECIST criteria comparing first PRE- and MID-NAC, then MID- and POST-

NAC lesion size. Pathological results were collected and used as reference standard for comparison with last CEDM and MR controls. Statystical analysis: Pearson correlation and Bland Altman plot to test, for each NAC step, the agreement between CEDM, MR and pathological measurements; Chi-square test to evaluate the agreement in assessing RECIST criteria

RESULTS

Consistent correlation was found between CEDM and MR measurements both in PRE (0.94, IC 0.90-0.96), MID (0.92, IC 0.86- 0.95) and POST-NAC (0.92, IC 0.86-0.95); when POST-NAC CEDM and MR measurements were individually compared with pathological findings, the correlation found was lower for both methods and with similar results (respectively 0.64, 95% CI 0.44-0.77 and 0.63, IC 95% 0.44-0.77). Classifying the response to therapy according to RECIST criteria, there was significative agreement between CEDM and MR at MID-NAC (88.2%, $p < 0.0001$) and at POST-NAC (84.6%, $p < 0.0001$). Comparing the POST-NAC controls with the pathologist's response, the agreement was higher for MR (84.6%, $p < 0.0001$) compared to CEDM (77%, $p < 0.0001$). MR showed significant higher sensitivity (79% vs 69%) and specificity (100% vs 91%) than CEDM for assessment of complete response (CR) category

CONCLUSION

CEDM seems to be equivalent to MR for assessing tumor size and evaluating the response to NAC although in this study it has shown some limitations compared to MR in estimating the final entity of response

CLINICAL RELEVANCE/APPLICATION

CEDM may represent a reliable alternative in case of contraindications to MR or when MR is not available

SSG01-07 Computerized Scheme for Distinguishing Sentinel Lymph Nodes with and Without Cancer Metastasis Using Computed Tomography Lymphography before Breast Cancer Surgery

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S102CD

Participants
Hiroshi Ashiba I, PhD,RT, Saitama City , Japan (*Presenter*) Nothing to Disclose
Ryohei Nakayama, PhD, Kusatsu, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Sentinel lymph node (SLN) biopsy for evaluating cancer metastasis during breast cancer surgery can cause the consequent increase in operation time or the abrupt changes in the treatment plan during the operation. Although it is desirable to distinguish SLNs with and without metastasis before surgery, there is no established examination for this purpose. The purpose of this study was to develop a computerized scheme for evaluating metastasis in SLNs by analyzing computed tomography lymphography (CTLG) images.

METHOD AND MATERIALS

Our database consisted of CTLG images obtained from 100 patients with breast cancer who underwent surgery. The number of patients with SLN metastasis was 45, whereas that without SLN metastasis was 55. In our computerized scheme, nine objective features were assessed for SLN and lymphoduct. Support vector machine (SVM) was employed to evaluate cancer metastasis in SLNs. The hyper-parameters of the SVM were determined with a Bayesian optimization. The objective features used as inputs for the SVM were selected from the nine features according to a stepwise method based on Wilks's lambda. A leave-one-out testing method was used for the training and testing of the SVM.

RESULTS

The six objective features used for the SVM were selected from the nine features using the stepwise method. These features were as follows: 1) the shape of the lymphoduct, 2) degree of enhancement of the SLN, 3) long axis of the SLN, 4) area of the SLN, 5) standard deviation of CT values of the SLN, and 6) mean CT value of the SLN. With the computerized scheme, the classification accuracy, sensitivity, and specificity were 98.0% (98/100), 97.8% (44/45), and 98.2% (54/55), respectively. The positive and negative predictive values were 97.8% (44/45) and 98.2% (54/55), respectively. In the receiver operating characteristic analysis, the area under the curve was 0.972.

CONCLUSION

The computerized scheme for distinguishing between SLNs with and without metastasis can provide high classification accuracy by analyzing CTLG images before breast surgery.

CLINICAL RELEVANCE/APPLICATION

The computerized scheme for analyzing CTLG images exhibited high classification accuracy and would be useful in planning surgical procedures for determining whether to implement lymph node dissection.

SSG01-08 Prospective Study: Added Value of Contrast-Enhanced Spectral Mammography (CESM) in the Clinical Management of Indeterminate to High-Risk Lesions

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S102CD

Participants
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PURPOSE

To assess the added value of CESM in clinical management of BIRADS 4/5 lesions.

METHOD AND MATERIALS

BIRADS 4/5 lesions detected on conventional imaging (mammogram and/or ultrasound) between July 2016 and Sep 2018 were selected for adjunct dual energy CESM. Histopathology correlation was obtained on all lesions. Additional suspicious lesions that were detected by CESM were also included for histopathological correlation. All images were evaluated independently by two breast-trained radiologists using BIRADS classification.

RESULTS

A total of 105 lesions (63 patients) were included- 30 BIRADS 4A, 21 BIRADS 4B, 34 BIRADS 4C and 20 BIRADS 5 lesions- of which 22 did not enhance. These 22 non-enhancing lesions were all BIRADS 4A and were all found to be benign. Out of the remaining 83 enhancing lesions, 54 (65.1%) were malignant and 29 (34.9%) were benign (p value< 0.05). CESM alone detected 6 additional lesions, which were all later identified on second look ultrasound and were included for biopsy. Out of these 6, 4 were proven malignant and resulted in clinical upstaging.

CONCLUSION

There is evidence that absence of enhancement in CESM strongly favours benignity (almost 100% negative predictive value in our study). Along with conventional imaging, it may lend sufficient confidence to the reporting radiologist to downgrade some cases to BIRADS 3. This can reduce unnecessary biopsies and improve the diagnostic yield of future biopsies. CESM also increases the detection rate for potentially malignant lesions, thereby changing treatment strategy.

CLINICAL RELEVANCE/APPLICATION

BIRADS 4 comprises 4A-4C lesions, all of which need biopsy. Adding CESM may help avoid up to 1/2 of benign biopsies, reduce patient's physical and mental stress and allow better resource utilization.

SSG01-09 Prediction of Invasive Component Using Contrast-Enhanced Spectral Mammography in Patients Diagnosed as Ductal Carcinoma in Situ on Preoperative Core Biopsy: Prospective Observational Study

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S102CD

Participants
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PURPOSE

To evaluate the role of contrast-enhanced spectral mammography (CESM) for the prediction of invasive component in patients diagnosed as ductal carcinoma in situ (DCIS) on preoperative core biopsy.

METHOD AND MATERIALS

A total of 113 tumors in 108 patients diagnosed as DCIS on preoperative core biopsy were prospectively included in this study. Digital mammography (DM), CESM, and breast MRI were performed. Detection rate, lesion type, size on imaging and pathologic features on core biopsy were recorded. CESM grey value of combined image were also evaluated. Intraclass correlation coefficient (ICC), chi-square test, and student t-test were used for statistical analysis. Multivariate logistic regression analysis was used to find independent factors for the prediction of an invasive component.

RESULTS

On final pathology, 50 (44%) were pure DCIS, and 63 (56%) were microinvasive or invasive carcinomas. Detection rate of pure DCIS was 74% for DM, 90% for CESM, 100% for breast MRI, while that of microinvasive or invasive carcinoma 76% for DM, 98% for CESM, and 98% for breast MRI. ICC of tumor size between imaging and final pathology 0.773 for DM, 0.904 for CESM, and 0.832 for breast MRI. A total of 113 lesions, 25% (28/113) was not detected on DM, 5% (6/113) in CESM, and 1% (1/113) in breast MRI. When lesions were divided into calcified and noncalcified lesions, calcified lesions were 59 (52%) and noncalcified lesions were 54 (48%). Detection rate of calcified DCIS was 100% for DM, 98% for CESM, and 98% for breast MRI, while that of noncalcified DCIS was 48% for DM, 91% for CESM, and 100% for breast MRI. On multivariate analysis, nuclear grade on core biopsy, tumor extent on CESM and breast MRI, maximum CGV and maximum-to-minimum difference on CC view of CESM were independent factors for the prediction of invasive components, and AUC of combined feature was 0.84.

CONCLUSION

This study showed that CESM for the detection of DCIS, especially noncalcified DCIS showed similar performance to breast MRI, and significantly higher than DM. Tumor extent and CGV on CESM were independent factors for the prediction of invasive component on final pathology, and AUC was 0.84 when adding the nuclear grade on core biopsy.

CLINICAL RELEVANCE/APPLICATION

As for the detection of DCIS and prediction of invasive component on final pathology, CESM could show a similar diagnostic performance to breast MRI,

SSG02

Cardiac (CT, MRI, and Nuclear Medicine: General Topics)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S104A

CA CT MR NM

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

Participants
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Sub-Events

SSG02-02 Imaging Findings after Aortic Valve Implantation on 18F-Fluorodeoxyglucose Positron Emission Tomography with Computed Tomography

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S104A

Participants
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PURPOSE

Although 18F-Fluorodeoxyglucose (18F-FDG) Positron Emission Tomography (PET) with computed tomography (CT) is an essential tool in diagnosing prosthetic heart valve (PHV) endocarditis, the normal uptake patterns after PHV implantation have not been studied prospectively. We prospectively assessed perivalvular FDG uptake at different time points after aortic PHV implantation.

METHOD AND MATERIALS

Patients who had undergone uncomplicated aortic PHV implantation were included and underwent 18F-FDG PET/CT at 5(±1) weeks (group 1), 12(±2) weeks (group 2) or 52(±8) weeks (group 3) after implantation. After a preparatory diet to suppress normal myocardial glucose uptake, FDG uptake in the myocardium as well as around the PHV was scored using the Qualification Visual Score for Hypermetabolism (QVSH) as 'none' (< mediastinum), 'mild' (> mediastinum but < liver), 'moderate' (> liver), or 'severe' (intense uptake) and quantitative analysis was performed with maximum Standardized Uptake Value (SUVmax) and target to background ratio (SUVratio) on standardized European Association of Nuclear Medicine Research Ltd. (EARL) reconstructions by an experienced nuclear medicine physician.

RESULTS

In total 37 patients (group 1: n=12, group 2: n=12, group 3: n=13) (age 66±8 years) were included. Myocardial FDG uptake was moderate or less in 29/37 scans (78%). QVSH around the PHV was in 8/12 (67%) mild and 4/12 (33%) moderate in group 1, 7/12 (58%) mild and 5/12 (42%) moderate in group 2 and 8/13 (62%) mild and 5/13 (38%) moderate in group 3 (p=0.91). No scan was scored as 'none' or 'severe'. EARL SUVmax was 3.48±0.57, 3.50±0.59 and 3.34±0.55 (mean±SD, p=0.77) and EARL SUVratio was 2.00±0.29, 1.96±0.41 and 1.71±0.26 (mean±SD, p=0.07) for groups 1, 2 and 3, respectively.

CONCLUSION

Baseline FDG uptake around aortic PHV at 5, 12 and 52 weeks after implantation is similar and mild in the majority of cases with an overall mean SUVmax and SUVratio of 3.44±0.56 and 1.89±0.34 respectively.

CLINICAL RELEVANCE/APPLICATION

Knowing the normal baseline FDG uptake around prosthetic heart valves on 18F-FDG-PET-CT is essential to discriminate between normal and infected valves in patients suspected of endocarditis.

SSG02-03 Accuracy of Absolute Myocardial Blood Flow Quantification with Dual-Source CT: Validation in Human Using 15O-Water PET

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S104A

Participants
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PURPOSE

15O-water PET is the most accurate method in quantifying myocardial blood flow (MBF). Model-based analysis of perfusion CT with correction of flow-dependent alteration in extraction fraction(E) of iodine contrast medium may permit quantification of absolute MBF. The purpose of this study was to determine the accuracy of CT measurements of stress MBF by CT using 15O-water PET as a reference.

METHOD AND MATERIALS

Thirty-four patients (70±8 years, 27 male) with known or suspected coronary artery disease(CAD) underwent dynamic stress CT perfusion and stress 15O-water PET. Perfusion index (PI) was quantified in 16 myocardial segments with a dual-source CT and its dedicated software (Force/VPCT body, Siemens) based on maximal upslope method. Since PI is mathematically equivalent to unidirectional influx constant in compartment model analysis, PI can be expressed as a product of MBF and E. For the quantification of stress MBF using 15O-water PET, non-commercial software (Carimas) was used. The E of iopamidol was determined using CT-derived PI and PET-derived MBF (PET-MBF) in 17 subjects (pilot group). For validation, CT-derived MBF (CT-MBF) was calculated using the relation between E and CT-derived PI for the remaining 17 patients (validation group) and compared with PET-MBF. The segments with myocardial infarction were excluded from the analysis.

RESULTS

In the pilot group, CT-derived PI was 1.33±0.27ml/min/g and PET-MBF value was 2.80±0.84 ml/min/g, respectively. From these data, the relationship between E and MBF was $E = 1-\exp[-(0.11\times MBF+1.58)/MBF]$. In the validation group, CT-MBF was 2.40±2.03ml/min/g, while PET-MBF was 2.54±2.03ml/min/g. CT-MBF showed a good linear correlation with PET-MBF ($r= 0.93$, $P<000.1$). The measurement bias in measuring MBF between CT and PET was 0.14±0.73ml/min/g.

CONCLUSION

The relationship between E of iodine contrast medium and MBF was determined in this study. By using the relationship, stress MBF can be accurately quantified from the perfusion index obtained from dual-source CT and its dedicated analysis software.

CLINICAL RELEVANCE/APPLICATION

CT-MBF quantification has potential to provide detection of perfusion abnormality and risk stratification in patients with known or suspected CAD with high accuracy comparable to 15O-water PET.

SSG02-04 Development of an Automated Software for 3D Quantification of Extracellular Volume in Cardiac CT: Comparison with Cardiac MRI

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S104A

Participants
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PURPOSE

The objective of our study is to develop and validate a software for automatic three-dimensional (3D) measurement of myocardial extracellular volume (ECV) in cardiac CT compared to CMR in patients with cardiac amyloidosis (CA)

METHOD AND MATERIALS

Twenty patients with a proven diagnosis of CA and 20 control patients free of cardiac pathology were included. Unenhanced and late enhanced (5 minutes) cardiac CT images were analyzed automatically by the software. Duration of processing was recorded. Manual measurements of myocardial attenuation were performed on both sets of images by one operator within the interventricular septum (IVS) as usually performed in clinical practice. Automatic and manual values of ECV were calculated using biological hematocrit and synthetic hematocrit (derived from blood pool attenuation values). Measurements were correlated together and with MR measurements for all patients.

RESULTS

3D automatic segmentation of unenhanced and late enhanced cardiac CT images was successfully performed by the software for all patients. The duration of myocardial segmentation was 20 +/- 5 seconds. The software was able to provide 3D ECV values for all patients. Automated (30+/-20%) and manual (32+/-18%) measurements of ECV were well correlated each other ($r2=0.8$; $p<0.005$), and significantly correlated ($r2>0.7$; $p<0.05$) with the ECV measured by CMR (34+/-21%). Automatic and manual ECV values calculated with synthetic hematocrit did not significantly differ from biological ones.

CONCLUSION

Automated 3D measurement of ECV in cardiac CT is feasible and well correlated with manual measurements and CMR values. These results have to be confirmed on a wider range of patients (work in progress)

CLINICAL RELEVANCE/APPLICATION

Myocardial extracellular volume (ECV) is a good diagnostic and prognostic marker in cardiac diseases. ECV measurement is traditionally performed with cardiac magnetic resonance (CMR). Assessment of ECV in cardiac CT may help to use it more often in clinical practice.

SSG02-05 Assessment of Myocardial Extracellular Volume on Routine Body Computed Tomography in Breast Cancer Patients Treated with Anthracyclines

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S104A

Participants
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Francesco Sardanelli, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Speakers Bureau, Bracco Group Advisory Board, Bracco Group Research Grant, Bayer AG Advisory Board, General Electric Company Reserach Grant, General Electric Company Speakers Bureau, Siemens AG Reserach Grant, Real Imaging Ltd

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PURPOSE

To evaluate the feasibility of estimating myocardial extracellular volume (ECV) on routine thoracic contrast-enhanced CT in breast cancer patients, and, if feasible, to assess if a rise in ECV is associated with anthracyclines administration even in absence of clinical symptoms or echocardiographic changes.

METHOD AND MATERIALS

After Ethics Committee approval, female patients with breast cancer who had undergone routine CT examinations at our institution before and shortly after the end of chemotherapy including anthracyclines were retrospectively evaluated. Patients without available haematocrit, with CT images with artefacts, or who had undergone radiation therapy of the left breast were excluded. Follow-up CT examinations were also analysed, when available. ECV was calculated on scans obtained at about 1, 3, and 7 min after contrast injection.

RESULTS

Thirty-two female patients (aged 57±13 years, mean±standard deviation) with pre-treatment haematocrit 38±4%, and ejection fraction 64±6% were analysed. Pre-treatment ECV was 27.0±2.9% at 1 min, 27.4±3.8% at 3 min, and 26.4±3.8% at 7 min, similar to normal values reported for normal subjects in the literature. Post-treatment ECV (median interval: 89 days after treatment) was 31.1±4.9%, 32.5±5.0%, and 30.0±5.1%, respectively, values significantly higher than pre-treatment values at all times (*$p < 0.005$). ECV at follow-up (median interval: 135 days after post-treatment CT) was 31.0±4.5%, 30.0±3.4%, and 27.7±3.7%, respectively, without significant differences ($p > 0.548$) when compared to post-treatment values.*

CONCLUSION

After anthracyclines treatment, ECV was significantly higher than pre-treatment values. In the follow-up ECV remains higher than pre-treatment values.

CLINICAL RELEVANCE/APPLICATION

Myocardial ECV values from routine contrast-enhanced CT scans could play a role in the assessment of myocardial condition in breast cancer patients undergoing anthracycline-based chemotherapy.

SSG02-06 Cardiac Energetics Alteration in Chronic Hypoxia Rat Model: A Non-Invasive In Vivo 31P Magnetic Resonance Spectroscopy Experimental Study

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S104A

Participants
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PURPOSE

Energetics alteration plays a key role in the process of myocardial injury in chronic hypoxic diseases (CHD).31P magnetic resonance spectroscopy (MRS) can investigate alterations in cardiac energetic in vivo. This study was aimed to characterize the potential of 31P MRS in evaluating cardiac energetics alteration of chronic hypoxia rats (CHR).

METHOD AND MATERIALS

Thirty CHR were induced by SU5416 combined with hypoxia. 31P MRS (Bruker BioSpec 7.0T) was performed weekly (0-5 week) to follow-up the ratio of concentrations of phosphocreatine (PCr) to adenosine triphosphate (ATP) (PCr/ATP). The index of myocardial structure and systolic function, including the left ventricular function (LVEF) and the right ventricular function (RVEF), were also measured by magnetic resonance imaging (MRI) in each rat. The myocardial injury was shown based on hematoxylin and eosin (H&E) staining and Masson's trichrome staining.

RESULTS

Along weeks, the resting cardiac PCr/ATP ratio decreased from 0 to 5 weeks of modeling. The ratio dropped more markedly after injection of isoproterenol and recovered slowly thereafter. The declension of resting cardiac PCr/ATP ratio in CHR can be observed at the first week, compared with the healthy ones((3.92±0.43vs.4.48±0.56, P<0.05). While the LVEF and RVEF in CHR was similar to healthy rats. Also, the myocardial injury cannot be observed in the first week.

CONCLUSION

31P MRS can sensitivily reveal the cardiac energetics alteration in CHD before the onset of myocardial injury and ventricular dysfunction.

CLINICAL RELEVANCE/APPLICATION

31P MRS at 7.0 T can investigate cardiac energetics alteration in chronic hypoxia rat. Of note, defects in energy regulation were present before detectable myocardial injury and ventricular dysfunction.

SSG02-07 ***Complete Free-Breathing Adenosine Stress Cardiac MRI Using Compressed Sensing and Motion Correction: Comparison of Functional Parameters, Perfusion and Late Enhancement with the Standard Examination in Breathhold***

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S104A

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PURPOSE

Stress cardiac MRI (CMR) is a demanding examination with multiple breathholds (BH) and long scan times. Aim of this study was to compare free breathing (FB) examinations with the gold standard acquired in BH.

METHOD AND MATERIALS

40 consecutive patients were enrolled prospectively and examined on a 3T MRI. Functional imaging, perfusion and late gadolinium enhancement (LGE) were performed in BH and in FB using compressed sensing and inline motion correction. Left (LV) and right ventricle (RV) functional parameters in BH and FB were compared using Bland-Altman plots and subjective image quality was assessed on a 5-point scale (1=non diagnostic to 5=very good). For perfusion and LGE imaging diagnostic confidence was rated on a 3-point scale (1=low up to 3=high) and image quality on a 5-point scale (1=non diagnostic to 5=very good). Wilcoxon test was used to compare image quality and diagnostic confidence.

RESULTS

Bland-Altman plots showed good agreement for LV and RV functional parameters in BH and FB. Subjective image quality was significantly better with BH for LV (p<0.01) but comparable for RV (p=1.0). Scan time for cine BH was 218s (range 130s-385s), for cine FB 16s (range 11-27s). Extent of perfusion defects, LGE and diagnostic confidence was comparable between both groups. Scan time for LGE BH was 371s (range 239-502s), for LGE FB 189s (range 122-286s).

CONCLUSION

FB adenosine stress CMR examination delivers diagnostic image quality and could represent an alternative for patients who are unable to meet the demands of multiple BH and long examination times.

CLINICAL RELEVANCE/APPLICATION

Free breathing stress cardiac MRI can be performed in significantly shorter time than the gold standard in breathhold.

SSG02-08 ***Image Quality and Reliability of a Novel Dark Blood Late Gadolinium Enhancement Sequence in Ischemic Cardiomyopathy***

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S104A

Participants
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PURPOSE

To assess the reliability of a novel dark-blood LGE (DBLGE) technique compared to standard bright-blood LGE (SBBLGE) sequence in patients with ischemic cardiomyopathy

METHOD AND MATERIALS

This prospective study included 78 patients (63.1 ± 12.6 years, 62 males) with clinical history of ischemic cardiomyopathy who underwent CMR at 1.5T (Discovery MR450w, GE Healthcare, Waukesha, WI) with postcontrast SBBLGE and DBLGE acquisition. Two observers performed the imaging analysis in a double blinded fashion. The endpoints were: a) qualitative and quantitative analysis of signal intensity ratio (SIR) b) n° segments involved; c) transmurality index (i.e. 0-25%;25-50%,50-75%and75-100%) d) papillary muscle enhancement e) microvascular occlusion (MVO). Statistical analysis was performed with non-parametric test.

RESULTS

There were no interobserver variability (all p >0.05). Subjective image quality in DBLGE compared to SBBLGE was higher for the discrimination between LGE and blood signal (p<0.001), inferior (p<0.001) between LGE and myocardium and similar between blood and myocardium (p=0.56). DBLGE provided higher SIR between LGE and blood signal (1.18±1.15vs0.18±0.42;p<0.001), lower SIR between LGE and myocardium (0.91±4.95vs1.96±1.64;p<0.001) and between blood and myocardium (-0.26±0.71vs1.57±1.26;p<0.001). The n° segments involved was similar (p = 0.08). The transmurality index was inferior for DBLGE (3.09±1.02vs3.30±1.11;p=0.007). DBLGE was superior in identifying papillary muscle hyperenhancement (25vs17 cases;p<0.001) and inferior in MVO detection (7vs12 cases;p<0.001).

CONCLUSION

The DBLGE sequences when compared to SBBLGE provided better contrast between LGE and blood-pool, seemed to be superior in identifying papillary muscle hyperenancement, whereas underestimated the trasmurality extension of LGE and the presence of MVO.

CLINICAL RELEVANCE/APPLICATION

Black blood LGE can be extremely useful for evaluation of patients with ischemic cardiomyopathy, however it would be carefully evaluated in patients with acute myocardial infarction.

SSG02-09 Transfer Learning has Potential to Produce Better Reconstruction of Highly-Accelerated, Single-Shot LGE Images than Conventional Deep Learning

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S104A

Participants
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PURPOSE

Compressed sensing (CS) is capable of highly accelerating single-shot late gadolinium enhanced (LGE) MRI for achieving relatively high spatial resolution (1.6mmx1.6mm), but the lengthy image reconstruction time (~50s per image) and inconsistent performance hinder its clinical translation. Given limited training data, we propose a transfer learning (TL) approach to leverage our access to a large database of real-time cine images having similar image content as single-shot LGE, for developing a rapid image reconstruction framework for single-shot LGE.

METHOD AND MATERIALS

Image reconstruction was performed on a GPU workstation equipped with Pytorch. As shown in Figure 1, we pre-trained two deep learning (DL) networks (one for real and another for imaginary data, layer depth = 3, 64 features on the first layer) using existing 5811 (42 rays per frame) zero-filled and the corresponding CS reconstructed (total variation as constraint) real-time cine images from 19 patients (mean age = 66.1 ± 12.0 years; 8 females) as input/output pairs. For TL, we prospectively obtained 2-shot (42 radial spokes per shot), breath-held LGE data sets from 12 patients (mean age = 51.1 ± 20.3 years; 6 females) on 1.5T scanners (Aera and Avanto, Siemens), retrospectively undersampled the 2-shot data (101 images) by a factor of 2 (42 rays per image), and trained the U-Nets using single-shot, zero-filled (input) and the corresponding 2-shot, CS reconstructed images (output). For validation, we obtained 1-shot LGE (42 rays per image) data sets from 10 other patients (mean age = 56.5 ± 16.2 years; 6 females) and compared TL to CS and DL reconstructed images.

RESULTS

As shown in Figure 1, TL produced sharper images and fewer residual artifacts than DL and CS. Both edge sharpness (1.8 ±0.4mm) and CNR for TL (33.5 ± 18.8) were significantly (p<0.05) different from DL (2.3 ±0.4 mm and 27.0 ± 15.7) and CS (1.9 ± 0.4mm and 15.9 ± 7.6). The reconstruction time for DL and TL (0.7 ± 0.0s) was significantly (p <0.05) lower than CS (49.6 ± 1.1s).

CONCLUSION

This study demonstrates a TL approach to rapidly reconstruct 1-shot LGE with better image quality than a conventional DL approach.

CLINICAL RELEVANCE/APPLICATION

While CS is capable of highly accelerating data acquisition, the lengthy image reconstruction hinders its clinical translation.

While CS is capable of highly accelerating data acquisition, the lengthy image reconstruction hinders its clinical translation.
Transfer learning enables rapid image reconstruction without requiring a large database of training data.

Printed on: 10/29/20

SSG03

Science Session with Keynote: Chest (Pulmonary Vasculature and Angiography/Dual Energy CT)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S404CD

AI CH CT VA

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

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSG03-01 Chest Keynote Speaker: Issues and Techniques in Imaging of Pulmonary Vasculature

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S404CD

Participants
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SSG03-02 CT Pulmonary Angiography in Pregnancy Specific Conversion Factors to Estimate Effective Radiation Dose from Dose-Length Product

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S404CD

Participants
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PURPOSE

Effective dose (ED) is used to understand radiation related malignancy risk of CT scans. Currently, ED for computed tomography pulmonary angiography (CTPA) in pregnancy is estimated by multiplying the CT reported dose length product (DLP) by a DLP-to-ED conversion factor (k-factor) for general chest CT. The purpose of this study is to determine the specific k-factor for CTPA in pregnant patients and its predictive factors.

METHOD AND MATERIALS

This retrospective study evaluates consecutive CTPA in pregnant women across a large health system from January 2012 to April 2017. Patient and CT-related data were obtained from the radiology information system, the picture archiving and communication system, and a radiation dose index monitoring system. Each patient's ED (mSv) was determined by patient specific Monte-Carlo simulation using Cristy phantoms and divided by study DLP to determine k-factor. K-factor was compared to the standard k factor for chest CT of 0.014 with one sample t-test. Patient size was determined by the CT scanner in water equivalent diameter. Bivariate and multivariable analysis were performed for k-factor based on patient and CT factors.

RESULTS

534 patients were included in this study. The mean k-factor for all patients was 0.0249 (mSv·mGy-1·cm-1), 78% greater than 0.014 ($p<0.001$). Multivariable analysis demonstrated lower k-factor was observed with decreasing pitch ($p=0.0002$), patient size ($p<0.001$), and scan length ($p<0.0001$). 120 kVp ($p< 0.001$) and 140 kVp ($p=0.0028$) studies showed a larger k-factor than 80 and 100 kVp studies combined.

CONCLUSION

The k-factor for CPTA for pregnant patients higher than the previously used value for chest CT, which statically increased with decreasing pitch, patient size, and scan length, and was higher for larger kVp values.

CLINICAL RELEVANCE/APPLICATION

The specific k-factor for CTPA in pregnancy should be used to estimate effective radiation dose in that population.

SSG03-03 Patterns of Failure of an AI-Based Software: A Report on False Positive Findings of an Algorithm Detecting Pulmonary Embolism on CT Pulmonary Angiograms

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S404CD

Participants
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PURPOSE

To detect patterns of false positive (FP) findings of an algorithm trained for the detection of pulmonary embolism (PE) in CT pulmonary angiograms (CTPAs) and derive future directions for software development.

METHOD AND MATERIALS

We identified all CTPAs with the clinical question of PE performed at our institution in 2017 (n=1465). The 1-mm slices in soft-tissue kernel were processed by an AI-based software for the detection of PE trained on more than 28,000 CTPAs from other institutions. It was based on a deep convolutional neural network with a residual neural network architecture. Findings suspected of presenting a pulmonary embolus were marked by an arrow on the output series. Findings were reviewed by two radiologists and classified as true positive or FP. Frequency and reasons of FP findings were noted. Ratio of FP findings per case was calculated.

RESULTS

In total, we found 178 FP findings (0.12 FP/case). The six most frequent causes of FP findings were contrast agent related flow artifacts in the pulmonary arteries (n=46), detection of pulmonary veins (n=32), lymph nodes (n=29), pulmonary infiltrates, (n=20), beam hardening artifacts (n=12) and pulmonary metastases (n=10). For all but three FP findings, there was an anatomical correlate (175 of 178; 98.3%). Most FP findings were caused by structures outside the pulmonary tree (120 of 178; 67.4%). A large portion of FP findings was due to non-tubular structures (79 of 178; 44.4%).

CONCLUSION

Most FP findings can be attributed to a limited number of categories comprising clearly visually definable structures. These are often located outside the pulmonary artery tree and/or non-tubular. Therefore, both segmentation of the artery tree and the integration of algorithms detecting nodular structures may be measures to further reduce FP findings.

CLINICAL RELEVANCE/APPLICATION

Irrespective of the performance level of an AI-based algorithm, it is recommended to identify patterns underlying failure to further improve accuracy.

SSG03-04 Machine Learning Assisted Risk Stratification of Acute Pulmonary Embolism on Computer Tomography Pulmonary Angiography Images

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S404CD

Participants
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PURPOSE

This study aims to investigate the value of a machine-learning prediction model based on radiomics features derived from computer tomography pulmonary angiography (CTPA) images in risk stratification of acute pulmonary embolism (APE) patients.

METHOD AND MATERIALS

30 APE patients confirmed by CTPA were divided into high-risk (n = 15) and non-high-risk (n = 15) groups according to 2014 European Society of Cardiology guidelines. Radiomics features were extracted from the manually segmented region of interest (ROI), and independent *t* test and least absolute shrinkage and selection operator (LASSO) were used for feature selection. A step-forward Multiple Linear Regression was used to build a risk stratification model with the selected features.

RESULTS

Among 1746 radiomics features, 7 features were eventually selected as the most discriminative features, including 0 short low gray level, 5-7 Correlation, 2Gauss Area, Hist Area, Convenx Hull Volume, Energy and Skewness. In the step-forward-linear-regression, only 5-7 Correlation, Convenx Hull Volume and Energy were included, R square of the equation is 0.899.

CONCLUSION

The radiomics-based machine learning is useful strategy of risk stratification of CTPA images of APE patients.

CLINICAL RELEVANCE/APPLICATION

The radiomics-based machine learning provides a useful strategy of risk stratification of CTPA images of APE patients.

SSG03-05 Comparison of a New Deep Learning-Based Image Reconstruction (DLIR) with Conventional Image Reconstruction for CT Pulmonary Angiography (CTPA)

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S404CD

Participants
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PURPOSE

A recently introduced deep learning based image reconstruction (DLIR) algorithm (TrueFidelityTM, GE Healthcare) aims to emulate very high dose FBP image texture, with low noise and high-resolution by employing deep CNN-based models, including millions of trained parameters. This study aims to compare image quality of the DLIR algorithm with standard image reconstruction in CTPA.

METHOD AND MATERIALS

52 CTPA studies scanned during routine clinical use (Revolution CT Apex edition, GE Healthcare) were retrospectively reconstructed at 1.25mm slice thickness using FBP, ASIRv50, and 3 levels of a prototype DLIR (low (L), medium (M), and high(H)). Quantitative measurements of noise (standard deviation), signal to noise ratio (SNR) and contrast to noise ratio (CNR vs. liver parenchyma) in Main PA were obtained for all recons. Two radiologists independently rated subjective image noise, nose texture, artifacts, and diagnostic quality of the ASIRv50 and DLIR-M on a 1-5 scale.

RESULTS

The noise (std dev) was 40.55, 29.32, 25.34, 20.42, 15.22 HU, the SNR was 9.81, 13.58, 15.82, 19.81, 27.44, and the CNR was 10.39, 16.22, 16.51, 21.06, and 30.39 in the FBP, ASIRv50, DLIR-L, DLIR-M, and DLIR-H images respectively. All comparisons were significant ($p<0.001$) except for CNR between ASIRv50 and DLIR-L ($p=0.175$). Qualitative scores for ASIRv50 and DLIR-M were 3.86 +/- 0.26 and 4.89 +/- 0.25 (mean +/- std dev) respectively for image noise ($p<0.001$), 3.24 +/- 0.27 and 4.26 +/- 0.27 respectively for noise texture ($p < 0.001$), 3.92 +/- 0.25 and 3.93 +/- 0.25 for artifacts ($p=0.322$), and 4.94 +/- 0.31 and 3.94 +/- 0.31 for diagnostic image quality (p = n.s.).

CONCLUSION

DLIR shows decreased image noise with increased CNR and SNR compared to FBP and ASIRv. DLIR medium strength show decreased image noise with improved image texture qualitatively as compared to ASIRv50. There was no significant difference in subjective assessment of diagnostic quality or artifacts.

CLINICAL RELEVANCE/APPLICATION

The use of AI based image recon to lower noise and improve image texture is an emerging technology. Further study is needed to evaluate translation into dose savings or clinical performance in CT.

SSG03-06 Vascular and Parenchymal Enhancement Assessment by Dual-Phase Dual Energy CT in the Diagnostic Investigation of Pulmonary Hypertension

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S404CD

Participants
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PURPOSE

To prospectively evaluate the non-invasive identification of pulmonary hypertension (PH) by dual-phase dual-energy CT pulmonary angiography (DE-CTPA) vascular enhancement and perfused pulmonary blood volume quantification (PBV) to assess mean pulmonary artery pressure (mPAP) and pulmonary vascular resistance (PVR), corroborated by right heart catheterization (RHC).

METHOD AND MATERIALS

102 patients were recruited to undergo RHC and standard DE-CTPA protocol (series 1) with a second 10 cm central DE-CTPA acquisition after 7 second delay (series 2). In both series, enhancement in the main pulmonary artery (PAenh) and descending aorta (DAenh) were calculated from DE-CTPA iodine images, and volumetric enhancement of each whole lung (WLenh) was analysed using PBV.

RESULTS

65 patients had PH defined by mPAP>=25 mmHg and 51 patients PH defined by PVR >3WU. In series 1, PH patients had significantly higher PAenh/WLenh ratio and lower WLenh and DAenh compared to no PH. By series 2, PH patients had significantly higher PAenh and WLenh than no PH. Change in WLenh (series 1 to 2) offered the best diagnostic accuracy to define disease by mPAP (AUC 0.78) and PVR (AUC 0.79) and the best correlation with mPAP ($r=0.62$). PAenh series 2 correlated best with PVR ($r=0.49$). Metrics incorporating series 2 were superior in multivariate linear regression analysis (mPAP, $r=0.62$; PVR, $r=0.56$). Utilizing DE-CTPA metrics improved the correlation achieved by conventional CT metrics (mPAP, $r=0.61$ to $r=0.71$; PVR, $r=0.53$ to $r=0.64$). The presence of

moderate or markedly prominent bronchial collaterals was not more common in patients with increasing WLenh in series 2 compared to those with decreasing WLenh in series 2 (p=0.71).

CONCLUSION

This large prospective RHC corroborated study determined that dual-phase DE-CTPA vascular and parenchymal enhancement assessment appear complimentary to conventional CT metrics and improve the ability to predict mPAP and PVR. This is predominantly by the incorporation of change in whole lung enhancement over time to diagnose PH and by the use of this parameter and delayed pulmonary arterial enhancement to characterize disease severity.

CLINICAL RELEVANCE/APPLICATION

This study has identified a reader independent method to improve the non-invasive diagnosis of PH. These novel techniques have the potential to monitor disease severity and to help identify PH patients where early identification improves poor prognosis.

SSG03-07 Dual Energy Derived Pulmonary Blood Volume Histogram Parameters as Biomarkers of Pulmonary Dysfunction in Acute and Chronic Pulmonary Thromboembolic Disease

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S404CD

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PURPOSE

To use dual energy computed tomography (DECT) histogram parameters as biomarkers to characterize the degree of pulmonary dysfunction in patients with acute and chronic pulmonary embolism (PE).

METHOD AND MATERIALS

Retrospective analysis of 95 DECT pulmonary angiography scans was performed from 2015-2019 for patients with suspected acute or chronic PE. 0.8mm thick whole lung PBV maps were reconstructed using material decomposition analysis and normalized with a 1cm2 circular region of interest within the main pulmonary artery. 0.8mm thick axial CT images were used to generate a lung mask to limit the PBV map analysis area. Histograms were generated from voxels falling within the label map and fitted with parametric models to generate parameters for analysis.

RESULTS

Of 95 patients, 36 were identified with acute PE, 30 with chronic PE (18 with chronic thromboembolic pulmonary hypertension (CTEPH); 12 with chronic thromboembolic disease without pulmonary hypertension (CTED)), and 29 normal patients without PE. Ages ranged from 21-95 years (average of 61 years). 49 patients were female and 46 were male. Mean voxel values were 109±33 in normal patients, 99±63 in acute PE patients, 83±24 in CTED patients, and 80±31 in CTEPH patients. Statistically significant differences ($p<0.05$) were observed in patients with CTED and CTEPH compared to normal patients. Statistically significant differences ($p<0.05$) were observed when comparing the kurtosis (curve pointedness) and skewness (curve symmetry) in acute PE, CTED, and CTEPH patients to normal patients. Right heart catheterization (RHC) data within 1 month of the DECT were available for review in 11/18 CTEPH patients. RHC-derived mean pulmonary artery pressure (mPAP) and pulmonary vascular resistance (PVR) correlated with mean voxel values with linear regression coefficients of determination (R2) of 0.64 and 0.74 respectively.

CONCLUSION

Preliminary data suggests DECT histogram parameters can characterize pulmonary dysfunction in patients with acute and chronic PE. Mean voxel value is a potential imaging biomarker for quantifying RHC-derived mPAP and PVR.

CLINICAL RELEVANCE/APPLICATION

DECT histogram parameters are a promising surrogate biomarker for pulmonary hemodynamic assessment. Additional studies are warranted to define the role of DECT in evaluating acute and chronic PE and the potential to supplant invasive RHC and echocardiography as the surveillance imaging modality of choice.

SSG03-08 Comparison of Lung Volumes and Perfusion Defects on DECT-Perfusion Blood Volume Images with Clinical Outcomes for Patients with Pulmonary Embolism

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S404CD

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PURPOSE

To determine whether presence and/or extent of perfusion defects on dual energy CT pulmonary angiogram (DECT-PA) of patients with pulmonary embolism (PE) affected their clinical outcomes in terms of morbidity and mortality.

METHOD AND MATERIALS

With IRB Approval, we identified 164 adult patients (86 males, 78 females, mean age- 62±17 years) from the institutional pulmonary embolism response team (PERT) registry. All patients underwent DECT-PA for suspected PE on 384-slice, dual-source CT (SOMATOM Force, Siemens). Deidentified DICOM images were processed with a Lung Lobe Segmentation prototype (eXamine, Siemens). The prototype performed automated lobar segmentation and provided lung volumes, and several perfusion parameters for each lung and each lobe. Two radiologists assessed all DECT-PA for presence/absence of PE, location, occlusive/non-occlusive, and presence and location of pulmonary infarcts and perfusion defects (matched and mismatched). The medical records were reviewed to record any adverse clinical outcome within 3 days of DECT-PA (need for ventilation/mechanical respiration, uncontrolled hypertension, or death). Data were analyzed with multivariable analysis of variance (MANOVA) with SPSS statistical software.

RESULTS

Of the 164 patients, 139 had PE and 25 had no PE. Of the 20 patients (group 1: 20/139 PE+) with adverse clinical outcomes, 60% had perfusion defects on DECT-PA (12/20) as opposed to 29% rate of perfusion defects in patients with stable or improved clinical outcomes (group 2: 35/119 PE+). All quantitative perfusion parameters (iodine concentration, uptake, skewness, kurtosis) in group 1 patients were significantly different from group 2 patients (p=0.0001). There was a higher frequency of central and multiple PE in patients with adverse clinical outcomes compared to those with stable or favorable outcomes. The right, left, and whole lung volumes between group 1 (mean 1701±674, 1487±620, 3181±1202 ml) and group 2 (mean 1954±885, 1506±697, 3461±1553 ml) were significantly different as well (p<0.008).

CONCLUSION

Qualitative and quantitative perfusion abnormalities, and lung volumes are independent prognostic predictors of adverse clinical outcome in patients with pulmonary embolism on DECT-PA.

CLINICAL RELEVANCE/APPLICATION

Patients with perfusion defects and decreased quantitative perfusion on DECT-PA have high incidence of adverse clinical outcomes.

SSG03-09 The Deep Learning Model in Evaluation of Acute Pulmonary Embolism on Computed Tomographic Pulmonary Angiography

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S404CD

Participants
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PURPOSE

Our goal is to use the deep learning method to calculate clot volume of acute PE on computed tomographic pulmonary angiography (CTPA) and explore its relationship with other imaging parameters.

METHOD AND MATERIALS

The method is on a fully convolutional network called U-Net model to segment acute PE. Two datasets were used to train the deep learning(DL) model. Dataset 1 contains 230 samples of acute PE on CTPA labeled by radiologists and Dataset 2 consists of 65 samples without PE on CTPA. We set the values to 0.1, 0.3, 0.5, 0.7 and 0.99 for the measurement of the clot volume. The test dataset included 144 patients with suspected acute PE admitted to our hospital from Jan 2016 to Oct 2018. The images of CTPA in the test dataset were transferred to the trained model to detect the clot while the clot volume of acute PE were automatically calculated. We evaluated diagnosing time, accuracy, sensitivity and specificity of the proposed model in detecting clot. Meanwhile, clot burden of acute PE patients were assessed with obstruction scores and other imaging parameters by the radiologists.

RESULTS

The test dataset included 51 patients without PE and 93 patients with clinically confirmed acute PE. The average measurement time of DL model was 12.9±3.8 seconds approximately, while the second-year residents needed 10±4 minutes. When the critical value of the model is set as 0.1, the sensitivity and specificity are the highest, 94.6% and 76.5% respectively, and the consistency between measurements two was 100%. The AUC was 0.926 (95% CI:0.884-0.968), which indicates good discriminative power. Clot burden measured with DL model at setting value of 0.1 was significantly correlated with Qanadli score (r=0.819, p<0.001) and Mastora score (r=0.874, P<0.001). And it is moderately correlated with parameters related to function of right heart.

CONCLUSION

Detection of acute PE with DL model could greatly improve the diagnosing efficiency and reduce the workload of the radiologists

Detection of acute PE with DL model could greatly improve the diagnosing efficiency and reduce the workload of the radiologists. The DL model had high degree of sensitivity and reproducibility.The clot volume was highly correlated with obstruction scores, while it is moderately correlated with parameters related to function of the right heart.

CLINICAL RELEVANCE/APPLICATION

The deep learning model has high degree of sensitivity and reproducibility in the detection of clot, which is recommended for the detection of clot in patients with pulmonary embolism.

SSG04

Gastrointestinal (Liver Fibrosis)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E353A

GI MR

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

Participants
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Aoife Kilcoyne, MBBCh, Boston, MA (*Moderator*) Author, Wolters Kluwer nv

Sub-Events

SSG04-01 Assessing Liver Tumor Stiffness by Diffusion-Weighted MR Imaging-Based Virtual Elastography

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E353A

Participants
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PURPOSE

Recent study showed that there was a significant strong correlation between MR elastographic shear modulus (μMRE) and a shifted apparent diffusion coefficient (sADC200-1500) calculated from diffusion MR signals acquired with *b* values of 200 and 1500 sec/mm2 in the liver parenchyma. The purpose of our study was to retrospectively estimate the liver tumor stiffness by calculating sADC200-1500, comparing with MR elastography (MRE). We also compared tumor standard ADC values (ADC0-800: *b* values of 0 and 800 sec/mm2) with MRE.

METHOD AND MATERIALS

Eighty-seven patients with hepatic tumors underwent liver MR imaging at 3T (hepatocellular carcinoma [HCC], 32; metastasis, 26; hemangioma, 29). Of these, forty-five patients underwent diffusion-weighted imaging (*b* values of 200, 1500 and *b* values of 0, 800 sec/mm2) and MRE. Of forty-five patients, we measured tumor stiffness in fifteen patients (HCC, 9; metastasis, 6) who had tumors larger than 3cm by calculating μMRE, sADC200-1500 and ADC0-800 values. We also measured liver stiffness in forty-five patients by calculating μMRE, sADC200-1500 and ADC0-800 values. Finally, we measured sADC200-1500 values of hepatic tumors in eighty-seven patients. The correlation between μMRE and ADC values was evaluated using Pearson's correlation test. Receiver operating characteristic (ROC) analysis was used to evaluate the diagnostic performance of sADC200-1500 values for differentiating between benign and malignant tumors.

RESULTS

μMRE and sADC200-1500 exhibited strong correlations both for liver tumor (r=0.80; p<.001), and for liver parenchyma (r=0.87; p<.001). Meanwhile, μMRE and ADC0-800 exhibited no correlation for liver tumor (r=0.32; p=.24), and weak correlation for liver parenchyma (r=0.45; p=.002). The mean sADC200-1500 value of hemangioma was significantly higher than that of HCC and metastasis (1.69, 0.88, and 0.92×10-3mm2/sec; p<.001). A cut-off value of 1.27×10-3mm2/sec for sADC200-1500 detected with ROC analysis yielded 96.6% sensitivity and 89.5% specificity for the differentiation between benign and malignant tumors.

CONCLUSION

There was a significant strong correlation in the liver tumor between μMRE and sADC200-1500. Mean sADC200-1500 value of benign tumors was significantly higher than that of malignant tumors.

CLINICAL RELEVANCE/APPLICATION

Liver tumor stiffness estimation could be performed with DWI, and liver tumor stiffness assessment by virtual elastography facilitates the differentiation of malignant and benign liver tumors.

SSG04-02 Intravoxel Incoherent Motion Diffusion-Weighted MRI for Characterization of Diffuse Liver Disease

Tuesday, Dec. 3 10:40AM - 10:50AM Room: E353A

Participants
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PURPOSE

To evaluate the diagnostic performance of diffusion-weighted imaging (DWI) intravoxel incoherent motion (IVIM) parameters and stretched exponential model parameters for assessing histological features in patients with chronic liver disease (CLD).

METHOD AND MATERIALS

This prospective, cross-sectional multi-center study was approved by the Institutional Review Board of the two participating institutions. Ninety patients with suspected or known CLD who underwent clinically indicated liver biopsies were recruited between January 2014 and July 2018. IVIM parameters (perfusion fraction *f*, diffusion coefficient *D*, and pseudo-diffusion coefficient *D**) and stretched exponential model parameters (intravoxel water diffusion heterogeneity *a* and distributed diffusion coefficient *DDC*) were estimated using a least-squares, non-linear regression on DWI series (10 *b* values up to 800 s/mm2). Inflammation, fibrosis, and steatosis were scored by an expert liver pathologist. Spearman's rho, Kruskal-Wallis test, Mann-Whitney U test, and receiver operating characteristic (ROC) analyses were performed. Multiple regression analysis was used to assess the effects of histological features on diffusion parameters.

RESULTS

Among all parameters and histological features, *f* and *a* showed the strongest correlation with inflammation grades (ρ = -0.57 and ρ = 0.40, respectively; $P < 0.001$). Both *f* and *a* were significantly different between all inflammation grades ($P < 0.001$) and between pairs of inflammation grades <= A1 vs >= A2 ($P < 0.001$ and $P = 0.007$, respectively). Areas under the ROC curve for distinguishing <= A1 vs >= A2 were 0.84 (95% confidence interval: 0.74-0.91) with *f* and 0.72 (0.60-0.81) with *a*. In multiple regression analysis, fibrosis had a significant impact on *f* ($P = 0.03$), but not on *a* ($P = 0.18$), while steatosis had a significant impact on *a* ($P = 0.01$), but not on *f* ($P = 0.08$). Association between inflammation and parameters *f* and *a* remained significant when including fibrosis and steatosis in the regression model ($P < 0.001$ and $P < 0.05$, respectively).

CONCLUSION

Perfusion fraction and intravoxel water diffusion heterogeneity show promise as surrogate biomarkers of liver inflammation using IVIM-DWI.

CLINICAL RELEVANCE/APPLICATION

DWI sequence with multiple b values should be performed on abdominal MR examination in patients with chronic liver disease as it could provide supplemental information on inflammatory activity within the liver.

SSG04-03 Can Single-Section, Machine Learning-Based Radiomics Differentiate Normal Liver from Diffuse Liver Diseases?

Tuesday, Dec. 3 10:50AM - 11:00AM Room: E353A

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PURPOSE

We hypothesized that machine learning (ML)-based segmentation and radiomic features of liver from a single section of dual-energy CT can differentiate between normal, fatty and cirrhotic liver.

METHOD AND MATERIALS

Our IRB-approved study included 75 patients (mean age 54 ± 16 years; 44 females, 31 males) who underwent clinically-indicated, contrast-enhanced, portal venous phase, dual-energy abdomen-pelvis CT (SOMATOM Flash, Siemens). Low and high tube potential

(80 and 140 kV) image datasets were de-identified and exported to a DECT segmentation and radiomic features analyses prototype (Radiomics, Siemens). The prototype enabled automatic segmentation of liver on a single CT section at the level of the porta hepatis. DECT iodine quantification and radiomics features were derived for the segmented portion of the liver in XML file format. The XML files were imported into a separate ML-based statistical analysis prototype (Radiomics, Siemens) for univariate and multivariate logistic regression and random forest classification.

RESULTS

Both iodine quantification (best AUC 0.95) and radiomic features (best AUC 0.95) differ significantly between normal, fatty and cirrhotic livers (p<0.0001). Normalized iodine concentration was superior than the iodine concentration and mean iodine uptake (p<0.0004) for differentiating the normal from fatty and cirrhotic liver. Amongst the radiomic features, the first order statistics demonstrated the highest accuracy (AUC 0.90-0.95, P< 0.0001). Machine learning based random forest classification yielded an AUC of 0.91 for differentiating normal from cirrhotic liver, 0.95 (AUC) for differentiating fatty and normal liver and 0.93 (AUC) for differentiating fatty and cirrhotic liver.

CONCLUSION

Single-section, DECT iodine quantification and radiomics features enable near-perfect differentiation (AUC up to 0.954) of normal, fatty, and cirrhotic liver from single-section analyses. The most accurate features were iodine concentration and first order statistics from radiomic analyses.

CLINICAL RELEVANCE/APPLICATION

Machine learning-enabled radiomics from single-section DECT can enable automatic distinction of normal liver from fatty and cirrhotic liver.

SSG04-04 Assessment of Liver Fibrosis with Quantitative Analysis of Tc-99m Diethylenetriamine-pentaacetic Acid-galactosyl Human Serum Albumin (GSA) SPECT/CT: Comparison with Histopathological Fibrosis in Hepatectomy Specimen

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E353A

Participants
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PURPOSE

Assessment of liver fibrosis severity is essential in optimizing treatment in patients with chronic liver disease. Tc-99m GSA scintigraphy has been shown to be useful in assessing regional liver functional reserve, because its liver uptake and blood clearance have strong association with several hepatic function tests such as ICG15. However, the relationship between liver fibrosis and quantitative indices by Tc-99m GSA imaging has not been fully elucidated. The purpose of this study was to evaluate the value of quantitative assessment of Tc-99m GSA SPECT/CT to estimate the extent of liver fibrosis determined by hepatectomy specimen.

METHOD AND MATERIALS

Fifty-five patients who underwent Tc-99m GSA imaging before hepatectomy were studied. Following bolus injection of 185MBq Tc-99m GSA, planar dynamic scintigraphy was performed for 20 minutes. Immediately after the planar acquisition, SPECT data was acquired for 8 minutes (60 steps of 6 s/step and 128x128 matrix). SPECT images were reconstructed with CT attenuation correction and scatter correction. Liver uptake ratio (LUR) defined as radioactivity in whole liver divided by injected radioactivity was calculated. LHL15, a conventional index used for Tc-99m GSA planar scintigram, was also measured. LUR and LHL15 measurements were compared with the histopathological grade of liver fibrosis (F0-F4: F0, absence of fibrosis; F4, severe fibrosis).

RESULTS

LUR measured by SPECT/CT had significant negative correlation with the liver fibrosis stage (p<0.0001, r=-0.60). LUR in patients with severe liver fibrosis (F4) (30.7±12.8%) were significantly lower than those with absence/mild liver fibrosis (F0-1) (49.8±6.6%, p<0.0001) and intermediate liver fibrosis (F2-3) (46.0±9.3%, p=0.017) (Figure 1A). The areas under ROC curve of LUR for the prediction of severe liver fibrosis (F4) was 0.90 (Figure 1B). With an optimal LUR threshold of 40.4%, the sensitivity and specificity of LUR in detecting severe liver fibrosis was 90.9%(10/11) and 90.9%(40/44). The sensitivity and specificity of LHL15 to diagnose severe liver fibrosis was 72.7%(8/11) and 81.8%(36/44), respectively.

CONCLUSION

Quantitative assessment of Tc-99m GSA SPECT permits accurate prediction of severe liver fibrosis with the sensitivity and specificity of > 90%.

CLINICAL RELEVANCE/APPLICATION

Liver uptake ratio quantified with Tc-99m GSA SPECT/CT is a promising biomarker to estimate the severity of liver fibrosis.

SSG04-06 Breath-Hold Look-Locker Inversion Recovery T1 Map on Gd-EOB-DTPA-Enhanced Liver MRI to Estimate Liver Function: Calibration, Reproducibility, and Diagnostic Value

Tuesday, Dec. 3 11:20AM - 11:30AM Room: E353A

Participants
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PURPOSE

To validate Look-Locker T1 map on EOB-MRI for the calibration performance, reproducibility, and diagnostic value to estimate liver function.

METHOD AND MATERIALS

Look-Locker T1 map was established to scan a slice in 13 seconds. For calibration, a quantitative T1-phantom was generated using Gd-EOB-DTPA solutions of various concentrations and was scanned to evaluate T1 linearity. In total 466 consecutive patients with chronic liver disease or liver cirrhosis, MRIs were scanned with a T1-phantom attached. In the liver, T1 values on precontrast and 20-min postcontrast T1 maps were measured and its difference (ΔT1 = T1post - T1pre) and relative change (%ΔT1 = ΔT1 / T1pre) were calculated. Relative liver enhancement at 20-min postcontrast T1-WI was calculated [%RLE = (SIpost - SIpre)/SIpre]. Correlation between MRI indices and Child-Pugh score was calculated. Accuracy of ΔT1, %ΔT1, and RLE to diagnose decompensated cirrhosis was evaluated by receiver-operating-characteristics (ROC) analysis. Reproducibility of T1 value of attached phantom across all patients (n=466) and test-retest repeatability of T1 map of the liver in the same patients (n=52) were evaluated using repeatability coefficient (RC).

RESULTS

Phantom study showed excellent T1 linearity (coefficient of determination R2, 0.9737). In patients, the correlation coefficients between MRI indices and Child-Pugh score was high in %ΔT1 (r=0.584), but low in ΔT1 (r=0.339) and %RLE (r=0.241). Accuracy to diagnose Child-Pugh class B and C differentiating from class A was high in both %ΔT1 and RLE (AUC 0.798 and 0.838, respectively), but low in ΔT1 (AUC 0.683). Accuracy to diagnose Child-Pugh class C differentiating from class A and B was excellent in both %ΔT1, RLE and ΔT1 (AUC 0.993, 0.976, and 0.976, respectively). Reproducibility across all patients (RC 68.16) and test-retest repeatability in the same patients (RCs, 74.7 in T1pre and 79.4 in T1post) were good.

CONCLUSION

T1 map using Look-Locker sequence on EOB-MRI showed promise for evaluating liver function in patients, especially diagnosing decompensated liver cirrhosis. Of MRI indices, %ΔT1 might be the best index for liver function assessment.

CLINICAL RELEVANCE/APPLICATION

Breath-hold Look-Locker T1 map on EOB-MRI can overcome the conventional T1 map's limitation, a long scan time, thus can be easily incorporated in the routine liver MRI for chronic liver disease.

SSG04-07 Diuretic Use Associated with Discordant Estimation of Liver Fibrosis between Magnetic Resonance Elastography (MRE) and Transient Elastography (TE)

Tuesday, Dec. 3 11:30AM - 11:40AM Room: E353A

Participants
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PURPOSE

Magnetic resonance elastography (MRE) and transient elastography (TE) are preferred surveillance tools for low-risk individuals with liver disease. However, the estimated METAVIR fibrosis stage of these two studies are frequently discordant, obfuscating clinical decision-making. This study aims to identify factors that may contribute to this discordance.

METHOD AND MATERIALS

The radiology database was queried for patients with a TE within 18 months of MRE study from January 1, 2015 to September 30, 2018. Relevant clinical data were collected and analyzed from identified subjects.

RESULTS

The subjects (N=35) had a mean age of 57.6 years and 51.4% were obese (BMI >= 30 kg/m2). The most represented liver disease was nonalcoholic fatty liver disease (62.9%). The most represented comorbidities were hypertension (40.0%) and diabetes (34.3%). A Pearson's chi-square test identified factors associated with discordance in estimated METAVIR fibrosis stage, defined as difference in estimated stage (F0 to F4) greater than 1. Even with the small number of patients on diuretic therapy (n=14), there was a statistically significant discordance associated with diuretic use (p=0.02). There was no significant discordance in individuals with hypertension (p=0.62), or elevated serum creatinine (p=0.79).

CONCLUSION

This small, retrospective cohort study demonstrates a statistically significant discordance in estimated METAVIR fibrosis stage between TE and MRE in patients on diuretic therapy (p=0.02).

CLINICAL RELEVANCE/APPLICATION

Prior studies have demonstrated that venous congestion affects MRE and TE estimation of liver fibrosis. It has also been shown that hepatic venous congestion preferentially accumulates in peripheral liver tissue. As MRE evaluates a larger proportion of the patient's liver, prior research in heart failure patients suggest that MRE more completely characterizes the liver parenchyma. Because TE primary evaluates peripheral tissue, its estimation of liver fibrosis may be more sensitive to changes in volume status. Thus, our observed discordance between MRE and TE in patients on diuretics may be a result of the location of liver tissue assessed. This suggests that MRE may be the preferred initial study for patients on diuretics as its fibrosis estimation may be less affected by fluctuations in volume status. Further study on variability of estimated fibrosis by TE and MRE with concomittant diuretic use is warranted.

SSG04-08 Estimation of Minimal Liver Fibrosis Using Gadoxetic Acid-Enhanced Liver MRI and Machine Learning

Tuesday, Dec. 3 11:40AM - 11:50AM Room: E353A

Participants
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PURPOSE

The prognosis of patients with chronic hepatitis depends on fibrotic progression. As the transition from minimal to intermediate fibrosis is a major deleterious step, the accurate diagnosis of minimal fibrosis is of clinical importance. Liver biopsy, the reference standard for diagnosing and staging liver fibrosis, is invasive. As MR elastography, an imaging method for diagnosing liver fibrosis, may not be available in many hospitals, we developed a new method for its estimation on gadoxetic acid-enhanced liver MR images using support vector machines (SVM), a traditional application of machine learning. We assessed the diagnostic ability of our SVM analysis using parameters derived from gadoxetic acid-enhanced MR images for identifying minimal liver fibrosis.

METHOD AND MATERIALS

We included 182 patients with pathologically-diagnosed fibrosis stages. The parameters were based on texture analysis of hepatobiliary-phase images. To investigate the significant parameters for the staging of liver fibrosis we performed univariate logistic regression analysis. Parameters with statistical significance were subjected to analysis using multi-class SVMs, and their ability to identify minimal liver fibrosis (F-score >= 2) was determined. The FIB4 index which considers the patient age, the aspartate aminotransferase- and alanine aminotransferase level, and the platelet count was also calculated because it is correlated with the severity of liver fibrosis.

RESULTS

Univariate logistic regression analysis revealed that mean, standard deviation, skewness, kurtosis, the angular second moment, contrast, and entropy were important for the staging of liver fibrosis. The FIB4 index was also significant. The sensitivity, specificity, and accuracy for staging minimal liver fibrosis were 91.5, 55.8, and 81.3% for SVM analysis and 85.4, 60.4, and 78.7% for the FIB4 index based on an optimal cutoff value of 1.90.

CONCLUSION

SVM analysis using parameters derived from gadoxetic acid-enhanced MRI scans was more accurate than the FIB4 index for the staging of minimal liver fibrosis.

CLINICAL RELEVANCE/APPLICATION

SVM analysis using gadoxetic acid-enhanced MRI scans of the liver is a promising method for assessing minimal liver fibrosis.

SSG04-09 Evaluation of Liver Fibrosis by Assessing Hepatic Extracellular Volume Fraction Before and After Direct-Acting Antiviral Therapy in Patients with Chronic Hepatitis C Infection: Comparison with Serum Fibrosis-4 Index

Tuesday, Dec. 3 11:50AM - 12:00PM Room: E353A

Participants
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PURPOSE

The utility of direct-acting antiviral therapy (DAA) in improving liver fibrosis in patients with chronic hepatitis C virus infection remains unclear. Recent studies demonstrated a strong correlation between hepatic extracellular volume fraction (ECV), assessed using contrast-enhanced CT (CE-CT), and histologic liver fibrosis. Additionally, the fibrosis-4 index (FIB-4) has been proposed as a surrogate marker for hepatic fibrosis in patients with chronic liver disease. This study aimed to evaluate time-dependent changes in ECV using multiphasic contrast-enhanced CT and FIB-4 before and after DAA, and to clarify the difference between both indices.

METHOD AND MATERIALS

Study participants included 41 patients with hepatitis C virus infection who achieved sustained virological response after DAA. All patients underwent multiphasic CE-CT and biochemical examination of blood before and after DAA (pre-treatment, time point 1 (T1); less than 6 months after DAA, T2; 6 to 12 months, T3; 12 to 24 months, T4; greater than 24 months, T5). Absolute enhancements (in Hounsfield units) of the liver parenchyma (Eliver) and aorta (Eaorta) were measured on precontrast and equilibrium phase scans. ECV was calculated using the following equation: ECV (%) = ΔHUliver/ΔHUaorta × (100 - Hematocrit [%]). FIB-4 was simultaneously calculated using age, AST, ALT and platelet count.

RESULTS

ECV and FIB-4 after DAA showed a significant decrease at the end of the study period as compared to their values at T1 (ECV: 27.49 ± 3.72 and 29.45 ± 4.83, $p=0.022$; and FIB-4: 3.07 ± 1.88 and 4.40 ± 3.47, $p=0.001$, respectively). ECV showed a significant positive correlation with FIB-4 ($r=0.458$, $p=0.003$) at T1, although there was no correlation at the end of the study period ($r=0.170$, $p=0.289$). In ECV comparisons between the different time points, a significant difference was seen between T1 and T4, and T1 and T5 ($p=0.046$ and 0.022, respectively). In FIB-4 comparisons, significant differences were seen between T1 and all other time points ($p=0.003$ to $p<0.001$), although no differences in FIB-4 were seen in all comparisons between T2 to T5 ($p>0.05$).

CONCLUSION

ECV decreased slowly after DAA, suggesting an improvement in hepatic fibrosis. On the other hand, FIB-4 decreased immediately, probably due to an improvement in hepatic inflammation.

CLINICAL RELEVANCE/APPLICATION

ECV has the potential to be a non-invasive biomarker for the assessment of liver fibrosis after DAA.

Printed on: 10/29/20

SSG05

Gastrointestinal (MR Diagnosis)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E351

GI MR

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

FDA Discussions may include off-label uses.

Participants
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Alessandro Furlan, MD, Pittsburgh, PA (*Moderator*) Book contract, Reed Elsevier; Royalties, Reed Elsevier

Sub-Events

SSG05-01 Recurrence of HBV-Related Hepatocellular Carcinoma: Diagnostic Algorithms on Gadoxetic Acid-Enhanced MRI

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E351

Participants
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PURPOSE

to better characterize intrahepatic recurrence <20mm after resection of HCC using gadoxetic acid-enhanced MR imaging

METHOD AND MATERIALS

Between March 2012 and January 2017, a total of 373 nodules (median size, 1.4 cm; range, 5.5-19 mm) in 204 HCC patients (median age, 55 years; range, 27-79 years) with chronic hepatitis B virus (HBV) infection after hepatectomy underwent gadoxetic acid-enhanced MR imaging and were included in the retrospective study. Diagnostic performance of the LI-RADS systems were calculated for characterizing recurrence. The modified diagnostic algorithms were proposed by combining significant imaging biomarkers respectively related to subcentimeter and 10-20mm recurrences in multivariate analyses and were compared with the LI-RADS imaging criteria by using McNemar test.

RESULTS

The multivariate analyses showed that nonrim arterial phase hyperenhancement and the three LI-RADS ancillary features (hepatobiliary phase hypointensity, mild-moderate T2 hyperintensity and restricted diffusion) were significantly related with recurrence <20mm. For subcentimeter recurrence, the modified diagnostic algorithm of combining at least two of the three ancillary features achieved better diagnostic performance (sensitivity: 83.3%; specificity: 87.7%) than the LI-RADS 4 criteria (sensitivity: 88.9%, P=0.211; specificity: 70.8%, P=0.006). For 10-19 mm recurrence, combining nonrim arterial phase hyperenhancement and at least one of the three ancillary features achieved significantly enhanced sensitivity of 85.1% and relative high specificity of 86.5% than the LI-RADS 5 criteria (sensitivity: 63.5%, P<0.001; specificity: 94.2%, P=0.134).

CONCLUSION

The diagnostic algorithms for subcentimeter and 10-19mm recurrent HCC should be stratified. For subcentimeter recurrences, the modified diagnostic algorithm on gadoxetic acid-enhanced MRI demonstrated preserved high sensitivity with significantly enhanced specificity than LI-RADS 4 criteria.

CLINICAL RELEVANCE/APPLICATION

The multivariate analyses showed that arterial phase hyperenhancement was the most reliable major feature for characterizing 10-20 mm recurrence while the ancillary features were more valuable for characterizing <10mm recurrence. 3. Our modified diagnostic algorithms demonstrated significantly enhanced sensitivity with preserved high specificity for characterizing recurrent HCC <20mm.

SSG05-02 Exploring Prognostic Risk Factors and Survival Models for T3 Locally Advanced Rectal Cancer: What Can We Learn From the Baseline MRI?

Tuesday, Dec. 3 10:40AM - 10:50AM Room: E351

Participants
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PURPOSE

To evaluate the baseline MRI characteristics in predicting disease-free survival (DFS) and cancer-specific survival (CSS) in patients with T3 LARC and to explore individualized prognostic risk-stratification models.

METHOD AND MATERIALS

This study retrospectively reviewed 256 T3 LARC patients evaluated from January 2008 to December 2012 in our institution with an average follow-up period of 6.1 years. Two trained radiologists independently evaluated baseline MRI characteristics and reached consensus. Kaplan-Meier survival curves and Cox regression analysis were used to determine the relationship of MRI parameters and other clinicopathological factors to DFS and CSS using SPSS. R software was used to develop individualized risk-stratification nomograms for 3-year and 5-year DFS and CSS. Independent validation was assessed by Harrell concordance (C)-index.

RESULTS

Independent predictors of DFS were found to include baseline MRI-defined T3 substaging (hazard ratio, HR = 3.09, P < 0.001), extramural venous invasion (EMVI) grading (HR = 3.08, P < 0.001), rectal mucinous adenocarcinoma (RMAC) (HR = 2.44, P < 0.001), threatened mesorectal fascia (MRF) (HR = 1.73, P = 0.038), neoadjuvant chemoradiotherapy (NCRT) (HR = 0.44, P < 0.001) and an elevated pretreatment carcinoembryonic antigen (CEA) level (HR = 1.93, P < 0.001). In addition, T3 substaging (HR = 4.09, P < 0.001), EMVI grading (HR = 2.19, P < 0.001) and NCRT (HR = 0.58, P = 0.006) independently affected CSS. The nomograms permitted individualized prediction of 3-year and 5-year DFS and CSS probability with high performance (C-index range, 0.848-0.883).

CONCLUSION

Baseline MRI-defined T3 substaging, EMVI grading, threatened MRF, RMAC, and elevated pretreatment CEA were adverse prognosticators, whereas NCRT promoted positive outcome, in patients with T3 LARC. The models can facilitate individualized pretreatment survival risk-stratification.

CLINICAL RELEVANCE/APPLICATION

This study identified independent prognostic factors and developed nomogram models with high performance for individualized pretreatment prediction of 3-year and 5-year disease-free survival and cancer-specific survival in patients with T3 locally advanced rectal cancer. The models can facilitate individualized pretreatment survival risk-stratification and aid in clinical decision-making.

SSG05-03 Interobserver Variation in the Interpretation of MR Enterography for Crohn's Disease

Tuesday, Dec. 3 10:50AM - 11:00AM Room: E351

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PURPOSE

Quantifying interobserver variability is an important part in evaluating medical imaging. Interpretation of MR enterography (MRE) is complex, and to date there has been little research into interobserver variability across multiple observers.

METHOD AND MATERIALS

The study utilised datasets from a prospective trial comparing the diagnostic accuracy of MRE and US for CD (either newly diagnosed or relapsing disease) recruited from 8 centres. A construct reference standard (multidisciplinary panel diagnosis) was used, incorporating 6 months follow up. 73 (28 new diagnosis, 45 suspected relapse) trial MREs were interpreted 3 times by one of 27 radiologists via an online platform (Biotronics 3Dnet). Radiologists were randomly allocated datasets, blinded to each other's interpretation, patient's symptoms and history, and documented the presence/location of small bowel and colonic disease. Data was analysed separately for new diagnosis and relapse cohorts. Interobserver variability was measured by averaging percentage agreement with the consensus reference standard across the 3 reads, grouped as disease positive or negative. Prevalence adjusted bias adjusted kappa (PABAK) was reported. Agreement between the radiologists irrespective of agreement with the reference standard was also reported.

RESULTS

For newly diagnosed patients, overall percentage agreement for small bowel disease presence against the consensus reference was 68%, with kappa coefficient(κ) 0.36 (fair agreement). Agreement for colonic disease presence was 61%, κ 0.21(fair agreement). For relapsing cohort, overall percentage agreement for small bowel disease presence against the consensus reference was 76%, κ 0.51(moderate agreement). Agreement for colonic disease presence was 61%, κ 0.21(slight agreement). Agreement was similar when reads were considered without reference to the consensus reference (72% and 60% for small bowel and colonic disease presence respectively).

CONCLUSION

Based on data from a multi-reader, multicenter prospective trial, there is fair to moderate agreement between radiologists for the presence of small bowel and colonic disease against an independent standard of reference

CLINICAL RELEVANCE/APPLICATION

Compared to an independent standard of reference there is fair to moderate agreement between radiologists for the presence of enteric disease on MRE. This indicates the need for standardised training.

SSG05-04 MRI Evaluation of Lateral Pelvic Lymph Node in Locally Advanced Rectal Cancer: Optimized Cutoff Value Chosen and the Relationship to Overall Survival

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E351

Participants
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PURPOSE

To study the relationship between MRI-detected pretreatment lateral pelvic lymph node (LPLN) metastasis and prognosis in patients with locally advanced rectal cancer treated with neoadjuvant chemotherapy-radiation therapy (CRT).

METHOD AND MATERIALS

This retrospective study included 517 patients with locally advanced rectal cancer evaluated from August 2008 to December 2014. Baseline and post-CRT MRI and follow-up data were retrieved for all patients. MRI findings of LPLN metastasis were evaluated. Kaplan-Meier curves and ROC analysis were used to determine the relationship of baseline MRI findings to overall survival.

RESULTS

227 patients (43.9%) had visible LPLNs with short axis of at least 5mm on pretreatment MRI. Univariate cox analysis indicated that the short axis (HR=1.12, 95%CI: 1.04-1.21, p<0.01) as well as the long axis of the largest LPLN (HR=1.07, 95%CI:1.02-1.13, P=0.01) were associated with the overall survival (OS). However, there was no significant relation to the metastasis free survival or the local recurrence free survival. A cut-off of 8mm and 12mm were selected for short and long axis respectively by using survival ROC analysis. Kaplan-Meier method showed LPLNs with a short axis greater than 8 mm resulted in a significantly poor OS (3-year OS 92.5% vs 79.7% for less than 8mm vs equal to or greater than 8mm, P<0.01). LPLNs with a long axis greater than 12 mm resulted in a significantly poor OS (3-year OS 92.3% vs 77.3% for less than 12mm vs equal to or greater than 12mm, P<0.01).

CONCLUSION

The presence of lateral pelvic lymph node (LPLN) was associated with overall death in patients with locally advanced rectal cancer. Further research is needed about which pretreatment features of the LPLN predict prognosis and what is needed to prevent these from developing.

CLINICAL RELEVANCE/APPLICATION

The presence of lateral pelvic lymph node at baseline MRI in local advanced rectal cancer is associated with overall survival in patients with locally advanced rectal cancer.

SSG05-05 Visual Grading of Hepatic Steatosis on In and Opposed Phase Imaging: Validation by Reference to Proton Density Fat Fraction

Tuesday, Dec. 3 11:10AM - 11:20AM Room: E351

Participants
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PURPOSE

To develop and validate a qualitative, visual scale that can be used to grade severity of hepatic steatosis on in and opposed phase imaging.

METHOD AND MATERIALS

An IRB approved retrospective study was performed. From our institutional PACS, 429 MRI exams were identified that included both quantitative evaluation of proton density fat fraction (PDFF), and dual gradient echo in and opposed phase imaging. PDFF was calculated using the IDEAL-IQ technique (GE Healthcare, Milwaukee, WI). A subset of 113 patients was selected, (44 men and 66 women, ranging from 24-77 years of age), with PDFF ranging from 2% to 43%. Cases with abnormal hepatic iron concentrations (n=4) were excluded. Two readers independently provided visual steatosis score (VSS) according to our proposed 7-point scale based on visual cues, using in and opposed phase imaging only, without reference to clinical history, PDFF or other images. The VSS and PDFF were then compared for each study. ANOVA was performed to identify differences in PDFF as a function of VSS. 95% confidence intervals (CI) were constructed to determine the PDFF values that correlated with each VSS. Interclass correlation coefficient (ICC) was calculated to assess reliability (agreement and correlation).

RESULTS

ANOVA showed a statistically significant difference in PDFF for each VSS ($p < 0.05$). 95% CI of PDFF for each VSS were as follows. VSS-0: PDFF 4 to 6%; VSS-1: PDFF 7 to 12%; VSS-2: PDFF 15 to 18%; VSS-3: PDFF 26 to 29%; VSS-4: PDFF 31 to 40%; VSS-5: No exams scored; VSS-6: PDFF 35 to 45%. ICC was 0.92, indicating excellent reliability.

CONCLUSION

Specialized sequences for quantitative evaluation of hepatic steatosis are not always included in routine MR abdomen examination. Simple dual-echo technique (matched in and opposed phase) is routinely used as a component of abdominal MRI, including for detecting hepatic steatosis, but severity of steatosis on these sequences is subjective and not standardized. We propose a visual scale that can easily be employed during interpretation which can reliably differentiate various degrees of steatosis in the range commonly seen clinically (0 to 40%).

CLINICAL RELEVANCE/APPLICATION

Simple visual cues can be used to qualitatively grade hepatic steatosis on in and opposed phase imaging, providing greater standardization than currently utilized; these grades are reproducible between readers and demonstrate distinct degrees of steatosis as validated by PDFF.

SSG05-06 The Utility of MR Elastography for Differentiating Non-Cirrhotic Portal Hypertension from Cirrhotic Portal Hypertension

Tuesday, Dec. 3 11:20AM - 11:30AM Room: E351

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PURPOSE

In clinical practice, it is difficult to differentiate non cirrhotic portal hypertension (NCPH) from cirrhotic portal hypertension (CPH), based only on clinical and non-invasive objective methods. In this study we evaluated the utility of MR Elastography (MRE) for differentiating NCPH from CPH

METHOD AND MATERIALS

From our database we retrospectively identified 60 patients with NCPH and had MRE. Forty age and sex-matched patients with CPH who had MRE formed the control group. Liver morphologic features, signs of portal hypertension, and overall impression of cirrhosis and PH on MRI images were evaluated. MRE was performed with standard clinical 2D-GRE-MRE sequence. Regions of interest (ROI) were drawn on both liver and spleen on the stiffness map and mean stiffness measurements (kilopascals, kPa) were generated for liver stiffness (LSM) and spleen stiffness (SSM) for each subject. Chi-square analysis for morphologic features and non-parametric analysis for mean LSM, mean SSM, and mean SSM/mean LSM ratio (SSM/LSM) were performed for significant differences. Receiver operating curve (ROC) analysis was also performed when differences were significant.

RESULTS

Mean LSM was significantly higher in CPH group than NCPH [9.7 kPa (95% CI 6.3-13.1) vs. 3.4 kPa (95%CI, 2.0-4.8), $p<0.001$]. Meanwhile mean SSM was not significantly different between CPH and NCPH [7.8 kPa (95%CI, 6.1-9.5) vs. 8.0 kPa (95%CI, 3.7-12.3), $p=0.21$]. SSM/LSM ratio was significantly higher in NCPH than CPH [2.6 kPa (95%CI, 1.0-4.2), vs. 0.9 kPa (95%CI, 0.6-1.2), $p<0.001$]. ROC analysis showed that a mean LSM >5.3 kPa had 100% sensitivity, 99% specificity and 98% accuracy to differentiate NCPH from CPH. SSM/LSM ratio of <1.3 had 88% sensitivity, 84% specificity and 92% accuracy to differentiate NCPH from CPH. Among the MRI morphological features, only the presence of esophageal varices (CPH > NCPH, $p<0.018$), the presence of perisplenic collaterals (NCPH>CPH, $p<0.04$) and the overall impression of cirrhosis (CPH> NCPH, $p<0.01$) were significantly different.

CONCLUSION

MR Elastography is a useful, non-invasive tool that can help differentiate NCPH from CPH.

CLINICAL RELEVANCE/APPLICATION

Non cirrhotic portal hypertension (NCPH) is difficult to differentiate from cirrhotic portal hypertension (CPH). MRE is an accurate non-invasive technique that can help differentiate NCPH from CPH.

SSG05-07 Role of Volumetric Functional MRI in Predicting Histopathologic Grade of Untreated Hepatocellular Carcinoma and Patient Survival

Tuesday, Dec. 3 11:30AM - 11:40AM Room: E351

Participants
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PURPOSE

To evaluate the role of volumetric ADC (vADC) and volumetric venous enhancement (vVE) in predicting the grade of tumor differentiation in hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

This HIPPA compliant retrospective study was approved by our institutional review board. The study population included 136 HCC patients (188 lesions) who had baseline MR imaging and pathologic report of the HCC either by biopsy or liver transplantation between January 2001 and June 2017. Volumetric measurements of venous enhancement (VE) and apparent diffusion coefficient (ADC) were performed on baseline MRI. The tumors were histologically classified into two groups (low-grade and high-grade). The parameters between the two groups were compared using bivariate and multivariable analysis.

RESULTS

A total of 136 patients, with a median age of 61(56-67) were evaluated. 111 were male and 25 were female. Lesions with higher vADC values and higher absolute vADC-skewness were more likely to be high-grade on histopathology assessment ($p=0.001$ and $p=0.0291$, respectively). Also, venous enhancement showed a trend to be lower in high-grade lesions ($p=0.079$). vADC value of 1218.19 (x10-6 mm2/s) resulted in the highest sensitivity and specificity (77% and 74%, respectively) in distinguishing between the 2 groups. Additionally, vADC-skewness showed association with patient survival (HR=1.64, $p=0.035$; per increments in skewness).

CONCLUSION

vADC shows the highest accuracy in predicting HCC differentiation. Novel imaging biomarkers depicting tumor heterogeneity (e.g. skewness/kurtosis) could also be used to predict tumor features and patient's survival.

CLINICAL RELEVANCE/APPLICATION

Volumetric functional MRI metrics can be considered as non-invasive measures for determining tumor histopathology in HCC. These metrics can be used for modifying the management approach and reduce the need for tumor biopsy.

SSG05-08 Clinical Validation of Synthetic MRI in Assessing Rectal Cancer and Extramural Fat Invasion: Initial Experience

Tuesday, Dec. 3 11:40AM - 11:50AM Room: E351

Participants
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PURPOSE

To evaluate the Clinical validation of Synthetic MRI in rectal cancer and extramural fat invasion.

METHOD AND MATERIALS

38 patients pathologically proven rectal cancer were included in the retrospective study, ethical approval and consent forms were obtained. All the patients underwent MR scans with both conventional MR and synthetic MR. Two experienced radiologists independently reviewed the images and identified the regions of normal rectal wall, tumor and extramural fat. The T1/T2/PD values of these different regions were obtained using synthetic MR. T test, Wilcoxon signed-rank test, and Mann-Whitney U test were used to contrast T1/T2/PD values between normal rectal wall and tumor, and that of extramural fat in rectal cancer between T1/2 stage cases and T3/4 stage cases. The diagnostic efficacy was evaluated using the ROC curve. The $P<0.05$ was used to indicate

statistical significance

RESULTS

Compared with normal rectal wall, the rectal cancer had higher T2 value (P=0.00), however, T1 and PD values had no statistical difference. ROC curve analysis: T2 value (AUC=0.706; 95%CI=0.591-0.822). All of the PD, T1 and T2 values of the extramural fat of T3/4 stage rectal cancer higher than that of T1/2 stage rectal cancer (P=0.00). ROC curve analysis: PD value (AUC=0.808, 95%CI=0.685~0.930), T1 value (AUC=0.997, 95%CI=0.998~1.000), T2 value (AUC= 0.850, 95% CI = 0.699~1.000).

CONCLUSION

Synthetic MRI was useful in accessing rectal cancer and extramural fat invasion. Compare with the normal rectal wall, T2 value of rectal cancer has significantly diagnostic efficiency. T1 value of extramural fat has the highest diagnostic efficiency for invasion of rectal cancer.

CLINICAL RELEVANCE/APPLICATION

The results of this study indicated that Synthetic MRI was useful in evaluating rectal cancer and extramural fat invasion, especially in the diagnosis of extramural fat invasion.

SSG05-09 Comparison of Pre-Operative and Post-Operative MRI after Complex Fistula-In-Ano Surgery - Lessons Learnt in Interpreting Postoperative MRI Scans in an Audit of 1323 MRI

Tuesday, Dec. 3 11:50AM - 12:00PM Room: E351

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PURPOSE

The evaluation of MRI after fistula-in-ano surgery has never been done. The aim was to evaluate the utility of MRI in postoperative period after fistula-in-ano surgery.

METHOD AND MATERIALS

Preoperative MRI was done in all the patients and post-operative MRI was done to check radiological healing in clinically healed fistulas or when postoperative complication/ healing problem was seen

RESULTS

1323 MRI were done in 1003 fistula-in-ano patients, out of which, 702 patients underwent surgery. In 702 patients, there were 361-recurrent fistulas,153-associated abscess, 388-multiple tracts, 146-horseshoe and 76-supralevator fistula. 320 postoperative MRI were done in 180/702 patients.There were 189 grade I, 200 grade II, 52 grade III, 205 grade IV and 56 grade V fistula(St James classification). The requirement of postoperative MRI was significantly higher in complex (grade III-V) than simple fistulas (grade I-II) [43.5%(136/313) vs 11.3%(44/389) respectively, p<0.0001]. Lessons learnt in interpreting postoperative MRI scans --MRI was quite accurate to assess healing as well as complications after fistula surgery. --Granulation tissue (healing tissue) and inflammation in tissues (post surgery) looked hyperintense on T2 and STIR and was difficult to differentiate from active fistula tract/ pus. Therefore MRI done in immediate postoperative period (upto 8 weeks post surgery) required care. --After complete healing, the complete tract and internal opening becomes hypointense on T2 and STIR --The complete radiological healing takes at least 10-12 weeks. So getting MRI scan for assessment of healing should be done after 12 weeks. --MRI is very accurate to identify and diagnose postoperative complications like abscess formation, missed tract during surgery or non-healing of a tract. MRI detects such complications even in clinically healed tracts. By early intervention, it helps to prevent delayed recurrence, abscess formation and further spread of tracts. --Closure/healing of internal opening and intersphincteric tract are assessed quite accurately by MRI and they correlate well with the fistula healing.

CONCLUSION

MRI is highly useful to assess healing and detect complications after fistula surgery espesially in higher grades.

CLINICAL RELEVANCE/APPLICATION

MRI is highly useful to assess healing and detect complications after anal fistula surgery. MRI scan for assessment of healing should be done at least after 12 weeks of surgery.

SSG06

Informatics (Artificial Intelligence: NLP and Reporting)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S406A

AI IN

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

FDA Discussions may include off-label uses.

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Bhavik N. Patel, MD, Fremont, CA (*Moderator*) Speakers Bureau, General Electric Company; Research Grant, General Electric Company

Sub-Events

SSG06-01 Prediction of Imaging Report Impression Sections Using Sequence to Sequence Long-Short-Term-Memory Neural Network Model with a Customized Healthcare Narrative Cloud Embeddings

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S406A

Participants
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PURPOSE

Natural language processing (NLP) has the potential to increase radiologist efficiency and even has potential to be a diagnostic assist tool. The purpose of this study was to determine if NLP could predict the impression of report based on the findings of report.

METHOD AND MATERIALS

In this IRB-approved retrospective study, 100,000 radiology reports were analyzed using a natural language processing tool. The findings and impressions of the reports were used to create a predictive model which could predict the impressions of reports based on the findings of an imaging report by incorporating sequence to sequence long-short-term-memory (LSTM) neural network model with a customized healthcare narrative cloud embeddings. An additional 1,000 predicted impressions were created based solely on the findings portion of imaging reports. Two radiologists then evaluated these predicted impressions (PIs) by the NLP tool as compared to the true impressions (TIs) created by the interpreting radiologist in these 1,000 reports based on a three-point scale: semantic concordance; mild discordance which would not affect patient management, prognosis, or diagnosis; or semantic discordance. Fifty reports were evaluated by both radiologists to assess inter-reader variation.

RESULTS

There was 98% concordance and substantial agreement (kappa: 0.675) between radiologists. The bilingual evaluation understudy score for machine PIs relative to radiologist generated TIs was 0.946 (SD 0.091) [range of 0-1]. There was >80% semantic concordance and mild discordance of PIs to TIs.

CONCLUSION

The evaluated NLP tool is highly accurate in the creation of PIs based solely on the findings portions of reports.

CLINICAL RELEVANCE/APPLICATION

Automated creation of impressions could decrease radiologist workloads and act as a diagnosis assist tool.

SSG06-02 Crowdsourcing with Amazon Mechanical Turk to Assess Patient Comprehension of Radiology Reports and Colloquialisms

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S406A

Participants
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CONCLUSION

AMT is an expeditious, cost-effective, and customizable tool for surveying laypeople for sentiment or task-based research. Patient

AMT is an expeditious, cost-effective, and customizable tool for surveying laypeople for sentiment or task-based research. Patient summaries can help increase patient comprehension of radiology reports. Radiology colloquialisms are likely to be misunderstood by patients.

Background

Direct patient access to radiology reports via "patient portals" is becoming the standard of care. Our objectives were to assess patient comprehension of 5 different radiology reporting styles and to identify radiology colloquialisms that are at risk for patient misinterpretation.

Evaluation

Survey participants as patient surrogates were crowdsourced utilizing Amazon Mechanical Turk (AMT). For the first AMT task, each participant was randomly assigned a set of radiology reports in a constructed reporting format: traditional unstructured; structured; impression only; patient summary; and traditional unstructured with patient summary. Radiology reports were modeled after real cases, to convey imaging results of a CT abdomen and pelvis pertaining to cancer care. For the second AMT task, each participant was randomly assigned a radiology colloquialism and asked to indicate whether the phrase indicated a normal, abnormal, or ambivalent finding.

Discussion

Within 48 hours, 207 participants responded to the first task and 1166 participants responded to the second task. Of 877 read radiology reports, 412 (47%) were interpreted by the patient surrogate correctly. Patient surrogates had higher rates of comprehension with the patient summary format compared to the traditional unstructured format (57% versus 39%, p <0.001). When the same patient summary was provided in conjunction with traditional unstructured text, statistical significance was lost (47% versus 39%, p=0.053). The majority of patient surrogates who were provided with an impression or patient summary alone expressed a preference for more information (65% and 54%). The majority of patient surrogates expressed a preference for receiving a full radiology report via an electronic patient portal (114 of 207, 55%). Radiology colloquialisms with modifiers such as "low", "underdistended", or "decompressed" had low rates of comprehension.

SSG06-04 Automatic Patient Data Summarization for Radiologist

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S406A

Participants
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PURPOSE

Additional patient information from the Electronic Health Records (EHRs) at the point of interpreting radiology exams can help improve radiologists' diagnostic decisions. However, manually extracting relevant patient information from the EHR can be time-consuming and thus skipped in the routine radiology workflow. Therefore, it would be beneficial to have a mechanism that automatically summarizes and presents to radiologists the most clinically relevant patient information pertinent to the case type they are reviewing in real time.

METHOD AND MATERIALS

We present the idea of EHR summarization using summarization templates crafted semi-automatically with clinician assistance. Clinicians manually generated an initial summarization template containing a high-level specification of the types of patient information that the radiologists would like to see in a holistic summary of the patient's EHR. This initial high-level template has a limited concept coverage, giving limited matches to the findings within an actual patient record. To address this problem, we have developed semantic expansion approach that leverages a rich biomedical knowledge-base. To expand the clinician identified seed clinical concepts in the initial template, we identify their clinical variants and related concepts based on an ontological hierarchy and relationships from the biomedical knowledge graph (UMLS). Further, the expanded concepts are automatically filtered by removing duplicate and semantically irrelevant concepts. Finally, the expanded template is reviewed and validated by clinicians.

RESULTS

The approach expands 1,385 seed concepts from the initial summarization template to 29,798 clinically, as well as semantically, relevant concepts (multi-fold expansion). After clinicians' review and validation of the expanded concepts, 97.32% of the concepts are identified as useful and relevant for the summarization template.

CONCLUSION

This study provides a useful and novel approach for EHR summarization by keeping the clinicians and radiologist at the center and leveraging their cognitive workflow in processing high yield patient information in the EHRs. This is the first EHR summarization approach developed that keeps the clinicians' inputs at the focal point and leverages the rich knowledge from the biomedical knowledge-base.

CLINICAL RELEVANCE/APPLICATION

The presented approach is used in a commercial product to assist radiologists for diagnostic decisions.

SSG06-05 Comprehensive Lesion Tagging on Diverse CT Images: Learning from Radiology Reports and Label Ontology

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S406A

Participants
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PURPOSE

We aim to develop an algorithm to describe a variety of lesions in CT images. For each lesion image, the algorithm can predict a set of 'tags', namely body part, type, and attributes.

METHOD AND MATERIALS

We use the DeepLesion dataset and its associated radiology reports in our study. DeepLesion is a large-scale and diverse dataset with 32,735 lesion images from 10,594 CT studies of 4,427 patients. First, we construct our lesion ontology (tags with relations) based on the RadLex lexicon. Then, we run a text-mining algorithm on reports to extract the relevant tags for each lesion and filter the irrelevant ones. These tags are mined automatically and minimum manual effort is required. They are used to train a multi-scale multi-label convolutional neural network (CNN). The CNN takes a lesion image patch as the input, and outputs a score for each tag. To leverage ontology-based medical knowledge, we incorporate label relations in the algorithm. The hierarchical relations between tags (e.g., lung is a parent of right lung) are used to infer missing parent tags in the training set. The mutually exclusive relations (e.g., left lung and right lung) are used to infer reliable hard negative tags. A score propagation layer is designed to capture implicit relations between tags. These three strategies are proved to improve tagging accuracy. We also combine lesion retrieval with tagging to enable interpretable prediction.

RESULTS

The final lesion ontology contains 171 tags with 115 body parts, 27 types, and 29 attributes. Compared to existing work, our tags are more comprehensive and fine-grained. Two radiologists manually annotated 500 random lesions to evaluate our algorithm. The area under the ROC curve averaged over all tags is 0.9398, showing that our algorithm can predict the tags with high accuracy. We found that body parts are generally easier to predict since their appearance is relatively stable. Some lesion types (e.g., metastasis) and attributes (e.g., lobular) are harder because they have variable or subtle appearance, or few training cases. See examples in the figure.

CONCLUSION

We proposed an effective algorithm to predict tags for a lesion in a CT image. Radiology reports and relations between tags provided knowledge to train the algorithm.

CLINICAL RELEVANCE/APPLICATION

The predicted tags are useful for downstream fine-grained diagnosis as well as the generation of structured reports.

SSG06-06 How Does Structured Reporting Impact Radiology Reporting Language?

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S406A

Participants
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PURPOSE

To investigate if the introduction of structured reporting has an impact on radiology reporting language in terms of report length, linguistic standardization and lexicon size.

METHOD AND MATERIALS

1,315,842 radiology reports from 2011 to 2018 were extracted from the institutional RIS without preselection. During this time period, body and cardiothoracic imaging sections introduced reporting templates (100% structured reporting). Musculoskeletal and neuroimaging sections continued reporting in prose. Findings and impression sections of each report were automatically separated and segmented with a linguistic natural language processing approach into part-of-speech categories such as character, word, noun, verb, adverb count. Furthermore, frequency of undesired uncertainty words (e.g. "prominent") and expressions ("cannot definitely exclude") was assessed. Data was aggregated per month and graphically analyzed as trending line graph.

RESULTS

A clear transition in the findings section line graphs for all part-of-speech categories corresponds to the introduction of structured reporting. Findings mean character count decreased significantly by 57.8% (240.4 to 101.5; $p<0.0001$) and distinct words by

52.7% (24.5 to 11.6; p<0.0001). Summary mean character count significantly increased by 17.8% (286.4 to 337.4; p<0.0001) and unique word count by 17% (30.0 to 35.1; p<0.0001). For prose reporting there was no significant change in linguistic metrics. Findings mean character count changed by 16.3% (258.1 to 216.1), summary by 2.4% (229.0 to 234.6). Findings mean unique word count varied by 6.9% (25.4.1 to 21.7) and summary by 1.3% (23.9 to 24.2). There was a significant decrease in undesired words from mean 0.77 to 0.67 (p<0.0002) for findings and 0.73 to 0.59 for summary (p<0.0001) in comparison to prose reporting (0.64 to 0.68 findings; 0.69 to 0.63 summary).

CONCLUSION

Length and variation of language in findings section of structured reports decreases and standardization increases. In comparison, length and variation of summary sections in structured reports increase. This reflects a growing effort of radiologists to communicate findings, recommend follow up according to guidelines and document phone calls.

CLINICAL RELEVANCE/APPLICATION

Both radiologists and referring clinicians benefit from increased standardization of language in radiology reports in terms of comparability, comprehensibility and potential big data analysis.

SSG06-07 Machine Learning Using Doc2Vec as a Similarity Report Search Tool in Radiology

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S406A

Participants
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PURPOSE

Large-scale radiology report databases provide access to a vast library of imaging findings, however searches typically match small strings of text perhaps with regular expressions or additional syntax tools. Machine learning (ML) techniques could consider higher level context via the entire document. We applied a ML technique targeted at language similarity which allows the search query to be an entire report with the results being other similar reports. This could be useful for both trainee and faculty education. Our hypothesis was that this method would find similar reports better than standard search methods. We evaluated the quality of these similarity search results compared to typical keyword-based and random searches.

METHOD AND MATERIALS

Approximately 5 million reports from 9 sites were used to fit a doc2vec neural network with a 100 node hidden layer. A web tool could rapidly search all 5 million reports using single instruction multiple data instructions and the cosine distance metric. 203 variable reports were provided by an expert. For each, search results from doc2vec (n=15), text indexing (n=15), and random (n=10), were blinded and presented randomly for the expert to rank for similarity with Likert scale scoring where '1' meant very dissimilar and '5' meant very similar.

RESULTS

80 searches were performed with normalized vectors (NV) and 123 with non-normalized vectors (NNV). Using NV, 25% of doc2vec results had a '1' score, versus 99.9% with text indexing and 95.6% with random controls; 35% of doc2vec results had a '5' score, versus <0.1% with Solr and 0.5% with random controls (p<0.0001; t-test). With NNV, 56% of doc2vec results had a '1' score, versus 99.8% with Apache Solr and 98.8% with random controls; 17% of doc2vec results had '5' scores, with <0.1% for both other types(p<0.0001; t-test). Smaller cosine distance correlated with higher Likert scores (i.e. better similarity).

CONCLUSION

Doc2vec based ML methods demonstrated statistically significantly higher Likert scores. Both text indexing and random results were comparable and performed relatively poorly.

CLINICAL RELEVANCE/APPLICATION

Searching by report similarity enables physicians to rapidly compare their drafts or index reports with highly similar reports to optimize style, differential diagnoses, and best practices.

SSG06-08 Can AI Generate Clinically Appropriate X-Ray Reports? Judging the Accuracy and Clinical Validity of Deep Learning-Generated Test Reports as Compared to Reports Generated by Radiologists: A Retrospective Comparative Study

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S406A

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PURPOSE

Implementations of deep learning algorithms in clinical practice are limited by the nature of output provided by the algorithms. We evaluate the accuracy, clinical validity, clarity, consistency and level of hedging of AI-generated Chest X-Ray (CXRs) compared to radiologist-generated clinical reports.

METHOD AND MATERIALS

297 CXRs done on a Conventional X-Ray system (GE Healthcare, USA) fitted with a Retrofit DR (Konika Minolta, Japan) were pulled from the PACS along with their corresponding reports. The anonymised CXRs were analysed by a CE approved deep learning-based CXR analysis algorithm (ChestEye, Oxipit, Lithuania) which detects abnormalities and autogenerates clinical reports. The algorithm is an ensemble of multiple classification, detection and segmentation neural networks capable of identifying 75 different radiological findings and perform findings' location extraction. The outputs from this model are used by a custom automatic text generator tailored by multiple radiologists to produce a structured and cohesive report. These models were trained using around 1 million chest X-rays coming from multiple data sources. The algorithm was not trained or tested before on CXRs from our institution. An informed review was performed by a radiologist with 9 years' experience to evaluate both the reports for the accuracy as well the clinical appropriateness of the reports.

RESULTS

In 236 (79%) cases, algorithm-generated reports were found to be as accurate as the radiologists' reports. In 16 (5%) cases, algorithm-generated reports were found to be either more accurate or more clinically appropriate. In 18 (6%) cases, the algorithm made significant diagnostic errors and in 27 (9%) cases, the algorithm-generated reports were found to be clinically inappropriate or insufficient even though the significant findings were correctly identified and localised.

CONCLUSION

We demonstrate, for the first time as of this date, a comparison between reports auto-generated by a deep learning algorithm and a practicing radiologist. We report good comparability of the clinical appropriateness of the reports generated by a DL network having high accuracy, paving the way for a new potential deployment strategy of AI in radiology.

CLINICAL RELEVANCE/APPLICATION

We report on an algorithm with potential to produce standardized, accurate reports in a manner that is easily understandable and deployable in the clinical environment.

SSG06-09 Reducing the Amount of Training Data for Natural Language Processing (NLP) in Radiology by an Active Learning Approach

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S406A

Participants
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PURPOSE

Data labelling is a very time-consuming part of machine learning NLP projects in radiology. The aim of our study was to assess the potential of active learning (AL) for the reduction of training data needed to reach desired levels of models` accuracy as opposed to standard random sampling (RS), exemplified on reports of CT pulmonary angiograms (CTPAs).

METHOD AND MATERIALS

We identified all reports of CTPAs with the clinical question of PE acquired at our institution in 2016 and 2017 (n=2801). Impressions were extracted and then labeled by a radiologist (PE: yes/no). The following process was repeated 100 times to account for effects of random data distribution: We randomized the dataset and split it into a training dataset (TDS; 2/3; n=1901) and a test dataset (TS; 1/3; n=900). From the TDS, we selected the first 50 impressions to train a NLP model based on a support-vector-machine predicting the status of the impression regarding PE. Then, in a step-wise approach, we added 60 impressions at each cycle until all impressions of the TDS were included. The selection of added impressions was performed (a) by adding random samples and (b) by adding samples selected with AL, a selection method that chooses the next samples adding most to the models predictive power. Accuracy depending on the amount of training data was calculated on the independent TS for every cycle.

RESULTS

The active learning approach required less training data for reaching a defined level of performance than standard random sampling. For example, based on 100 simulations, AL achieved >95% mean accuracy with standard deviation of 0.8% at 230 samples, where RS achieved the same mean accuracy with standard deviation of 0.7% at 830 samples. This effectively means that for the mentioned accuracy, the RS approach needs 3.6 times more training data than the active learning approach.

CONCLUSION

Active learning reduces the amount of training data needed to reach a desired performance. This facilitates NLP projects in radiology as the data labeling cost is substantial. The effect size will depend on the concrete NLP project.

CLINICAL RELEVANCE/APPLICATION

High quality labeled data is a scarce resource in radiology. Therefore, it is recommended to try to understand and optimize the relation between the amount of training data and performance. Active learning can contribute to a better utilization of data.

Printed on: 10/29/20

SSG07

Molecular Imaging (New Tracers and Alternative Imaging Modalities)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S505AB

MI

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

SSG07-01 Targeted Delivery of Bismuth-Based Nanoparticles for the Diagnosis of Liver Fibrosis via Spectral CT

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S505AB

Awards
Trainee Research Prize - Medical Student

Participants
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PURPOSE

Early diagnosis of liver fibrosis is essential to prevent progression to cirrhosis. However, there is currently few effective medical imaging technique to accurately diagnose it. This study assesses the potential utility of targeting nanoparticles, BaBiF5@PDA@HA, as contrast agents for gemstone spectral computed tomography (GSCT) in the diagnosis of liver fibrosis.

METHOD AND MATERIALS

BaBiF5 nanoparticles were synthesized and transformed to be hydrophilic with polydopamine (PDA). Then hyaluronic acid (HA) derivatives, target-specific biomarkers for liver fibrosis, were conjugated onto the nanoparticles. The resulting BaBiF5@PDA@HA nanoprobes were further applied as contrast agents for GSCT. The CT Hounsfield unit (HU) value was measured on monochromatic images (40 to 140 keV) acquired by GSCT for experimental group for liver fibrosis mice models(induced by 8-week MCD diet), and sham mice group(regular diet). Resulting data were compared using Student-t and Mann-Whitney tests. All animal experiments were performed following protocols approved by the institutional animal care and use committee. Sirius red staining were performed for histopathological assessment.

RESULTS

After BaBiF5@PDA@HA nanoparticles were injected , the CT value of liver was significantly greater ($P < .0001$) in experimental group than in sham group from10 minutes to 80 minutes. The maximal difference of the liver CT value between two groups was observed 30 minutes after the injection (88.33±11.00 HU vs 47.78±3.53 HU), as a result of accumulation of BaBiF5@PDA@HA in the fibrosis zone of experimental group. Moreover, in the experimental group ,the spectral HU curve of liver analyzed at post-30 minutes indicated that the CT value of liver increased as the monochromatic energy level decreased. Such a characteristic of X-ray attenuation endowed BaBiF5@PDA@HA with comparatively potential for liver fibrosis diagnosis, in lower monochromatic energy images. Thus, monochromatic energy level at 40 keV increased detection sensitivity by revealing highest CT value (130.67±13.96 HU). Additionally, the area of liver fibrosis was more visible and closer to pathological results on 40keV monochromatic images.

CONCLUSION

BaBiF5@PDA@HA nanoparticles, as GSCT contrast agents, were successfully used to detect liver fibrosis.

CLINICAL RELEVANCE/APPLICATION

GSCT employing targeted bismuth-based nanoparticles may improve the early noninvasive diagnosis of liver fibrosis.

SSG07-02 Stem Cell Labeling and Tracking Using Mechanoporation

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S505AB

Participants
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PURPOSE

Until now, the only ways of labeling adipose fat derived stem cells (ADSC) for in vivo imaging have required manipulation of the cells in the laboratory. In a clinical setting, ADSC are harvested and transplanted within one surgery. To provide instant iron labeling, we tested the ability of a new microfluidic device to label ADSC with ferumoxytol nanoparticles within 15 minutes or less such that the labeled cells can be detected with magnetic resonance imaging (MRI) and magnetic particle imaging (MPI).

METHOD AND MATERIALS

Studies were performed with a custom-designed microfluidic device, which contains ridges to compress ADSC during their device passage. Cell relaxation after compression leads to cell volume exchange for convective transfer of nanoparticles and nanoparticle uptake into the cell. ADSCs were passed through our ferumoxytol-doped microfluidic device and the cellular iron uptake was evaluated by DAB-Prussian blue, fluorescent microscopy, and inductively coupled plasma spectrometry (ICP). To evaluate the effect of mechanoporation on MR signal, labeled and unlabeled ADSCs were imaged in vitro as well as ex vivo in pig knee specimen by MRI and MPI. T2 relaxation times and iron concentrations calculated by MPI were compared between labeled and unlabeled cell transplants using Student T-test with $p<0.05$.

RESULTS

DAB-Prussian blue, flourescent microscopy, and flowcytometry analysis demonstrated labeling efficiency of more than 95% of the ADSCs. ICP results showed iron uptake of more than one pg per cell in the labeling group. Ferumoxytol labeled ADSCs revealed significantly shorter T2 relaxation times (24.2±2.1 ms) compared to unlabeled cells (79.5±0.8 ms) on MRI ($p<0.05$). After implantation of the ADSCs into pig knee, labeled implants demonstrated significantly higher iron concentration (1.13±0.07 ug) compared to unlabeled cells (0.008±0.003 ug) on MPI and significantly shorter T2 relaxation times (33±6.2 ms) compared to unlabeled group (102.7±5.9 ms) ($p<0.05$).

CONCLUSION

Mechanoporation provided instant ferumoxytol labeling of ADSC within 15 minutes or less such that the labeled cells can be detected with MRI and MPI.

CLINICAL RELEVANCE/APPLICATION

Mechanoporation represents a new, fast, and readily clinically translatable method for labeling therapeutic cells with ferumoxytol. This facilitates iron labeling approaches for in vivo tracking of therapeutic cells with MRI and MPI.

SSG07-03 Ultrasmall Hybrid Protein-Copper Sulfide Nanoparticles Targeting Photoacoustic Image with a High Signal-to-Noise Ratio for Orthotopic Hepatocellular Carcinoma

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S505AB

Participants
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PURPOSE

Although photoacoustic imaging combined with second near infrared (NIR II) molecular probes for tumor diagnosis has drawn tremendous attention during the past few decades, the targeted photoacoustic imaging of orthotopic hepatocellular carcinoma (O-HCC) still remains a challenge due to high liver vascularization and non-specificity of probes in liver tumors.

METHOD AND MATERIALS

We report on cyclic arginine-glycine-aspartic acid (cRGD) peptide conjugated ultrasmall CuS@BSA-RGD NPs which encapsulate bovine serum albumin (BSA) and possess high optical absorption at 1064 nm. The encapsulation of BSA results in great biocompatibility of the NPs along with excellent photostability and physiological stability. The cRGD conjugation enables the improvement of tumor uptake of the NPs by virtue of its positive tumor cell targeting capability.

RESULTS

Ultrasmall CuS@BSA-RGD NPs were successfully synthesized for the photoacoustic imaging of targeted O-HCC. The NPs exhibited strong absorbance in the NIR II wavelengths. photoacoustic imaging in deep tissue areas with a lower background was achieved because the biological tissues show low optical absorption and photon scattering at the NIR II window, The efficient accumulation of the NPs in the tumor over time after intravenous administration to O-HCC bearing mice was achieved, which resulted in highly sensitive photoacoustic visualization. the active tumor targeting capability of the NPs enables them to accumulate significantly in the tumor region. and the O-HCC region showed significantly enhanced photoacoustic signals (consequently much higher SNR) compared to that of the normal liver tissue. in addition, the NPs were non-toxic both in vitro and in vivo.

CONCLUSION

The first time validation of the CuS@BSA-RGD NPs for targeting photoacoustic imaging of the O-HCC model revealed its great potential for highly sensitive and accurate HCC detection in future translational medicine.

CLINICAL RELEVANCE/APPLICATION

A targeted, highly effective and safe photoacoustic imaging were constructed by using the advantages of (NIR II). the team studied the CuS-NPs and image noise reduction,cutting and despecking , Research aim to explore theperforming fusion molecular imaging and promote deep cancer integrating diagnosis, targeted hybrid protein-CuS NPs which are for the first time, applied for photoacoustic imaging of O-HCC with a high signal-to-noise ratio, has important clinical prospects and significance.

SSG07-04 Near-Infrared Fluorescence Labeled Anti-PD-L1-mAb For Tumor Imaging in Human Colorectal Cancer Xenografted Mice

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S505AB

Participants
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PURPOSE

Our objective of this study was to develop a non-invasive imaging technique to monitor the dynamic changes in PD-L1 expression in CRC tumor.

METHOD AND MATERIALS

The expression levels of PD-L1 in different CRC cell lines in vitro (SW620, SW480 and HCT8) were detected by FACS analysis and Western blot assay. Subsequently, we labeled an anti-PD-L1 monoclonal antibody with near-infrared (NIR) dye and tested the ability of the NIR-PD-L1-mAb probe to monitor PD-L1 expression in CRC-xenografted mice by performing optical imaging. Finally, based on the best time of in vivo imaging, different freshly dissected tissues were quantified by optical imaging for bio-distribution study.

RESULTS

The final protein concentration of NIR-PD-L1-mAb was 47.9 μg/ml and the dye/protein ratio was 1.954. SW620, SW480 and HCT8 cell lines showed positive expression of PD-L1, the expression level of PD-L1 in SW620 cells was significantly higher as compared to SW480 or HCT8 cell cells. Our in vivo imaging showed the highest fluorescence signal of the xenografted tumors in mice bearing SW620 CRC cells, followed by tumors derived from SW480 and HCT8 cell lines. We detected the highest fluorescent intensity of the tumor at 120 hours after injection of NIR-PD-L1-mAb. The highest fluorescence intensity was seen in the tumor, followed by the spleen and the liver in SW620 xenografted mice. In SW480 and HCT8 xenografted mice, however, the highest fluorescent signals were detected in the spleen, followed by the liver and the tumor.

CONCLUSION

Our findings indicate that SW620 cells express a higher level of PD-L1 among those three types of CRC cells, and the NIR-PD-L1-mAb binding to PD-L1 on the surface of CRC cells was specific. The technique was safe and could provide valuable information on PD-L1 expression of the tumor for development of therapeutic strategy of personized targeted immunotherapies as well as treatment response of CRC patients.

CLINICAL RELEVANCE/APPLICATION

The technique was safe and could provide valuable information on PD-L1 expression of the tumor for development of therapeutic strategy of personized targeted immunotherapies as well as treatment response of CRC patients.

SSG07-05 The Accumulation of Tumor-Derived Exosomes Can be Visualized by Molecular Imaging and Leads to Changes in the Immune Cell Composition in Target Sites of Metastasis

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S505AB

Participants
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PURPOSE

Exosomes, small vesicles carrying inter alia proteins, miRNA and RNA, are important mediators in intercellular communication. We assessed the in vivo biodistribution of exosomes from highly malignant breast cancer cells in comparison to exosomes from the serum of healthy mice, and their effect on the immune cell infiltrate in target organs of metastasis using molecular imaging.

METHOD AND MATERIALS

Exosomes were isolated from the tissue culture supernatant of highly malignant 4T1 breast cancer cells or the serum of healthy BALB/c mice using a protocol comprising size-exclusion chromatography and ultracentrifugation. The purity of the isolate was checked by electron microscopy and western blotting. After labeling with the fluorescent dye DiR (750/780 nm), exosomes were injected i.v. into healthy BALB/c mice and their distribution was assessed using fluorescence-reflectance imaging (FRI). After ex vivo imaging of the organs, lungs and spleen were stained for FACS analysis of granulocytes, T- and B-cells to identify changes in the immune cell content.

RESULTS

The assessment of the in vivo distribution of DiR-labeled exosomes with FRI showed exosomes from highly malignant 4T1 cells, in comparison to exosomes from the serum of healthy BALB/c mice, to preferentially accumulate in the target organs of metastasis, in this case lung, liver and spine (tumor-exosomes vs. serum-exosomes: lung 18.6 vs. 10.4, $p=0.01$; liver 72.2 vs. 56.5, $p=0.02$; spine 5.1 vs. 3.5, $p<0.01$). Furthermore, flow cytometry analysis of the immune cell composition revealed an increase of cytotoxic CD8+ T-cells and a decrease of CD4+ T-helper cells in the lung. Also, we observed an increase in macrophages and a trend towards a decrease in monocytes.

CONCLUSION

Exosome accumulation changes the immune cell composition in target-organs of metastasis and can be visualized by FRI.

CLINICAL RELEVANCE/APPLICATION

In vivo imaging allows to track labeled tumor-derived exosomes, providing information about their role in the metastatic spread of solid tumors.

SSG07-06 Evaluation of the Efficacy of Superparamagnetic Iron Oxide-Labeled Bone Marrow Mesenchymal Stem Cells in the Treatment of Acute Myocardial Infarction in Rats by 7.0T MRI

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S505AB

Participants
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PURPOSE

To evaluated the efficacy of bone marrow mesenchymal stem cells (BMSCs) in the treatment of acute myocardial infarction (AMI) in rats by 7.0T MRI.

METHOD AND MATERIALS

20 male SD rats were randomized into experiment group (n = 7) and normal control group (n = 7). Rats were anesthetized with chloral hydrate (0.3ml/100g). Opened the rats' chest and ligated the left anterior descending coronary artery to modeled AMI. 25μg/ml Superparamagnetic Iron Oxide combined with 0.75μg/ml L-poly-lysine labeled BMSCs 48h, then BMSCs were collected and directly injected into the infarcted area. MRI scans were performed on D1 and D14 after modeling. Left ventricular ejection fraction (LVEF) and other cardiac function indexes, myocardial strain, the morphological changes of the infarcted area and the signal of infarcted area were used CVI42 software to analysis, then objectively evaluated the therapeutic effect of BMSCs on AMI.

RESULTS

The signal intensity of SPIO-labeled area in experimental group was significantly lower than control group and muscle (P<0.001). The values of end diastolic volume (EDV), end systolic volume (ESV), LVEF, peak strain radial (PSR) and peak strain circumferential (PSC) on D1 were 0.35 ± 0.12ml, 0.19 ± 0.09ml, 0.46 ± 0.08, 54.93 ± 15.83 and 24.50 ± 3.82 respectively in control group and were 0.38 ± 0.13ml, 0.21 ± 0.06ml, 0.46 ± 0.05, 59.16 ± 12.23 and 26.24 ± 2.51 respectively in experiment group. Left ventricular wall thickness on D14 was significantly thinner than D1, and the values of EDV, ESV, LVEF, PSR and PSC on D14 became to 0.7 ± 0.22ml, 0.46 ± 0.18ml, 0.35 ± 0.11, 38.84±15.84 and 20.24 ± 6.43 respectively in control group and were 0.54 ± 0.12ml, 0.33 ± 0.07ml, 0.38 ± 0.05, 65.48 ± 14.35 and 27.21 ± 2.06 respectively in experiment group. The EDV, ESV and LVEF on the D1 and D14 of the control group were no significantly different from the experimental group (P>0.05). There was no significant difference in PSR and PSC between the experimental group and the control group on D1 (P>0.05), but PSR and PSC on D14 of the control group were significantly lower than the experimental group (P<0.05).

CONCLUSION

BMSCs have no significantly improvement in EDV, ESV and LVEF in the treatment of AMI, but delay the myocardial strain impairment. MRI can be used to evaluate the effect of SPIO-labeled BMSCs transplanted into AMI.

CLINICAL RELEVANCE/APPLICATION

MRI can be used to evaluate the effect of SPIO-labeled BMSCs transplanted into AMI.

SSG07-07 Construction of Pepstatin A-Conjugated Ultrasmall SPIONs for Targeted Positive MR Imaging of Epilepsy-Overexpressed P-glycoprotein

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S505AB

Participants
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Daoying Geng, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To develop the ultrasmall superparamagnetic iron oxide nanoparticles (USPIONs) for the highly sensitive T1-wighted MR imaging of the epileptogenic region by the positively enhanced T1 effect.

METHOD AND MATERIALS

A peptide-targeted nanoprobe, based on ultrasmall superparamagnetic iron oxide nanoparticles (USPIONs), PA-USPIONs, was elaborately constructed to enable highly selective delivery and sensitive T1-weighted positive magnetic resonance (MR) imaging of the epileptogenic region. Especially, Pepstatin A (PA), a small peptide which can specifically target to P-glycoprotein (P-gp) overexpressed at the epileptogenic region in a kainic acid (KA)-induced mice model of seizures, was conjugated onto the surface of PEGylated USPIONs. The in vitro/vivo relaxivity of PA-USPIONs nanoprobes was conducted on a 3.0 T clinical MRI scanner at room temperature. Both of the in vitro/vivo biosafety evaluation of PA-USPIONs nanoprobes have been studied.

RESULTS

The as-constructed PA-USPIONs nanoprobes have favorable T1 contrast enhancement and high r1 relaxivity compared with the clinically used T1-MR contrast agent (Gd-DTPA) by systematic in vitro and vivo assessments. Importantly, the toxicity evaluation, especially to brains, was assessed by the histological as well as hematological examinations, demonstrating that the fabricated PA-USPIONs nanoprobes are featured with excellent biocompatibility, guaranteeing the further potential clinical application.

CONCLUSION

In this work, a highly targeted positive MR contrast agent based on USPIONs by surface modification with PEG, followed by conjugation with Pepstatin A, PA-USPIONs, has been successfully constructed for sensitive and precise molecular T1-weighted MR imaging of the epileptogenic region that holds the high potential for precise resection of the according lesion in order to achieve therapeutic, often curative purposes.

CLINICAL RELEVANCE/APPLICATION

N/A

SSG07-08 Gene Reporter Technique Visualizing Cellular Gene Expression Based on MRI

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S505AB

Participants
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PURPOSE

The recent innovations in biology provides with new potential therapeutic strategies in medicine such as gene therapy and stem cell therapy. The purpose of this study was to develop a gene reporter technique for visualizing cellular gene expression using gadoxetic acid enhanced MRI.

METHOD AND MATERIALS

We used a plasmid form human organic anion transporting protein (human OATP) 1B3 cDNA attached to CMV promoter (pCMV-hOATP1B3) to induce ectopic OATP expression in target cells. For comparison we used a blank plasmid with CMV promoter (pCMV-blank). HEK 293 cells (which are non-hepatocyte origin) were transfected with these DNAs. Western blot and confocal microscopy exam were performed to measure OATP protein expression. The cells were in vitro co-cultured at various concentrations of gadoxetic acid for 24 hours. We made a cell phantom and obtained T1, T2 weighted images and performed T1 and T2 mapping with 9.4T MRI. We also performed MRI of the xenograft tumor (pCMV-hOATP1B3 and pCMV-blank HEK 293) bearing nude mice before and after intravenously injecting gadoxetic acid (1.2ul/g).

RESULTS

Western blot and confocal microscopy after OATP1B3 immunofluorescence staining revealed that pCMV-hOATP1B3 transfected HEK 293 cells produced abundant OATP1B3 proteins which were localized on cell membrane. MRI of cell phantom showed that only the pCMV-OATP1B3 transfected cells could generate T1 contrast enhancement, which effect was strongest when the gadoxetic acid co-culture concentration was 1.2ul/ml. MRI of mice revealed that pCMV-OATP1B3 transfected HEK 293 xenografts but not pCMV-blank control xenografts showed contrast enhancement 15 minutes after gadoxetic acid enhancement which lasted up to 9 hours.

CONCLUSION

OATP1B3 gene can be genetically manipulated to induce OATP1B3 expression in target cells of non-hepatocyte origin and that these cells generate T1 contrast enhancement effect on gadoxetic acid enhanced MRI.

CLINICAL RELEVANCE/APPLICATION

OATP1B3 gene can be used as a MRI gene expression reporter, which implies it can be applied for non-hepatocyte target cell selective imaging and context-dependent imaging.

SSG07-09 Multimodality Molecular Imaging of Lung Disease Using PET, CT and Optical Imaging

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S505AB

Participants
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PURPOSE

Our long term goal is to develop novel therapies for lung diseases that involve pathologic permeability of the alveolar-capillary barrier. Exposure to toxins, commonly used drugs and even surgical intervention have the potential of causing abnormal epithelial permeability which is manifest as infiltrative processes on CT, including widespread infiltrates seen in acute respiratory distress syndrome (ARDS). However, anatomic changes do not quantitate the underlying disease, which does not allow real-time diagnosis of subacute disease, response to therapy or personalization of treatment regiments. Therefore, our objective in this work is to develop a translational quantifiable test of alveolar-capillary barrier integrity for the purpose of informing our drug discovery efforts.

METHOD AND MATERIALS

We used a published model of ARDS, which involved intranasal delivery of LPS. 72 hours post LPS delivery, we intravenously injected mice with Cy7- or 68-Gallium (68Ga) labeled mouse albumin. Two hours post tracer injection, we imaged mice using MILabs optical imaging (OI)/CT platform and an Inveon PET scanner. Images were scanned on a common bed and automatically coregistered. Lung counts were obtained and quantified for both PET and optical imaging.

RESULTS

We observed significantly increased lung activity of Cy7-albumin on OI at 72 hours after LPS injection, which correlated with the abnormal appearance on gated microCT as well as quantification of the Cy7-albumin in the bronchoalveolar lavage (BAL) fluid. In order to translate these findings, we radiolabeled albumin with 68Ga, a short half-life positron emitting radioisotope that is used in clinical PET scans. We found that 72 hours after lung injury, [68Ga]albumin PET correlated with our optical imaging findings and demonstrated abnormal activity in the lung fields, indicative of abnormal epithelial permeability.

CONCLUSION

[68Ga]albumin can be utilized as a translational radiotracer for quantifying the abnormal epithelial permeability that is the underlying cause of various lung pathologies, including ARDS. Furthermore, the ability to use Cy7-albumin optical imaging as a preclinical translational surrogate for [68Ga]albumin offers a high throughput means of rapidly screening potential therapeutics that aim to reverse the underlying disease process.

CLINICAL RELEVANCE/APPLICATION

[68Ga]albumin PET/CT can potentially be utilized as a biomarker for various lung pathologies, including ARDS

SSG08

Musculoskeletal (Machine Learning and Artificial Intelligence)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E451A

AI MK

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

FDA Discussions may include off-label uses.

Participants

Martin Torriani, MD, Boston, MA (*Moderator*) Nothing to Disclose
Jan Fritz, MD, Baltimore, MD (*Moderator*) Institutional research support, Siemens AG; Institutional research support, Johnson & Johnson; Institutional research support, Zimmer Biomet Holdings, Inc; Institutional research support, Microsoft Corporation; Institutional research support, BTG International Ltd; Scientific Advisor, Siemens AG; Scientific Advisor, General Electric Company; Scientific Advisor, BTG International Ltd; Speaker, Siemens AG; Patent agreement, Siemens AG

Sub-Events

SSG08-01 A Deep Learning System for Synthetic Knee MRI: Is Artificial Intelligence-Based Fat Suppressed Imaging Feasible?

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E451A

Participants
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PURPOSE

To determine the feasibility of using a deep learning system (DLS) to create synthetic artificial intelligence-based fat-suppressed MR images (AFMRI) of the knee, for the detection of internal derangement.

METHOD AND MATERIALS

A DLS modified CNN based U-Net was developed to create synthetic AFMRI from non-fat-suppressed (FS) images. The U-Net CNN used a training set from 3T-acquired high-resolution 3D volumetric sequences, a FS PD (n=5,568 images) and non-FS-PD (n=6,960 images) in 29 subjects. Three musculoskeletal radiologists reviewed the images in two sessions, the original (PD + FSPD) and the synthetic (PD + AFMRI) imaging, and recorded image quality (diagnostic, diagnostic with artifact, non-diagnostic). Readers recorded the presence or absence of meniscal, ligament and tendon tears, cartilage defects and bone marrow abnormalities (edema/fracture). Contrast-to-noise (CNR) measurements were made between subcutaneous fat, fluid, bone marrow, cartilage, and muscle. Reader interpretations and CNR measures made on synthetic images were compared to the gold standard (original).

RESULTS

Image quality of the AFMRI sequence was uniformly rated as diagnostic with artifact, whereas 96.5% (28/29) of original sequences were of diagnostic quality. Diagnostic performance of AFMRI (sensitivity/specificity) for the presence of tears was excellent for the medial meniscus (n=17/29) (94.4%/100%), lateral meniscus (n=5/29) (100%/100%), cruciate ligaments (n=3/29) (100%/100%), collateral ligaments (n=1/29)(100%/100%), and tendons (n=1/29, 100%/100%), respectively. For the detection of cartilage defects (n=76), AFMRI offered an overall sensitivity/specificity of 94.7%/85.5%; for the detection of bone marrow abnormalities (n=51), the overall sensitivity/specificity was 94.1%/83.1%. Correlation coefficients for CNR measurements between original and AFMRI sequences were excellent (all >0.95).

CONCLUSION

AFMRI offers excellent sensitivity for the detection of internal derangement of the knee, with moderate specificity for the assessment of cartilage and bone marrow abnormalities. Although image quality is reduced with AFMRI, this technique is feasible for diagnostic imaging.

CLINICAL RELEVANCE/APPLICATION

The development of deep learning synthetic AFMRI could obviate the need for acquiring separate FS fluid-sensitive sequences, thereby offering a novel technique for fast imaging of the knee.

SSG08-02 Machine Learning Predicts Rate of Cartilage Loss: Data from the Osteoarthritis Initiative

Tuesday, Dec. 3 10:40AM - 10:50AM Room: E451A

Participants
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PURPOSE

The rate of annual cartilage loss can vary widely between patients at risk or already suffering from knee osteoarthritis (OA), but the causes for these differences are still unknown. We investigate whether quantitative and semi-quantitative radiographic features can be used to predict the rate of Joint Space Width (JSW) loss.

METHOD AND MATERIALS

We collected bilateral knee radiographs, acquired in the context of the OAI study, from 4100 patients (2383 female, 1717 male). Over a period of 8 years, each patient had follow-up radiographs up to 7 times, separated by at least 12 months. Each radiograph was analyzed by software to obtain Kellgren-Lawrence (KL) and OARSI grades for osteophytes, sclerosis and joint space narrowing (JSN), as well as JSW measurements for each individual knee. Linear regressions of JSW were performed per individual knee compartment (medial or lateral) to estimate the rate of JSW loss. Individual knees with rate of JSW loss above 0.072 mm/year (the average yearly loss within JSN grade) were classified as progressors (956 knees). From these, knees in the top 10% of JSW loss rate were classified as fast progressors (91 knees). A logistic regression model was used to predict fast progressors with KL and OARSI grades at baseline as independent variables. Model performance was estimated using 10-fold cross-validation training/testing dataset splits and used area under the curve (AUC) as performance criteria.

RESULTS

The logistic regression classifiers achieved AUCs of 0.71 (SE 0.015) and 0.66 (SE 0.013) at classifying individual knees as fast progressors for medial and lateral compartments, respectively. Analysis of the individual coefficients of the classifiers reveals that JSN and sclerosis OARSI grades are the main predictors of rapid JSW decrease.

CONCLUSION

Our results show that it is possible to predict rapid cartilage loss from quantitative and semi-quantitative readings from a single plain radiograph. Interestingly, neither KL grade nor Osteophytes OARSI grade contributed greatly to this prediction. Instead, Sclerosis and JSN grade seem to be the major predictors of rapid cartilage loss, suggesting a non-canonical mode of OA progression.

CLINICAL RELEVANCE/APPLICATION

Prediction of rapid cartilage loss is an important but unresolved problem. Our work suggests that these patients can be detected from radiographic features.

SSG08-03 Knee Cartilage Segmentation Using Deep Convolutional Neural Networks for 3D Quantitative Ultrashort Echo Time MR Imaging

Tuesday, Dec. 3 10:50AM - 11:00AM Room: E451A

Participants
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PURPOSE

To develop a deep learning-based knee cartilage segmentation method for 3D quantitative ultrashort echo time (UTE) imaging and to automatically calculate UTE-MRI biomarkers including T1, adiabT1ρ, and T2*.

METHOD AND MATERIALS

61 human subjects (aged 20-88 years, 30 males, 31 females) were recruited for this study. The input MR images were acquired using 3D UTE-Cones sequences at 3T (GE MR750). The protocol included a 3D UTE-Cones actual flip angle imaging with variable flip angle (Cones-AFI-VFA) sequence for accurate T1 measurement, an adiabatic T1ρ-prepared UTE sequence for adiabT1ρ measurement, and a fat-suppressed multi-echo UTE sequence for T2* measurement. A radiologist with 18 years of experience manually segmented the knee cartilage based on the UTE adiabT1ρ-weighted MR images. Then, the 2D slices from the UTE adiabT1ρ images and the corresponding masks were input to the deep learning networks. U-Net architecture was adopted for the proposed knee cartilage segmentation, where attention layers were additionally employed as skip connections to improve the segmentation performance. Transfer learning was employed using the VGG 19 model. The dataset was divided into training, validation, and test sets with a 36/10/15 split. The U-Net was trained using the following parameters: Adam optimizer, weights

initialized using Xavier uniform initializer, batch size=32, learning rate=0.001, and momentum=0.9. The networks were trained in Tensorflow. For the test set, the binary masks from the radiologist and CNN were used as ROIs to calculate T1, adiabT1ρ, and T2* parameters, respectively.

RESULTS

Dice coefficient between the masks from the radiologist and CNN was 0.82±0.10. Fig1a shows representative 2D slices with the segmented cartilage regions. Fig1b shows scatterplots for the average T1, adiabT1ρ, T2* values with the manual and automatic segmentations, which show high correlation: 0.95 for T1, 0.88 for T1ρ, and 0.86 for T2*. Fig1c summarizes the estimated parameters.

CONCLUSION

The proposed framework for automatic knee cartilage segmentation achieved performance similar to that of the radiologist, demonstrating feasibility in automatically providing UTE-MR-based biomarkers.

CLINICAL RELEVANCE/APPLICATION

The proposed framework can be used for assessment of knee osteoarthritis.

SSG08-04 Automated Detection and Classification of Shoulder Arthroplasty Models Using Deep Learning

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E451A

Participants
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PURPOSE

Accurate identification of arthroplasty implant models is important for surgical planning and is a task which could be facilitated by deep learning. The purpose of this study was to develop and test the performance of deep convolutional neural networks (DCNNs) for automated identification and classification of shoulder arthroplasty (SA) models on radiographs.

METHOD AND MATERIALS

We collected a dataset of 156 AP shoulder radiographs with equal proportions of native shoulders and SA (equal proportions of total SA [TSA] and reverse TSA [RTSA]), and a dataset of 326 AP shoulder radiographs with 5 different TSA models: Biomet BioModular Choice (37), DePuy Global (125), DePuy HRP (63), Stryker Solar (51), and Zimmer Bigliani-Flatow (50). We trained ResNet DCNNs (pretrained on ImageNet) to 1) detect the presence of SA; 2) differentiate between TSA and RTSA; and 3) differentiate amongst the 5 TSA models. For each DCNN, the datasets were divided into training/validation/test splits of 70/10/20%; training and validation images were augmented up to 20x using crops, rotations, flips, and affine transformation. Receiver operating characteristic (ROC) curves were generated with area under the curve (AUC) calculated to assess test performance. Class activation mapping (CAM) was used to identify distinguishing imaging features used for DCNN classification decisions.

RESULTS

The DCNNs trained to detect SA and to distinguish between TSA and RTSA both achieved AUC of 1. In both cases, Heatmaps demonstrated appropriate emphasis of the arthroplasty components in decision-making (Figure 1A & B). The DCNNs trained to distinguish between the 5 TSA models achieved AUCs ranging from 0.94 for the Biomet Biomodular Choice TSA to 1 for the Zimmer Bigliani-Flatow TSA. Heatmaps for TSA model classifiers showed emphasis of unique features of TSA designs, such as the 3-holed lateral fin of the DePuy Global TSA (Figure 1C) and the 2-holed lateral fin of the Zimmer Bigliani-Flatow TSA (Figure 1D).

CONCLUSION

DCNNs can accurately identify presence of SA and distinguish between TSA & RTSA, as well as between 5 specific TSA models. The proof-of-concept of these DCNNs may set the foundation for an automated arthroplasty atlas for rapid model identification.

CLINICAL RELEVANCE/APPLICATION

Deep neural networks can accurately identify presence of shoulder arthroplasty and distinguish between specific models.

SSG08-05 Radiologist versus the Machine: Can a Machine Learning Algorithm Adequately Identify the Surgical Level in Patients Undergoing Lumbar Decompression

Tuesday, Dec. 3 11:10AM - 11:20AM Room: E451A

Participants
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PURPOSE

To determine if radiologists or a machine learning algorithm (MLA) can more accurately identify the surgical level for patients undergoing microdecompression.

METHOD AND MATERIALS

107 consecutive patients (mean age 65, range 28-89; 64 women, 43 men) with single level central lumbar microdecompression performed by one surgeon and lumbar MRI exams (< 1 year prior to surgery) were retrospectively evaluated. MRI reports by 29 faculty radiologists were reviewed for central canal stenosis (CCS) with the following grading: 1=normal, 2=mild, 3=moderate, 4=severe. Lateral recess stenosis and/or traversing nerve root displacement also was recorded. A MLA for automated evaluation of MRI exams (SpineNet; previously trained, validated, and tested with 12,078 disc levels from the Genodisc consortium; http://zeus.robots.ox.ac.uk/spinenet) was applied to sagittal T2-weighted images. At each level, the MLA provided CCS grades utilizing the same 1-4 scale. The radiologist report and MLA data were evaluated for their ability to predict the surgical level in a blinded fashion. Spearman correlation between the radiologist and MLA CCS grades was determined.

RESULTS

The worst lumbar level reported by radiologists matched the surgical level in 102/107 patients (95%), compared to 77/107 (72%) who had surgery at the level of greatest CCS determined by the MLA. Radiologist and MLA CCS grades correlated moderately ($r=0.53$, $p<0.001$). For each MLA CCS grade, the average radiologist CCS grade was as follows: MLA1 = 2.46, MLA2 = 3.13, MLA3 = 3.60, MLA4 = 3.81. The MLA yielded 24 normal CCS grades at the surgical level. Of these, the radiology report described lateral recess stenosis and/or nerve root displacement in 20/24 (83%), with variable CCS (severe in 3, moderate in 2, mild in 7, none in 1, grade not specified in 11).

CONCLUSION

This study highlights success with an automated approach to grade CCS using only sagittal images on most lumbar MRI exams, as compared to radiologist reports and eventual surgical level. However, the technology needs to be refined to incorporate axial images and lateral recess evaluation in order to match human interpretation.

CLINICAL RELEVANCE/APPLICATION

Automated approaches to MRI grading have the potential for improved patient care but need to be further augmented in order to match human interpretation.

SSG08-06 Prediction of Sarcopenia: Quantitative Evaluation of Skeletal Muscle Using Shear Wave Ultrasonographic Elastography by Radiomics and Deep Learning Convoluted Neural Network (CNN) Model Approach

Tuesday, Dec. 3 11:20AM - 11:30AM Room: E451A

Participants
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PURPOSE

To investigate if deep features extracted via transfer learning can generate radiomics signatures for prediction of sarcopenia in by investigating the B-mode ultrasonography (USG) and shear wave ultrasonographic elastography (SWE) on right rectus femoris muscle with their radiomic features to build the deep learning-based radiomics model.

METHOD AND MATERIALS

This study comprised a data set of 44 patients and an independent validation data set of 18 patients. A total of 62 USG and corresponding 62 USE images were included. Qualitative evaluation of muscle grade was performed by 4 grades: Grade 0, normal; Grade 1, some area of increased echogenicity; Grade 2, echogenic as perimysial fat; Grade 3, isoechoic to fat. For quantitative radiomic features, 43 radiomic features were extracted from all the images: 3 global features, 9 features from the Gray-Level Co-occurrence Matrix (GLCM), 13 features from the Gray-Level Run-Length Matrix (GLRLM), 13 features from the Gray-Level Size Zone Matrix (GLSZM), and 5 features from the Neighborhood Gray-Tone Difference Matrix (NGTDM). After feature selection, top 5 features were selected by using the least absolute shrinkage and selection operator (LASSO) Cox regression model. For deep learning-based CNN, we used a GoogleNet Inception v3 CNN architecture that was pre-trained on 1.28 million images. The top layer of the Inception v3 network was re-trained using ultrasonography images to produce a model for the classification of USG and USE images.

RESULTS

The muscle degeneration on USG and SWE showed significant negative correlation ($r=-.641$, $p<0.001$). Four radiomics features showed correlations: sum of average, variance, autocorrelation of GLCM features and high gray-level zone emphasis (HGZE) of GLDZM. The CNN classification of muscle grade showed 90.5% (n=19/21) in independent test set. The radiomics features associated with sarcopenia were gray-level nonuniformity (GLN) and HGZE of GLDZM. The diagnostic accuracy of CNN in detection of sarcopenia was 94.4% (n=17/18).

CONCLUSION

Deep learning-based CNN and radiomics can be utilized to classify the muscle degeneration and sarcopenia. This approach for muscle could be applied to determine sarcopenia, improving the patient care.

CLINICAL RELEVANCE/APPLICATION

Radiomics evaluation and deep-learning evaluation of USG and SWE improved the prediction of sarcopenia.

SSG08-07 Prediction of Cartilage Collagen and Proteoglycan Fractions Using Multiparametric Quantitative MRI and Machine Learning

Tuesday, Dec. 3 11:30AM - 11:40AM Room: E451A

Participants
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PURPOSE

In the early and possibly reversible stages of cartilage degeneration, the tissue remains structurally grossly intact while only slight changes in composition such as alterations in collagen (CO) and proteoglycan (PG) contents are present. This study aims at predicting the CO and PG fractions using quantitative MRI (qMRI) and sophisticated machine learning approach in efforts to non-invasively predict degeneration-related compositional features based on qMRI.

METHOD AND MATERIALS

11 histologically intact cartilage-bone samples were harvested from the medial femoral condyle and cut to 8 mm diameter were obtained after joint replacement. On a clinical 3T scanner (Achieva, Philips), T1, T1?, T2 and T2* maps were obtained at high resolution along the mid-sagittal plane (0.25x0.25 mm). Hereafter spatially resolved CO and PG fractions were determined using Fourier-Transform-Infrared Microspectrometry. An artificial neuronal network (ANN) and a multivariate linear model (MLM) were implemented and trained by leave-one-out cross validation to predict the CO and PG fractions in a voxel-wise manner. Predictive performance was assessed by calculating percentage deviations (PD) between modelled and measured contents.

RESULTS

The ANN performed better than the MLM (PD: 1.1% [PG-ANN], 11.9% [PG-MLM]), 0.3% [CO-ANN], 3.8% [CO-MLM]). Strong correlations (i.e. Pearson's correlation coefficients $r > 0.7$) between modelled and measured contents were found throughout, irrespective of the underlying model.

CONCLUSION

Trained properly, machine learning approaches are able to predict local CO and PG contents with high accuracy and precision and in a voxel-wise manner based on a multiparametric qMRI.

CLINICAL RELEVANCE/APPLICATION

Once modified for the clinical setting, machine learning approaches, in particular ANN, may be used to determine compositional features of cartilage based on qMRI parameters alone with potential implications for the diagnosis of (early) degeneration and for the monitoring of therapeutic outcomes.

SSG08-08 Performance of a Deep Learning-Based MR Reconstruction Algorithm for the Evaluation of Peripheral Nerves

Tuesday, Dec. 3 11:40AM - 11:50AM Room: E451A

Participants
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PURPOSE

To evaluate the clinical performance of a new deep learning-based MR prototype reconstruction method ('DLRecon') for evaluation of peripheral nerves.

METHOD AND MATERIALS

This was an IRB approved pilot study of 23 subjects (13F, mean age=49±16) undergoing routine clinical 3T MRI evaluation of neuropathy (MR750 GE Healthcare). Axial 2D intermediate weighted FSE sequences were acquired on each subject, and two sets of image series were reconstructed from the same raw dataset: standard of care MRI (SOC-MRI) using a conventional reconstruction method and DLRecon-MRI using a DLRecon method employing a convolutional neural network trained to reduce noise and ringing. All exams were anonymized, randomized, and scored by a blinded radiologist who evaluated: pulsation, aliasing, and bulk motion artifacts, fascicular architecture, and outer epineurium conspicuity (on a 4 point scale) as well as identification of DLRecon- vs SOC- MRIs. Agreement between DLRecon- and SOC- MRI grades were evaluated using ordinal weighted Gwet's agreement coefficients. Marginal ordinal logistic regression models analyzed grade differences between DLRecon- and SOC- MRIs.

RESULTS

Near perfect agreement (AC>0.81) was found between DLRecon- and SOC- MRIs for evaluation of pulsation artifact and outer epineurium conspicuity. Substantial agreement (AC>0.70) was found between the DLRecon- and SOC- MRIs for aliasing artifact, bulk motion, and fascicular architecture. With the exception of aliasing artifacts (OR=2; 95%CI: 1.3-3.1; p=0.002) no significant differences were found between DLRecon- and SOC- MRI outcome measure grades. Finally, the blinded radiologist's ability to correctly determine if an image set was DLRecon- vs SOC- MRI was 15%.

CONCLUSION

Results of the current pilot study suggest that DLRecon-MRIs perform comparably to SOC-MRIs for evaluation of peripheral nerves, preserving key anatomic details. DLRecon may provide clinically important information with visible noise reduction and image sharpening. In cases of peripheral neuropathy where SOC-MRIs had sufficient spatial resolution to detect the presence of pathology, associated DLRecon-MRIs demonstrated marked fascicular detail and architecture (FIG. 1).

CLINICAL RELEVANCE/APPLICATION

DLRecon-MRI provides statistically similar anatomic detail and artifacts compared to SOC-MRI for peripheral nerve evaluation, and may aid visualization of nerve fascicular detail and pathologic change.

SSG08-09 Rib Fracture Detection Algorithm in X-Ray Images Using Deep Learning

Tuesday, Dec. 3 11:50AM - 12:00PM Room: E451A

Participants
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PURPOSE

To develop an algorithm that mimics the exact way that radiologists look for rib fractures during conventional chest radiographic read.

METHOD AND MATERIALS

Our dataset includes 1200 unique patients each with frontal (AP or PA) x-ray image representing rib fracture(s). We asked 3 experienced radiologists to use a bounding box for annotating each fracture using labels such as: fracture age (acute (A), indeterminate (I), old (O)), and fracture displacement (large-(L), medium-(M), non-displaced(N)). The algorithm is comprised of two networks: 1) two-second glimpse, and 2) attention. Our rationale for using the glimpse model is due to radiologists rapid ability identifying the gist of fractures, often large-displacement, in several seconds. To this end, we used multiscale U-Net as detector followed by localization and verification models. If no fracture is found, then the attention model is deployed, consisting of multiscale patch generation and classification using ResNet model. This replicates when radiologists magnify images and track along each rib looking for any discontinuity or deformation. We trained and validated (80-20% split) our models using 2549 fractures (AL:253, AM:560, AN:454, IL:26, IM:157, IN:354, OL:43, OM:99, ON:603). A balanced dataset of 1000 patients with (n=893) and without fractures is used as test set.

RESULTS

The algorithm performed very well at the patient level, detecting fractures with specificity (SP), sensitivity (SEN) and area under ROC curve of 87%, 86%, and 92%, respectively. Fracture detection with large and medium displacement (SP=91%, SEN=87%) was better than non-displaced ones (SP=83%, SEN=81%). The performance was superior in detecting acute (SP=85%, SEN=83%) vs. non-acute (indeterminate+old) (SP=78%, SEN=77%) fractures. It also detected 39 fractures that had been missed during data (train+test) annotation process. There was a 1.1% improvement in detection but readers were told to focus more on identifying rib fractures in this enriched dataset with rib fractures. So, in general application, the improved detection we theorize would be higher.

CONCLUSION

We introduce a novel deep learning driven system on conventional chest radiographic images and achieved promising results.

CLINICAL RELEVANCE/APPLICATION

The proposed algorithm could assist radiologists in rib fractures detection during frontal conventional chest radiographic interpretation, and as a second reader to assess for missed fractures.

SSG09

Nuclear Medicine (Lymphoma PET)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S504CD

NM OI

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

Participants
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Sub-Events

SSG09-01 Impact of PET/CT on Clinical Management in Patients with Cancer of Unknown Primary

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S504CD

Participants
Christian P. Reinert, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the impact of PET/CT on clinical management decisions in patients with Cancer of Unknown Primary (CUP).

METHOD AND MATERIALS

A cohort of patients with CUP undergoing clinically indicated PET/CT was prospectively enrolled in a local PET/CT registry study between 01/2013 to 06/2018. Questionnaire data from referring physicians on intended patient management before and after PET/CT were recorded. The questionnaire included items on PET/CT indication (primary staging, re-staging, lesion characterization), intended diagnostic procedures (biopsy, additional imaging), and intended treatment concept (no treatment plan, curative treatment, palliative treatment, watchful waiting). Changes in management before and after PET/CT were analyzed. Patient outcome was measured as overall survival from initial diagnosis and drawn from available patient records.

RESULTS

155 patients (53 female; 63.4±12.1y) with CUP were included. PET/CT detected the primary in 36 patients (23.7%). Intended treatment concepts were changed in 74 patients (47.7%) on the basis of PET/CT results. The treatment plan changed from 'curative' or 'no treatment plan' before PET/CT to 'palliative' in 28 patients (18.1%) and from 'no treatment plan' to a 'curative' concept in 15 patients (9.7%). Minor therapy adjustments without change of treatment goal were documented in 30 patients (19.4%). Additional invasive procedures and imaging (CT, MRI) were intended in 40 (25.8%) and 98 (63.2%) patients before PET/CT and in 21 (13.5%) and 10 (6.5%) patients after PET/CT. Overall patient survival was significantly longer in patients with one CUP manifestation (4.6±0.4y) compared to patients with 2-3 (2.8±0.4y) or more than 3 manifestations (2.4±.4y)(p=.001). Patients with cervical CUP manifestations showed a significantly longer survival (4.3±0.3y) than patients with extracervical manifestations (3.5±0.5y)(p=.01), as well as patients with intended curative (4.0±3.6y) compared to palliative treatment (2.7±0.6y) after PET/CT (p=.001).

CONCLUSION

PET/CT significantly influences clinical management in patients with CUP. It helps referring physicians to select a more appropriate and individualized treatment and to avoid unnecessary additional diagnostics.

CLINICAL RELEVANCE/APPLICATION

PET/CT has a high impact on clinical management of CUP patients due to its potential as a method for detection of the primary and distant metastases that directly influences overall patient survival.

SSG09-03 Characterization of Interim Residual Lymphoma Masses Using Diffusion-Weighted MRI with Apparent Diffusion Coefficient Mapping: FDG-PET as the Reference Standard

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S504CD

Participants
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PURPOSE

To assess the value of diffusion-weighted MRI in characterizing residual lymphoma masses early during first-line chemotherapy, compared with FDG-PET as the reference standard.

METHOD AND MATERIALS

Our two-nation and two-institutional prospective study included 133 patients with bulky disease (at least one mass >7cm in diameter) at diagnosis. Whole-body diffusion-weighted MRI at 3.0-T (b = 50, 400, 800 sec/mm2) and FDG-PET/CT were performed within a week from each other, or simultaneously using FDG-PET/MRI in the later patients, before initiation in all and after 2 chemotherapy cycles (interim) in 126 patients. Volume-of-interest encompassing the entire bulky mass before and after treatment was drawn semi-automatically to obtain the mean apparent diffusion coefficient values (ADCmean). The 2014 Lugano classification was used for PET response interpretation and a Deauville score of 4 or 5 was considered positive.

RESULTS

There were 64 diffuse large B-cell (DLBCL), 45 Hodgkin (HL) and 24 follicular (FL) lymphoma patients with a total 157 bulky masses at diagnosis. Before treatment, ADCmean of these masses was 1.071 ± 0.352 x10-3 mm2/sec (range, 0.415-2.400). They were all FDG-avid with a maximum SUV of 17.0 ± 8.1 (range, 4.0-43.3). ADCmean values were comparable between two institutions for each histology subtype (P = .621-.769). Among three lymphoma subtypes, HL (52 masses) had significantly higher ADCmean values than either DLBCL (75 masses) or FL (30 masses), 1.321 v. 0.976 or 0.873 x10-3 mm2/sec, respectively (P < .0001), while only marginal difference was found between DLBCL and FL (P = .048). At interim, ADCmean values were lower in PET-positive (poor response, 50 masses) than in PET-negative (good response, 100 masses) residual masses, 1.442 ± 0.486 v. 1.865 ± 0.559 x10-3 mm2/sec (P < .0001).

CONCLUSION

Diffusion-weighted MRI with ADC mapping demonstrated in lymphoma patients with bulky disease at diagnosis different features between HL and the other two major histology subtypes. In addition, interim residual masses with good response on FDG-PET showed higher ADCmean values than those with poor response (NCT02300402).

CLINICAL RELEVANCE/APPLICATION

Diffusion-weighted MRI with ADC mapping seems useful in characterizing residual masses in lymphomas, by providing quantitative information of lesion cellularity.

SSG09-04 Comparison of FDG PET/CT-Guided Percutaneous Metabolic Bone Marrow Biopsy and Conventional Trephine Bone Marrow Biopsy for the Assessment of Lymphomatous Bone Marrow Infiltration in Newly Diagnosed Lymphoma

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S504CD

Participants
Rajender Kumar, MBBS, Chandigarh, India (*Presenter*) Nothing to Disclose
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PURPOSE

To compare the diagnostic-values of PET/CT-guided targeted metabolic bone marrow (BM) biopsy and trephine bone marrow-biopsy (TBMB) to assess lymphomatous infiltration in newly diagnosed lymphoma.

METHOD AND MATERIALS

Newly diagnosed patients of lymphoma were recruited for FDG PET/CT. FDG uptake in the marrow was classified as focal, multifocal, diffuse and negative and PET/CT guided BM biopsy was done from focal or multifocal marrow lesion. The PET-guided biopsies were done using a dedicated automated-robotic-arm assisted device on the same day of diagnostic PET/CT. The real-time tissue sample was retrieved after confirming the needle tip to the target lesion. All the patients underwent TBMB from bilateral posterior superior iliac spine as a routine staging work-up. The reference standard was histopathology results of the biopsies. The diagnostic values of PET/CT-guided BM-biopsy with TBMB was compared for assessment of BM infiltration. The PET/CT-guided procedure related complications and radiation exposure to the interventionist were also recorded.

RESULTS

From January 2017 to December 2018, 167 patients of lymphoma were recruited for baseline FDG PET/CT staging. The FDG uptake in bone marrow was classified as focal (n=8), multifocal (n=25), diffuse (n=32) and negative (n=102). Of these 33/167 patients underwent both, PET/CT guided targeted BM biopsies and TBMB. Of these 33 patients, PET-guided-biopsy revealed 30 true-positive (TP), no false-positive (FP), two true-negative (TN), and one false-negative (FN). The sensitivity, specificity, positive predictive values, NPV and accuracy of 96.7%, 100%, 100%, 66.7%, 96.9 % respectively. TBMB revealed TP-18, FN-12, FP-0 and TN-3 with sensitivity, specificity, positive predictive values, NPV and accuracy of 60.0%, 100%, 100%, 20%, 63.6% respectively. No procedure related complications were encountered in the present study. The estimated absorbed radiation dose was 566.7 μSv/year for the interventionist.

CONCLUSION

PET/CT-guided targeted BM biopsy has shown a higher diagnostic performance as compared to routine TBMB from iliac spine. It is highly practical and useful in characterization of focal FDG avid lesion and negates the false negative results.

CLINICAL RELEVANCE/APPLICATION

TBMB is established method for evaluation of BM involvement in lymphoma but only a fraction of the BM is sampled leading to a FN results. PET-guided targeted BM biopsy may reduce these FN findings.

SSG09-05 Radiomic Features of Glucose Metabolism Enable Prediction of Outcome in Mantle Cell Lymphoma

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S504CD

Participants
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PURPOSE

To determine whether, in mantle cell lymphoma (MCL), [18F]FDG-PET/CT-derived radiomic features are predictive of 2-year progression-free survival (PFS), alone or in combination with clinical, laboratory and biologic data, and whether they enable outcome prognostication.

METHOD AND MATERIALS

107 treatment-naïve MCL patients scheduled to receive CD20-antibody-based immuno(chemo)therapy were retrospectively included. Standardized uptake values (SUV), total lesion glycolysis, and 16 co-occurrence matrix radiomic texture features were extracted from metabolic tumor volumes on pre-therapeutic [18F]FDG-PET/CT. A multi-layer perceptron neural network in combination with logistic regression analyses for feature selection was used for 2-year PFS prediction. Outcome prediction was first performed for radiomic features alone, and then and in combination with ECOG, WBC, LDH, and Ki67 index. International prognostic indices (MIPI and MIPI-b) were calculated, and combined with radiomic data (MIPI-m, MIPI-bm). Kaplan-Meier estimates with log-rank tests were used for PFS prognostication.

RESULTS

SUVmean (odds ratio OR, 1.272; P=0.013) and Entropy (heterogeneity of glucose metabolism; OR, 1.131; P=0.027) were significantly predictive of 2-year PFS: median areas-under-the-curve were 0.72 based on the two radiomic features alone, and 0.82 with addition of ECOG, WBC, LDH, and Ki67. Higher SUVmean in combination with higher Entropy, reflecting high 'metabolic risk', was associated with a poorer prognosis (median PFS, 20.3 vs. 39.4 months; hazard ratio HR, 2.285; P=0.005). Best PFS prognostication was achieved with the MIPI-bm (i.e., combination of MIPI-b and metabolic risk): median PFS was 43.2 months in the low risk group; 38.2 months in the intermediate risk group; and 20.3 months in the high risk group (P=0.005).

CONCLUSION

In MCL, [18F]FDG-PET/CT-derived radiomic features SUVmean and Entropy may improve 2-year PFS prediction and PFS prognostication. Best results may be achieved by a combination of metabolic, clinical, laboratory and biologic data.

CLINICAL RELEVANCE/APPLICATION

Radiomic features extracted from pre-therapeutic [18F]FDG-PET/CT may improve outcome prognistication in mantle cell lymphoma patients, and may therefore be useful for risk stratification and treatment decisions. Radiomic features could be easily integrated into an artificial intelligence-based outcome prediction model together with clinical, laboratory and biological data.

SSG09-06 The Potential Value and Pitfalls of Radiomics for Clinical Positron Emission Tomography (PET) in DLBCL: Results from the Phase 3 GOYA Study

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S504CD

Participants
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Paul E. Kinahan, PhD, Seattle, WA (*Presenter*) Research Grant, General Electric Company Co-founder, PET/X LLC

PURPOSE

We are using the large multi-center (207 sites) phase 3 GOYA study to investigate using quantitative image texture features (ITFs, i.e. 'radiomics') to improve the prognostic value of the FDG-PET baseline exams in patients with previously untreated diffuse large

B-cell lymphoma (DLBCL). Here we evaluate the robustness of ITFs in clinical practice.

METHOD AND MATERIALS

Images with regions of interest (ROIs) defined by qualified physicians were transferred to the imaging core laboratory. Analysis was performed on the original images and after interpolation to common voxel sizes of 2, 4, 5, 10mm. ITFs were computed using the open-source 'PET oncology radiomics test suite (PORTS). The stability of standard metrics (SUV-mean, SUV-max, MTV, TLG), SUV histogram metrics (variance, skewness and kurtosis), and ITFs were analyzed as a function of image voxel size. Supervised machine learning models (SVM, LDA, KNN, GBRM, RF) were applied to a training set (80% of patients) to differentiate the lesion from an ROI in liver. Diagnostic accuracy was calculated on the test set (20% of patients).

RESULTS

FDG-PET images came from a variety of PET/CT scanners; thus, a unified image reconstruction protocol was not possible. Using a threshold of > 5ml, a total of 1085 radiomics-evaluable patients with 9307 lesions were analyzed. Standard SUV and histogram metrics were stable w.r.t. to image voxel size. There was a substantial variation in the distribution of many of the ITFs w.r.t. to image voxel size. Eight of the ITFs were stable w.r.t. to image voxel size, in particular GTSDM Autocorrelation, and GLZSM High Gray-Level Zone Emphasis. While the rest of the ITFs were not stable, several were stable except for the 2 or 10 mm voxels (e.g. GTSDM Sum Entropy). The stable metrics were able to differentiate liver from lesions with a diagnostic accuracy for all ML models ranging from 0.995 to 0.999.

CONCLUSION

While radiomics signatures can potentially increase the prognostic value of risk prediction of DLBCL patients at baseline, the impact of variable voxel size inherent to clinical imaging, and the distributed nature DLBCL disease visualized by PET, imply caution in interpretation by image texture analysis.

CLINICAL RELEVANCE/APPLICATION

The impact of variable voxel size inherent due to variations inherent in clinical imaging, and the distributed nature DLBCL disease visualized by PET, imply caution in interpretation by image texture analysis.

SSG09-07 Is Inappropriate Imaging Really the Culprit? An Analysis and Comparison of Published PET/CT Guidelines

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S504CD

Participants
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PURPOSE

Inappropriate imaging strains patients and the health system. Several Positron Emission Tomography/Computed Tomography (PET/CT) imaging guidelines have been proposed with varying formats. Our purpose was to examine the current rates of inappropriate imaging and guideline coverage using several national guidelines to evaluate PET/CT imaging in Canada.

METHOD AND MATERIALS

Academic PET/CT centers across Canada were surveyed and asked to provide exam requests from a consecutive 7-day period. Four sets of guidelines were used to analyze the appropriateness of the exam requisitions by the author and verified by a senior radiologist: the Canadian Association of Radiologists (CAR) Referral Guidelines, the American College of Radiologists (ACR) Appropriateness Criteria, the National Cancer Care Network (NCCN) Practice Guidelines and the Institut National d'Excellence en Santé et Services Sociaux (INESSS) Interactive Tool.

RESULTS

In total, 521 exam requisitions were received from 8 PET/CT centers across Canada with most (435, representing 83%) submitted for oncological investigations, 36 (7%) for neurological conditions, 26 (5%) to investigate infectious/inflammatory processes, and the remaining 24 (5%) for various reasons. The guidelines indicated that 14-31 (3-7%) of the oncological cases were inappropriate, 123-301 (29-69%) were appropriate, and the remaining 118-299 (27-69%) were indeterminate. Among neurological exams, 0-1 (0-3%) were inappropriate, 0-29 (0-81%) were appropriate and 0-36 (0-100%) were deemed indeterminate. Of the infection/Inflammation requests, 0-1 (0-4%) were inappropriate, 0-14 (0-56%) were appropriate, and 11-25 (44-100%) were indeterminate.

CONCLUSION

While the rate of inappropriateness was similar across guidelines, the proportions deemed appropriate and indeterminate varied substantially. These results demonstrate that in addition to the existence of guidelines, further education for referring physicians, as well as development of consensus, integrated guideline assistance and override justification could prove useful.

CLINICAL RELEVANCE/APPLICATION

Insufficient information on requests and lack of guidelines are much more prevalent than inappropriate imaging, further review of PET/CT guideline utility is required.

SSG09-08 Is it Time to Reduce FDG PET Dose to 5 mCi? Findings from an NCI Quick Trial NCT03519659

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S504CD

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PURPOSE

FDG PET imaging dosing in the US is based on two recommendations, the NCI workshop guidance (10 to 20 mCi FDG (Shankar et al.)) and the FDA packaging label for the production of FDG which allows dosing above 5 mCi. These recommendations have remained unchanged in spite of major PET technology developments. We performed a prospective clinical quick trial aimed to validate equivalency of 5 mCi, low dose FDG PET/CT compared to current standard of care (SOC) FDG PET/CT based on both true low dose and simulated low dose imaging.

METHOD AND MATERIALS

Low dose PET/CT imaging was assessed in 228 whole body PET studies exams, 50% true 5 mCi dosing, 50% simulated by reduced frame time of the SOC. As intraindividual comparison with two dose and scan sessions was not feasible, a matched pair distribution in BMI, gender, and age was accomplished within the desired time frame. All PET acquisitions were performed using time of flight 75 minutes post-injection using 90 seconds per bed position. A subpopulation of 97 patients were imaged on two TOF PET systems in direct succession. The low dose group had a dose of 4.9 mCi +/- 0.4, the matched SOC group 13.0 mCi +/- 0.8. Target lesion SUVmax and visual image quality evaluation were the primary assessment points. Secondary assessments include qualitative and quantitative image quality, uptake in other tissues, diagnostic confidence, and presence/visibility of artifacts. As established in prior studies, optimized image reconstruction was BMI adapted for the low dose data sets.

RESULTS

Assessment of image quality, diagnostic confidence, and image artifacts demonstrates equivalency ($p<.01$) for the dose reduced 5 mCi FDG for whole-body oncologic PET imaging. There was no loss of diagnostic capabilities, even when maintaining an acquisition time consistent with standard of care examinations. We have found that the key is the re-optimization of TOF reconstruction parameters to account for the reduced relative count density.

CONCLUSION

This trial demonstrates the ability to perform oncologic whole-body imaging at the low dose of 5 mCi with high quality and quantitatively equivalent by using TOF optimized, BMI adapted reconstruction at the lower count density without any negative diagnostic impact.

CLINICAL RELEVANCE/APPLICATION

We demonstrate that FDG dose reduction to 5 mCi is feasible in oncologic whole body TOF PET provided that an optimized, BMI adapted reconstruction approach is implemented.

SSG09-09 Accelerating Whole-Body PET Acquisitions Using Deep Learning: External Validation on Foreign Country Data

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S504CD

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PURPOSE

The goal of this study was to evaluate the use of deep learning to enhance the image quality of 2-fold, 3-fold, and 4-fold accelerated whole-body PET acquisitions.

METHOD AND MATERIALS

Seven subjects (5 males, age: 57±14 years, weight: 81±10Kgs) referred for a whole-body FDG-18 PET/CT scan on a GE Discovery 710 scanner (GE Healthcare, Waukesha, WI) were recruited for this study following IRB approval and informed consent. The standard of care was a 2 min/bed PET acquisition acquired in list-mode. 2-fold, 3-fold, and 4-fold accelerated acquisitions were synthesized using the first 30s, 40s, and 60s list-mode PET counts of the original 2min acquisition. All accelerated PET acquisitions were enhanced using a FDA-cleared commercially available deep learning software: SubtlePET (Subtle Medical, Menlo Park, CA). Quantitative image quality metrics such as normalized root-mean-squared-error (NRMSE), peak signal to noise ratio (PSNR), and structural similarity (SSIM) were calculated for all enhanced and non-enhanced accelerated PET scans, with the standard 2min acquisition as the ground-truth. Image slices in regions of elevated PET uptake (bladder and brain) were excluded from the analysis. Paired 2-tailed t-tests were computed to evaluate whether the quantitative metrics were superior for the deep-learning enhanced accelerated acquisitions compared to the non-enhanced acquisitions.

RESULTS

NRMSE, PSNR, and SSIM were significantly better ($p<0.001$) for all deep learning enhanced PET scans for all acceleration factors compared to the non-enhanced images (except 2-fold accelerated SSIM, $p<0.05$). All the deep learning enhanced images (2 to 4-fold) demonstrated similar perceptual image quality and lesion conspicuity when compared to standard of care scans. Representative PET images and quantitative metrics are seen in Figure 1.

CONCLUSION

Up to 4-fold faster PET scans can be enhanced using deep learning while maintaining similar image quality and diagnostic accuracy as the standard of care acquisition.

CLINICAL RELEVANCE/APPLICATION

Deep learning can enhance the speed of PET acquisitions for enhancing patient comfort and increasing efficiency and throughput of PET imaging, especially in resource constrained countries.

Printed on: 10/29/20

SSG10

Neuroradiology (Stroke 2)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: N229

ER MR NR

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

FDA Discussions may include off-label uses.

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Sub-Events

SSG10-01 Don't Be Cowed: Bovine Arch and Stroke Laterality

Tuesday, Dec. 3 10:30AM - 10:40AM Room: N229

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PURPOSE

Left-hemispheric strokes are more frequent and often have a worse outcome than their right-hemispheric counterparts. The present study aims to evaluate whether laterality of cardiogenic cerebral embolization is affected by anatomical characteristics of the aortic arch. We hypothesized that laterality varies between patients with a bovine versus standard arch branching.

METHOD AND MATERIALS

We retrospectively identified 1598 acute cardioembolic strokes in patients with atrial fibrillation from our institutional stroke database (2009-2017). Selecting the first event in each patient yielded 1459 infarcts. Inclusion criteria were an acute anterior circulation ischemic infarct and availability of both arch and brain imaging (MR or CT). Alternative causes of stroke (e.g. >50% intra/extracranial stenosis ipsilateral to the stroke, lacunar infarct, dissection) and anomalous arch were excluded. Imaging was reviewed for stroke characterization and laterality and arch branching pattern. Bovine arch denotes a common origin of the brachiocephalic trunk and the left common carotid artery. Strokes were classified as bilateral, left or right hemispheric. Univariate analysis was performed using Chi square tests.

RESULTS

The final cohort comprised 615 patients, mean age 77 (SD 11.8) with 376 women (61%). The majority were ethnic minorities (33% white, 30% black, remainder mixed/Hispanic). Standard arch (n=424) stroke distribution was left 43.6% (185), right 45.1% (191) and bilateral 11.3% (48). Bovine arch (n=191) stroke distribution was left 51.3% (98), right 35.6% (68) and bilateral 13.1% (25). Bovine arches were associated with more left sided strokes compared with standard arches (p=0.035). Of note, 43% of patients with bovine arch were black and there was an association between black race and bovine arch (p=0.0001).

CONCLUSION

Bovine aortic arch configuration is associated with left hemispheric laterality of cardioembolic stroke.

CLINICAL RELEVANCE/APPLICATION

Our study enriches the understanding that arch anatomy influences stroke laterality and highlights the need for further research into the causative hemodynamic factors.

SSG10-02 Reporting Quality and MR Technical Heterogeneity of Intracranial Vessel Wall MR Imaging: A Systematic Review of the Literature

Tuesday, Dec. 3 10:40AM - 10:50AM Room: N229

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PURPOSE

A systematic review of the literature was performed to identify studies using vessel wall MR imaging (VWI) to study intracranial vasculopathies. A qualitative synthesis of each study and an assessment of MR technical heterogeneity and reporting quality was conducted.

METHOD AND MATERIALS

PubMed, MEDLINE and EMBASE databases were searched up to September 2018 using inclusion/exclusion criteria for studies assessing intracranial vasculopathies with VWI. Two independent reviewers screened potential studies and extracted data. Foreign language articles were translated. The 22-point Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline was used to appraise reporting quality of analytic observational studies by calculating a Complete Reporting Score (CRS=yes/[yes+no]) for each study; criteria were scored as 'yes' if reporting was fulfilled. Scores of each manuscript section (introduction, methods, results, discussion) were also assessed. Inter-rater agreement was summarized by a Cohen's kappa (κ). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline was used.

RESULTS

Among 2431 articles, 79 met the inclusion criteria. Work was contributed most frequently from Asia (68%, n=54), received federal funding (62%, n=49), was retrospective (52%, n=42), and designed as analytic observational studies (51%, n=40). Intracranial atherosclerosis (ICAD) was the most commonly studied intracranial vasculopathy (52%, n=41). Considerable MR technical heterogeneity in magnet strength (range: 0.5T to 7T), spatial resolution (in-plane voxel size range: 0.11 to 1.27), and MR protocol was present with postcontrast imaging performed in 62% (n=49) of the exams. Among the 40 analytic observational studies, the overall mean STROBE CRS was 0.64 (range= 0.32-0.82); the introduction section had the strongest mean reporting score (CRSIntro=0.99) compared to the methods section, which emerged as the weakest (CRSMethods=0.53).

CONCLUSION

Assessment of the literature showed considerable MR technical heterogeneity in MR imaging methods. Among the analytic observational studies, the completeness of reporting based on STROBE guidelines, was variable.

CLINICAL RELEVANCE/APPLICATION

Reducing the heterogeneity of MR protocols in VWI studies and more consistent adherence to STROBE guidelines should maximize effective synthesis and clinical translation of findings for intracranial vasculopathies.

SSG10-03 Radiomic Analysis on Symptomatic Intracranial Atherosclerotic Plaque Using High Resolution MRI

Tuesday, Dec. 3 10:50AM - 11:00AM Room: N229

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PURPOSE

This study aims to evaluate a quantitative radiomic approach based on High-resolution magnetic resonance imaging (HR-MRI) to differentiate symptomatic intracranial artery plaque from asymptomatic plaque.

METHOD AND MATERIALS

This study retrospectively analyzed 158 patients with middle cerebral artery (MCA) and basilar artery (BA) stenosis underwent HR-MRI between September 2013 and October 2016. Atherosclerosis plaques from MCA and BA were extracted as the region of interest (ROI) for quantitative evaluation. The stenosis value, plaque area/burden, lumen area, intraplaque hemorrhage (IPH), contrast enhancement ratio and 109 quantitative radiomic features were extracted and compared between symptomatic and asymptomatic patients. Univariate analysis was applied first to find possible variable that was associated with symptoms. Student t-test or two-sample Wilcoxon test was used if the variable was/was not normally distributed. P-values <0.05 were considered as statistical significant. Multi-variate logistic analysis and a random forest model were used to evaluate the diagnostic performance.

RESULTS

A total of 158 patients met the inclusion criteria. There were 75 acute, 36 sub-acute symptomatic patients, and 47 asymptomatic patients. Smoking (odds ratio [OR]=2.724; 95%CI,1.200-6.183), IPH (OR=11.340; 95%CI, 1.441-89.221) and enhancement ratio (OR=6.865; 95%CI, 1.052-44.802) were independently associated with symptomatic plaques. The combined smoking, IPH and enhancement ratio had an area under the curve (AUC) of 0.714 for identifying symptomatic plaques. Radiomic features in T2, T1 and CE-T1 images were associated with symptomatic plaques , whose AUC respectively are 0.801,0.835 and 0.846. The combined all radiomic approach had a significantly higher AUC of 0.953. Combination of all features reached an AUC of 0.976, with accuracy of 87.4%. (Figure-1)

CONCLUSION

Radiomic analysis of intracranial artery plaque on HR-MRI accurately distinguished between plaques in patients who were symptomatic and plaques in patients who were asymptomatic. The highest accuracy was achieved by combining radiomic features with traditional assessment of clinical and morphological features.

CLINICAL RELEVANCE/APPLICATION

The favorable accuracy values in this study over those previously reported by conventional HR-MRI support the use of radiomic analysis to improve identification of acute symptomatic plaque.

SSG10-04 Arterial Transit Artefacts on ASL Perfusion-Weighted MRI in Patients with Carotid Artery Stenosis are a Better Predictor of Recent Symptoms than Degree of Stenosis or Carotid Plaque Morphology

Tuesday, Dec. 3 11:00AM - 11:10AM Room: N229

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PURPOSE

Using comprehensive advanced MR imaging at 3T, including carotid plaque imaging and ASL perfusion MR, we aim to identify parameters that best distinguish between asymptomatic and symptomatic carotid stenosis, and to gather new evidence regarding the mechanisms causing clinical symptoms.

METHOD AND MATERIALS

We recruited patients with ICA stenosis participating in ongoing trials, who had ASL and carotid plaque imaging in the same sitting. Patients were assessed clinically for recent symptoms of TIA or stroke. MR images were analysed for the degree of stenosis, plaque morphology, presence of intraplaque haemorrhage (IPH), collateral circulation of the circle of Willis, presence and severity of arterial transit artefacts (ATAs). We used t-test and Fisher's exact test to investigate which features were associated with symptomatic status.

RESULTS

44 patients met the inclusion criteria, 22 of these were symptomatic. ATAs were only seen in patients with a >70% stenosis (p for association <0.001), and were associated with the configuration of the circle of Willis (p=0.001), particularly the absence of anterior communicating artery (ACOM) (p=0.003). Associations between symptoms and degree of stenosis, IPH, and plaque surface morphology were non-significant. However, patients with ATAs (n=16) were significantly more likely to be symptomatic than those without ATAs (n=28) (p=0.004). Symptomatic status correlated further with the severity of ATAs (p=0.002).

CONCLUSION

ATA was the only predictor of recent ischaemic symptoms in patients with carotid stenosis.

CLINICAL RELEVANCE/APPLICATION

Haemodynamic factors play a greater role in the mechanism of TIA and stroke associated with carotid stenosis of >70% than currently appreciated.

SSG10-05 Susceptibility-Weighted Imaging in Hyperacute Phase of Ischemic Stroke

Tuesday, Dec. 3 11:10AM - 11:20AM Room: N229

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PURPOSE

Using a large animal experimental middle cerebral artery occlusion model, this work sought to determine if there was a significant change in the SWI signal intensity on regions of interest drawn in the penumbra and ischemic core based on perfusion and diffusion-weighted imaging.

METHOD AND MATERIALS

Eight mongrel canines (20-30kg) underwent permanent endovascular occlusion of an M1 segment of the middle cerebral artery (MCA) and acute ischemic stroke MR imaging. Anesthesia was chosen so as not to influence cerebrovascular reactivity. MRI was acquired on a 3 Tesla unit (Achieva, Philips Healthcare, Best, Netherlands) and included susceptibility- weighted imaging (SWI), diffusion-weighted imaging (DWI) with the corresponding apparent diffusion coefficient (ADC) maps, and perfusion imaging. Susceptibility- weighted imaging was acquired within the first 60 minutes of MCA occlusion. The signal intensity was calculated on SWI images using Image J software (National Institutes of Health, Bethesda, Maryland). Regions of interests (ROI) were drawn manually on the infarct core, penumbra, and deep gray matter and was compared to that of the corresponding contralateral side. The infarct core was selected based on the hypointense areas on the ADC maps, penumbra chosen based on the perfusion imaging and identified by the defect between the ADC abnormality and the perfusion defect. The normality of data was assessed using the Shapiro-Wilk W test.

RESULTS

The median (interquartile range) of signal intensity on the infarct core (374.6 (366.5-393.6), vs. 432.6 (412.3-448.2), P-value<0.0001), and on the penumbra (433.7 (407.6-458.9) vs. 491.6 (467.6-510), P-value<0.0001) was significantly lower than signal intensity on their uninvolved contralateral side. The mean ± SD of signal intensity was also significantly lower on deep gray matter compared to the uninvolved contralateral side (418.1 ± 44.89 vs. 464.5± 42.61, P-value<0.0001).

CONCLUSION

Signal intensity significantly drops during the hyperacute phase of MCA occlusion in the infarct core, penumbra, and deep gray matter comparing to the contralateral side. Presumably, this is a result of deoxyhemoglobin effect and venous vasodilation in the early stages of ischemia.

CLINICAL RELEVANCE/APPLICATION

Susceptibility- weighted imaging could possibly be used as a fast and noninvasive imaging to predict cerebral hemodynamic changes.

SSG10-06 Improvement of the Diagnostic Performance for Brain Hemorrhage Using Deep Learning-based Computer-Aided Detection System

Tuesday, Dec. 3 11:20AM - 11:30AM Room: N229

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PURPOSE

To elucidate the diagnostic performance with deep learning-based computer-aided detection (CAD) for non-expert and expert doctors in detecting cerebral hemorrhage from head CT.

METHOD AND MATERIALS

40 head CT datasets were evaluated by 15 doctors (5 board certificated radiologists, 5 radiology residents, and 5 interns). The CT datasets have 16 normal and 24 hemorrhagic patients with 48 intracranial hemorrhagic lesions including 5 types of cerebral hemorrhages: extradural hematoma, subdural hematoma, intracerebral hemorrhage, subarachnoid hemorrhage, and intraventricular hemorrhage. The doctors attended 2 reading sessions: diagnosing without and with CAD (more than a week between 2 reading sessions). All doctors annotated the hemorrhagic regions and gave them the degree of confidence on a scale of one to ten. Our CAD system was developed with 522 patients' head CT which consist of 242 normal (5,929 slices) and 280 hemorrhagic patients (2,899 slices), and detection results were displayed as corresponding probability heat maps using U-Net and a machine learning-based false-positive removal method. The normal and hemorrhagic patients were randomly split into training (90%) and validation (10%) datasets and used for constructing CAD. Sensitivity, specificity, and accuracy were evaluated using a paired t test. In addition, a figure of merit (FOM) derived from the jackknife free-response receiver operating characteristic were evaluated.

RESULTS

The mean accuracy of all doctors with patient-based evaluation significantly increased from 83.7% to 89.7% (p<0.01) by using CAD. In addition, the accuracies of board certificated radiologists, radiology residents, and interns showed 92.5%, 82.5%, and 76.0% (without CAD) and 97.5%, 90.5%, and 81.0% (with CAD), respectively. The rate of increase of the mean accuracy for non-expert doctors was 6.5%; it was greater than that for expert doctors (5.0%). The mean FOM of all doctors increased from 0.78 to 0.82 (p<0.05) by using CAD.

CONCLUSION

The diagnostic performance and confidence of intracranial hemorrhage detection improved among all doctors, especially for non-expert doctors by using CAD.

CLINICAL RELEVANCE/APPLICATION

Our CAD software could improve the diagnostic performance of all doctors in detecting hemorrhage from head CT and reduce the missed reports of faint or small hemorrhage, especially for non-expert doctors.

SSG10-07 Deep Learning Model to Predict Patient Outcome in ICH Using Fluid-Attenuated Inversion Recovery Imaging Data

Tuesday, Dec. 3 11:30AM - 11:40AM Room: N229

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PURPOSE

Timely and accurate outcome prediction in intracerebral hemorrhage (ICH) patients is important for optimizing rehabilitation strategy. The objective of this study was to investigate if a deep neural network model can predict recovery outcome in patients with ICH at 3 months using T2-weighted fluid-attenuated inversion recovery (FLAIR) imaging data.

METHOD AND MATERIALS

A convenience sample of 53 left thalamocapsular ICH patients (hemorrhagic volume < 20cc; mean age = 52.4 yrs) were included from the Ethnic/Racial Variation in Intracerebral Hemorrhage (ERICH) study. T2-weighted FLAIR data were acquired using clinical protocols in this multicenter cohort. A deep learning model was trained to identify patients likely to have unfavorable outcomes, defined as 3-month modified rankin scale (mRS) score 3-6. As shown in Figure 1, we employed a pre-trained VGGNet-19 model as a feature generator to learn high-level features from input FLAIR images. We then built a convolutional neural network (CNN) classifier based on the high-level features to identify the patients with unfavorable outcomes. Rotation and shift-based data augmentation strategy was implemented to increase the training samples by 20 times (but not testing samples). Performance was evaluated using 5 fold cross-validation with the metrics of accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC).

RESULTS

Our model was able to correctly identify patients likely to have unfavorable outcomes with an accuracy of 81.8% (95% confidence interval: 80.7%, 82.9%), AUC of 0.82 (0.80, 0.83), sensitivity of 90.6% (89.6%, 91.6%) and specificity of 72.6% (70.1%, 75.1%).

CONCLUSION

This work demonstrates the feasibility of deep learning approach for predicting outcomes of ICH patients using only FLAIR imaging data with a promising accuracy. Future model improvements will include the incorporation of clinical data. A larger multidimensional study is important to validate our approach.

CLINICAL RELEVANCE/APPLICATION

Deep learning model on FLAIR imaging data can identify ICH patients likely to have unfavorable outcome. Such prognostic model can potentially help with the treatment decision and rehabilitation strategy optimization.

SSG10-08 Microstructural ASYmmetry (MASY) of DTI in Stroke Reveals Interaction Effect of Sex and Clinical Covariates

Tuesday, Dec. 3 11:40AM - 11:50AM Room: N229

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PURPOSE

Microstructural investigation of stroke is one of the flagship clinical applications of diffusion tensor imaging (DTI). The purpose of this work was to examine the interaction effect of sex and clinical scores on stroke microstructure measured using DTI. It was hypothesized that using the microstructural *difference* between the contra and ipsilesional regions would be statistically more powerful than using the microstructural measures within the lesion. It was further hypothesized that considering the *distributional difference* of their microstructure, instead of the difference between their averages, would be more sensitive in gleaning this effect.

METHOD AND MATERIALS

Diffusion weighted MR images on n=16 subjects (ages: 52.8+/-14.5(n=6 females), 62.4+/-14.1(n=10 males)) were acquired with a b-value of 2000 s/mm2 along 56 unique non-colinear gradient directions, in addition to 10 non-diffusion weighted (b=0) images. Preprocessing was performed using FSL's eddy to remove distortions from eddy currents and motion. The analysis was performed using the four main (DTI) measures: fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD) and radial diffusivity (RD) and two clinical covariates: the ratio of acute time period to age and normalized verbal fluency (corrected for age and education) at the time of MRI. The acute time period is the number of days between MRI visit and stroke onset. A linear model that includes the interaction effect of sex and clinical covariates was fit for each of the following dependent variable: (1) average DTI in the acute ipsilesion mask, (2) difference between the average DTI in contra and ipsilesional masks and (3) *microstructural asymmetry (MASY)* computed using symmetrized Kullback-Leibler divergence between DTI distributions of contra and ipsilesional masks. The p-values for the interaction effect from the models were reported.

RESULTS

The main results are summarized in Figure 1. The microstructural features were positively correlated with acute time period ratio and inversely correlated with verbal fluency.

CONCLUSION

The relationships between clinical scores and microstructural asymmetry of DTI in stroke were more pronounced in males compared to females.

CLINICAL RELEVANCE/APPLICATION

(delaing with interaction effects in stroke microstructure) '*Distributional difference approach* is recommended for greater statistical sensitivity to relationships between clinical scores and imaging.'

SSG10-09 High Definition Imaging Reduces Procedure Time Without Impacting Patient Dose in Image-Guided Neuro Interventional Procedures

Tuesday, Dec. 3 11:50AM - 12:00PM Room: N229

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PURPOSE

To quantify the clinical impacts and radiation dose of a novel fluoroscopic x-ray detector that combines high definition (Hi-Def) crystalline-Si imaging modes with 76µm pixels and high efficiency amorphous-Si imaging modes with 194µm pixels.

METHOD AND MATERIALS

DICOM Radiation Dose Structured Report (RDSR) data was collected for all neurointerventional procedures performed before and after installation of the Hi-Def detector at a single center over a 32 month period. There were 1,702 pre- and 2,499 post-Hi-Def cases with over 390k irradiation events in total. A real-time patient skin dose tracking system was used to monitor peak skin dose during the Hi-Def cases. A two-sample student's t-Test analysis was performed to compare various technical parameters included in the RDSR before and after installation of the new Hi-Def technology. To further investigate any potential impacts on radiation dose, cumulative air kerma, dose area product and peak skin dose were plot as a function of Hi-Def utilization as a percentage of the total number of irradiation events.

RESULTS

Hi-Def modes were used in more than 50% of the most complicated cases defined as having procedure times lasting more than 90 minutes. Improved visualization capabilites were demonstrated especially during device deployment and manipulation. Average procedure time and the total number of irradiation events were both significantly reduced by 9% ($p< 0.01$). Average fluoro time, number of CBCT scans and cumulative air kerma were trending lower (5-10% less) but not yet reaching statistical significance ($0.05< p < 0.16$). Peak skin dose data was available for 1,518 cases with 97.7% and 99.5% of cases below 3Gy and 5Gy, respectively. No correlation was observed (R2< 0.10) using a best of all fits for all dosimetric indications as a function of Hi-Def utilization.

CONCLUSION

Preliminary results from over 4,000 neurointerventional procedures at a single center demonstrate that the improved spatial resolution of the Hi-Def detector may result in reduced procedure time and number of irradiation events. In addition, there was no observable increase in patient dose with the utilization of the Hi-Def detector.

CLINICAL RELEVANCE/APPLICATION

This is the first study investigating clinical benefits of a new detector that can provide more than 2x the spatial resolution of any other clinically available technology and no patient dose penalty.

SSG11

Neuroradiology (Cognition/Memory)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: N230B

NR

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

FDA Discussions may include off-label uses.

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Sub-Events

SSG11-01 Cerebral Lobar Volume: Concordance of Visual and Quantitative Assessment

Tuesday, Dec. 3 10:30AM - 10:40AM Room: N230B

Participants
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PURPOSE

To assess concordance of visual and quantitative assessment of individual cerebral lobe volume. The inter-rater agreement in visual assessment is very low. There however are variations in assessment based on individual interpreting radiologists experience that can have implication particularly with the availability of dedicated softwares. Our study intends to evaluate the rate of concordance amongst radiologists of varying experience and the quantitative assessment software in assessing the age-appropriateness of individual lobe volumes.

METHOD AND MATERIALS

MRI brain of mild cognitive impairment patients for quantitative volumetric assessment were retrospectively reviewed by three Neuroradiologists of varying experience. Axial T2, Axial FLAIR, Sagittal 3D-T1 were utilized to rate lobar volume as age-appropriate or low (below 25th percentile). The data was compared to software results. Concordance was assessed for each individual eight lobes, and defined as agreement amongst all neuroradiologists and software data, whether age-appropriate or low.

RESULTS

Concordance of lobar volumes of the reviewed pilot data of 25 patients was only 70 lobes out of the 200 lobes(35%). Highest concordance in right occipital lobe(13/25; 52%), and lowest in both frontal lobes(6/25; 24%) was noted. Whereas concordance for low-volume for age was 50%(32/64), that for age-appropriate volume was surprisingly low(38/136; 28%). For the low-volume for age, left parietal lobe had maximum(6/8; 75%) and left occipital lobe had minimum concordance(0/3). Amongst age-appropriate volume, right occipital lobe had maximum(12/23; 52%) and the left frontal lobe had minimum concordance(1/16; 0.06%).

CONCLUSION

While it has been thought that assessment of low for age overall brain volume can have significant individual variation, our pilot data suggests that the assessment of age-appropriate lobar volume may have much more individual variation, especially when compared to available quantitative tools.

CLINICAL RELEVANCE/APPLICATION

Identifying the cerebral lobes that are more vulnerable to escape accurate volume assessment, may help in appropriately establishing patterns of lobar volume loss which are important in classifying different dementia types. Additionally, this may promote appropriate labelling of age-appropriate brain volume by radiologists, which otherwise may lead to misdiagnosis and potential social, family, insurance or employment implications.

SSG11-02 The Right Hippocampus Cornus Ammonis 1 Region for Alzheimer's Disease Diagnosis Based on Simultaneous 18F-FDG PET/fMRI Study

Tuesday, Dec. 3 10:40AM - 10:50AM Room: N230B

Participants
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PURPOSE

Hippocampal dysfunction is an early hallmark of Alzheimer's disease (AD) and the hippocampus subfield cornus ammonis (CA1) region is a selectively affected functional region in AD-related neuropathology. We aimed to compare hybrid fluorine 18 (18F) fluorodeoxyglucose (FDG) PET/MR CA1 global functional connectivity (gFC) and hypometabolism in distinguishing patients with AD and mild cognitive impairment (MCI) from normal control (NC) participants.

METHOD AND MATERIALS

We simultaneously acquired resting-state functional MRI (rs-fMRI) and 18F-FDG PET data from patients with AD (n=18), MCI (n=29) and NC (n=27) using hybrid PET/MR. The gFC of the bilateral CA1 regions was computed through seed-based resting-state fMRI correlations through each voxel in the gray matter. 18F-fludeoxyglucose (FDG)-PET metabolism in the CA1 regions was scaled by the mean standard uptake value of the cerebellum. Model was analyzed with sensitivity, specificity and receiver operating characteristic (ROC).

RESULTS

Analyses revealed decreased CA1 metabolism in patients with AD and MCI compared with NC participants both in the right and left CA1 regions. In addition, a higher right CA1 gFC was associated with lower hypometabolism and higher Mini-Mental State Examination score specific in AD not the left. In the right CA1 region, the 18F-FDG PET biomarker achieved larger area under the receiver operating characteristic curve (AUC) of 0.94 (0.86-1.00) (100% specificity, 77.78% sensitivity) in discriminating AD patients from NC than rs-fMRI (AUC of 0.90 (0.79-1.00), 96.3% specificity, 83.3% sensitivity). In MCI patients, the rs-fMRI biomarker achieved larger AUC of 0.788(0.669 to 0.907)(77.78 specificity, 65.52 sensitivity) in discriminating MCI patients from NC than 18F-FDG PET (AUC of 0.710 (0.571-0.849), 74.07% specificity, 72.41% sensitivity).

CONCLUSION

By using hybrid PET/MR, 18F-FDG PET demonstrated hypometabolism in right CA1 region higher specificity but lower sensitivity than rs-fMRI in discriminating AD from NC. However, rs-fMRI had higher sensitivity in distinguishing MCI from NC compared with the 18F-FDG PET hypometabolism.

CLINICAL RELEVANCE/APPLICATION

(dealing with functional MR and FDG PET)18F-FDG PET demonstrated quantitative hypometabolism in right CA1 region has higher specificity than rs-fMRI in distinguishing AD from NC. However, when distinguish MCI from NC, rs-fMRI had higher sensitivity compared with 18F-FDG PET hypometabolism.

SSG11-03 'ERICA' Score and Posterior Cingulate and Pre-Cuneus ASL Perfusion in Differentiating Mild Cognitive Impairment and Dementia due to Alzheimer's Disease

Tuesday, Dec. 3 10:50AM - 11:00AM Room: N230B

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PURPOSE

The aim of this study was to test the diagnostic utility of 'ERICA' (Entorhinal Cortical Atrophy) score along with measured cerebral blood flow (CBF) in the posterior cingulate and precuneus using pseudo-continuous ASL in differentiating patients with mild cognitive impairment (MCI) and Alzheimer's Dementia (AD).

METHOD AND MATERIALS

MR imaging of a prospectively recruited, age-matched groups of subjects, 21 cognitively normal healthy controls (HC), 20 MCI and 19 AD patients were analysed. 'ERICA' score is a 4 point atrophy rating scale of parahippocampal gyrus, from 0 to 3, where 0 indicates no evidence for atrophy of the entorhinal cortex and 3, marked atrophy. ERICA score was determined by 2 independent neuroradiologists and an atlas based estimation of CBF in the posterior cingulate and precuneus (PCG +PC) with ASL was done in all the three groups. Statistical comparison was performed between the groups for disease prediction probability with these parameters independently and in combination using a binary logistic regression model.

RESULTS

ERICA score performed well in distinguishing AD from HC, with predicted probability of 0.887 (area under the curve, P< 0.001). The mean CBF of PCG + PC also predicted this (AUC 0.810, P= <0.001). Combining the ERICA score and ROI CBF was the best marker for distinguishing AD from HC with the predicted probability of 0. 957(area under the curve, P< 0.001). In distinguishing between MCI and AD also ERICA score did well with an AUC of 0.838 (P< 0.001). However regional CBF was not useful in differentiating these two groups (AUC= 0.589, (P= 0.339). Combining ERICA and CBF marginally decreased the predictability by ERICA alone (AUC= 0.829, P< 0.001). ERICA scored poorly in distinguishing between MCI and HC (AUC= 0.571, P= 0.493). Here regional CBF fared well, with an AUC of 0.776 (P=0.002). Combining ERICA and CBF marginally improved the predictability (AUC= 0.781, P= 0.002).

CONCLUSION

ERICA score performed well in distinguishing between AD- HC and AD- MCI, but not in differentiation of MCI- HC. Regional CBF in

PCG + PC independently predicted MCI from HC and AD from HC but not between AD and MCI. Combining both ERICA and regional CBF helped in distinguishing between all the three groups.

CLINICAL RELEVANCE/APPLICATION

ERICA + regional ASL score may be better than ERICA score alone in differentiating MCI from AD

SSG11-04 APOE4 is Associated with BBB Permeability Change in Cognitive Impaired Subjects: A Prospective Study Using DCE MRI

Tuesday, Dec. 3 11:00AM - 11:10AM Room: N230B

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PURPOSE

We hypothesized that subtle BBB damage would be observed in patients with mild cognitive impairment (MCI) depending on the status of APOE4 mutation, by comparing the BBB permeability seen in DCE-T1WI of MCI patients with that of normal controls.

METHOD AND MATERIALS

In this study, 26 patients (mean age, 70.9 ± 6.8 years) with clinically diagnosed MCI and 27 cognitively normal control subjects (mean age, 64.1 ± 5.8 years) underwent DCE-T1WI with gadobutrol and 10 min acquisition time. We processed the DCE data to generate permeability map. Concentration of the contrast in tissue was calculated by using relative signal change and T1 mapping. Vascular input function was generated from superior sagittal sinus by semiautomatic method in Nordic ICE software. For calculating the tissue permeability, we used Patlak model to generate the permeability parameter, K trans. Student t-test and chi-square test was performed for parametric and non-parametric variables, respectively. In addition, the analysis of co-variance (ANCOVA) was performed with an age as a covariate for K trans.

RESULTS

The patient group was older than the normal control group ($p<0.001$). The patient group showed lower MMSE score compared to the control group (25.8±2.7 vs 27.9±1.9, respectively, $P=0.003$). Patients with MCI demonstrated increased Ktrans in the left fronto-parietal white matter ($p=0.033$), right and left temporal white matter ($p=0.004$ and $p=0.006$), right and left hippocampi ($p=0.023$ and $p=0.028$). Even after controlling for age as a covariate, left fronto-parietal white matter ($p=0.025$), right and left temporal white matter ($p=0.011$ and $p=0.018$, respectively), left hippocampus ($p=0.030$) showed the higher Ktrans (increased BBB permeability) in MCI group. In a subgroup analysis of subjects with known APOE status (n=26), there was a tendency of increased Ktrans of right hippocampus and right temporal white matter depending on the presence of APOE4 mutation, but not with statistical significance ($p = 0.069$).

CONCLUSION

BBB permeability is increased in MCI subjects as compared to normal control subjects. BBB permeability increase in MCI shows spatial predilection in hippocampus and temporal white matter, which may contribute to cognitive decline as in AD.

CLINICAL RELEVANCE/APPLICATION

Our study indicates that DCE-MRI with K trans mapping can be an early imaging marker for representing underlying BBB breakdown in the cognitively impaired subjects.

SSG11-05 Regional Variation in Interhemispheric Functional Connectivity (IFC) for Different Types of Dementia: A Resting State fMRI Study

Tuesday, Dec. 3 11:10AM - 11:20AM Room: N230B

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PURPOSE

To explore Interhemispheric functional connectivity (IFC) in patients of Alzheimer's disease (AD), Mixed Dementia (MD), Vascular Dementia (VD) and Subjective Cognitive Decline (SCD) based on Default Mode Network (DMN), Salience Network (SN) and Executive Control Network (ECN) with Heathy control (HC). The IFC was analyzed using voxel-mirrored homotopic connectivity (VMHC).

METHOD AND MATERIALS

75 participants (25 HC, 21 AD, 6 MD, 18 VD and 6 SCD) were recruited to undergo MRI scanning using Siemens 3T scanner. All

participants were asked to remain quiet and relax during the scan, with their eyes closed but not to fall asleep. Resting state functional images were acquired using echo-planning imaging (EPI) technique. The fMRI images were preprocessed by SPM12 with Mathlab 2018a. It included elimination of the first 10 time points, slice timing correction and head motion correction. For VMHC, we adopted the method of calculation used by Kelly et al 2011 and Zuo et al 2010. VMHC map was obtained. T-test was performed by SPSS (v.25.0) to compare each group with HC.

RESULTS

AD group showed significant lower VMHC values in DMN (T=-2.48 to -3.49, p<0.05) than that of HC. For SCD group showed significant higher VMHC values in SN (T=+2.68 to +4.336, P<0.05) and ECN (T=+2.537 to +3.203, P<0.05) than HC. For MD, significant higher VMHC values was found in SN (T=+2.743 to +4.464, p<0.05) but lower VMHC values in other networks (T=-2.989 at mid temporal gyrus to -4.487 at lateral occipital cortex, p<0.05). For VD group, VMHC values was significantly lower in DMN (T= -2.942 to -3.065, p<0.05) than that of HC, while having higher VMHC values in ECN (T=+2.502 to +3.540, P<0.05).

CONCLUSION

Resting state fMRI showed different patterns in interhemispheric functional connectivity for AD, VD, MD, and SCD groups when comparing to HC group based on the DMN, SN, and ECN. Consistent with other studies, AD showed decreased IFC in all three networks. While for VD and MD, coexistence of decreased and increased IFC among three networks. The result suggested that recruitment of other brain regions as adaptations to compensate for the reduced IFC.

CLINICAL RELEVANCE/APPLICATION

Characterization of different types of dementia, including AD, MD, VD and SCD by IFC using resting state fMRI. Resting state fMRI can be a non-invasive tool for early diagnosis of dementia.

SSG11-06 Blood-Brain Barrier Opening in the Hippocampus and Entorhinal Cortex Using MR-Guided Focused Ultrasound in Patients with Alzheimer's Disease

Tuesday, Dec. 3 11:20AM - 11:30AM Room: N230B

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PURPOSE

Alzheimer's disease (AD) is the most common cause of dementia and has no effective treatment. MR-guided low intensity focused US (LIFU) has been shown to reversibly open the blood-brain barrier (BBB), reduce amyloid-ß plaque burden, improve memory and allow for targeted drug and stem-cell delivery in animals. As a proof of concept, a recent phase I clinical trial demonstrated safe and temporary opening of the BBB with LIFU in the dorsolateral prefrontal cortex in 5 patients with AD. We report initial results and MRI findings of a phase II trial, which is currently in progress to assess safety and efficacy of BBB opening within the hippocampus and entorhinal cortex at sites of abnormal amyloid burden in patients with early AD.

METHOD AND MATERIALS

Inclusion criteria of this phase II Insightec-sponsored and FDA/IRB-approved trial includes early stage AD and amyloid-PET positivity. Three successive treatments were administered to two female patients (aged 61 and 73 years) at two week intervals. Treatments consisted of stereotactic headframe placement followed by MR-guided LIFU sonication with 220kHz using the ExAblate Neuro Type 2 system and concomitant IV microbubble (Definity®) bolus injection. Three sonication targets in the right (first patient) and left (second patient) hippocampus/entorhinal cortex, were targeted based on anatomy and amyloid burden.

RESULTS

Post-sonication brain MRI revealed immediate IV contrast enhancement within the targeted hippocampus/entorhinal cortex and adjacent subcortical regions (figure), indicating BBB opening focally within treated areas. Resolution of contrast enhancement, indicating BBB closure, was observed at each parenchymal target within 24 hours. There were no clinical or radiologic treatment-related adverse effects. A distinctive perivascular pattern of enhancement and FLAIR hyperintensity was consistently observed.

CONCLUSION

This report of the first two patients to undergo MR-guided LIFU sonication of the hippocampus/entorhinal cortex for AD demonstrates safe, precise, reversible, and reproducible BBB opening in the hippocampus/entorhinal cortex, and a distinctive postsonication MR imaging pattern.

CLINICAL RELEVANCE/APPLICATION

Preliminary results of the first two patients to undergo MR-guided LIFU sonication of the hippocampus/entorhinal cortex for AD demonstrates safe and reversible targeted BBB opening with no adverse effects.

SSG11-07 Using Convolutional Neural Networks to Determine the Impact of White Matter Hyperintensities on

Cognitive Performance

Tuesday, Dec. 3 11:30AM - 11:40AM Room: N230B

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PURPOSE

Some degree of ischemic damage to white matter tracts is common in older adults; this damage is visible on magnetic resonance imaging (MRI) as focal or confluent white matter hyperintensities (WMH). Although growing evidence suggests links between WMH and Alzheimer's disease, the effects of WMH on cognition are unclear. Convolutional neural networks (CNN) have proven useful in image analysis in different domains. We compared the usefulness of CNN and Fazekas' visual rating scale for determining whether WMH burden is related to cognitive impairment.

METHOD AND MATERIALS

We studied 418 healthy participants (mean, 66.67±7.96 years [range, 50-96 years]) consecutively recruited for a population-based study of aging. All imaging studies were obtained on a 1.5 T MRI system (Vantage Elan, Canon Medical Systems, Japan). CNNs were used to assess WMH volume, mean distance, number, and mean entropy. Two radiologists also rated WMHs on Fazekas' scale. Cognitive performance was evaluated with Symbol Digit Modalities Test (SDMT), Verbal Fluency Test, Semantic Verbal Fluency Test (SVFT), Delayed Free Recall, Digit Span Test (forward), and Stroop Color and Word Test (SCWT). Multivariate linear regression models were adjusted to assess the association between WMH measured by the Fazeka's scale or the CNN approach on several neuropsychological tests. Standardized beta coefficients and coefficients of determination were estimated. All models were adjusted by age, gender, scholarship and cerebral volume.

RESULTS

WMH burden was associated with SDMT, SCWT, and SVFT. In all models, compared to visual rating with Fazekas' scale (R2SDMT=0.464, ß= -0.085, P=0.020), CNN-metrics found that WMH burden was a more significant contributor to information processing (R2SDMT=0.478, ßmean entropy= -0.233, P<0.001), executive function (R2SCWT=0.306, ßmean entropy= -0.416, P<0.001; ßmean distance= 0.154, P=0.005), and verbal functioning (R2SVFT=0.186, ßmean entropy= -0.223, P-value=0.013; ßlesion number= 0.215, P-value=0.012; ßlesion volume= 0.241, P-value=0.040).

CONCLUSION

Our results suggest the impact of WMHs on cognitive performance can be better assessed by CCN than by conventional visual rating.

CLINICAL RELEVANCE/APPLICATION

CNN-based quantification could be useful to characterize the pathology of cerebral small vessel disease that affects the vasculature of white matter tracts, subcortical structures and cognitive performance.

SSG11-08 Brain Network Alterations in Subjects with Smartphone Dependence

Tuesday, Dec. 3 11:40AM - 11:50AM Room: N230B

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PURPOSE

Smartphone dependence (SPD) is regarded as a psychological problem on the rise, yet the underlying neural substrates of SPD are still not clear. In this study, a functional network analysis based on a resting state BOLD fMRI was used to investigate the changes of brain connectivity and hub functions in young adults with SPD.

METHOD AND MATERIALS

Forty-nine right-handed young adult volunteers were recruited and subsequently placed in the control or SPD group depending on the score obtained in the Mobile Phone Addiction Tendency Scale (MPATS). The fMRI scanning was conducted on a 3.0-Tesla Siemens Skyra MRI System with a 32-channel phase array head coil. A gradient echo T2*-weighted pulse sequence was used. Functional image preprocessing was conducted using SPM8 under a typical pipeline. Voxel-wise degree centrality was calculated and group comparisons of DC measures were performed. Functional network construction and statistical analysis was performed using GRETNA toolbox. The interregional connectivity was calculated using the Pearson correlations between the regional mean time series of all possible pairs of the 90 brain regions. A two-sample t test was conducted for all possible connections represented in the correlation metrics between the patients and controls.

RESULTS

Subjects with SPD, showed decreased DC in right rostral middle frontal gyrus, bilateral superior frontal gyrus, and bilateral medial orbitofrontal cortex. Compared with other healthy controls, 30 connections showed significant decrease in positive connections in SPD, including intrahemispheric connections between temporal and parietal regions, frontal and parietal regions, regions within occipital lobe, as well as interhemispheric connections between temporal and parietal regions, frontal and parietal regions. The most significantly altered connections involved on one hand the left inferior temporal gyrus and right superior parietal gyrus, and on the other the left hippocampus and right posterior cingulate gyrus. The result demonstrates that SPD is characterized by the impairment of network connections and hub functions in the brain regions involved in visual processing, somatosensation, attention span & memory, and behavior control.

CONCLUSION

Functional network analysis based on a resting state BOLD fMR offers a new approach to understanding brain changes in subjects with SPD.

CLINICAL RELEVANCE/APPLICATION

Brain network alterations in subjects with SPD

SSG11-09 Brain Connectivity in Tobacco Dependent Patients: Correlations of the Default Mode Network with the Smoking Cessation Outcome after Neurofeedback Assisted Therapy

Tuesday, Dec. 3 11:50AM - 12:00PM Room: N230B

Participants
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PURPOSE

The aim of the study was to explore the potential of resting state functional connectivity (rsfc) MRI for predicting the succees of smoking cessation in patients with tobacco dependence after group psychotherapy and realtime(rt)-fmri neurofeedback training.

METHOD AND MATERIALS

Fifty-four tobacco-dependent patients conducted three rt-fmri neurofeedback sessions including rsfc-MRI-runs each within a period of four weeks after professionally assisted smoking cessation. Patients were randomized into two groups performing either real neurofeedback of a brain region associated with addiction (ACC, insula, DLPFC) or sham neurofeedback. The aim was to reduce neural activity during nicotine cue exposure. Rsfc was measured before and after each neurofeedback session. After preprocessing the rsfc data were statistically evaluated using a seed based ROI approach with the UK Biobank DMN template taking into account the smoking status of patients after three months into account (abstinence or relapse) with a family-wise error (FWE) correction and a Threshold-Free Cluster Enhancement (TFCE) correction of each $p<0.05$.

RESULTS

The preliminary results of the baseline runs of eighteen subjects of the real feedback group revealed several significant co-activations in frontal and temporal brain regions of the relapse group ($n=10$) including bilateral insular regions exceeding the UK DMN template with much more activated voxels than the abstinence group ($n=8$). The positive correlations from the DMN seed to whole-brain were significantly increased in the relapse group, while the abstinence group shows a less positive correlation to all other regions in the brain. The abstinence group showed significantly higher correlations within the DMN than the relapse group.

CONCLUSION

Variations in the intrinsic DMN in patients with tobacco dependence seem to be associated with a negative therapeutic outcome.

CLINICAL RELEVANCE/APPLICATION

Rsfc MRI after rt-fmri neurofeedback assisted therapy of tobacco dependent patients may be useful as an early indicator of later therapy response or non-response.

SSG12

Physics (CT Image Quality)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S501ABC

CT PH SQ

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

FDA Discussions may include off-label uses.

Participants
Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Moderator*) Institutional research agreement, Siemens AG
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Sub-Events

SSG12-01 DQE of Si and CdTe Detectors for Photon-Counting CT: Impact of Object Scatter

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S501ABC

Participants
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PURPOSE

Silicon (Si) and cadmium telluride (CdTe) have been proposed as detector materials for photon-counting CT, but the relative performance of these materials is incompletely understood. Previously, a linear-systems model has been used to compare the DQE of Si and CdTe detectors, but this model ignores scatter from the object. This work extends this comparison by incorporating object scatter and the anti-scatter grid, resulting in a more complete model for photon-counting detector DQE at low flux.

METHOD AND MATERIALS

Monte Carlo simulation was performed of a CT geometry with a water cylinder of 30 cm diameter in the isocenter and a curved detector with 79 mm isocenter coverage and sensitive absorption lengths of either 60 mm Si or 3 mm or 1.6 mm CdTe. A 1D or 2D anti-scatter grid with 25 mm high W lamellae was placed in front of the detector. From the resulting scatter-to-primary ratio (SPR) in the central 20 cm of the detector, a DQE factor could be calculated as (geometric efficiency)/(1+SPR) where SPR is the scatter-to-primary ratio. This factor was combined with the intrinsic detector DQE obtained from linear-systems models of Si and CdTe detectors incorporating intradetector scatter, fluorescence and charge sharing.

RESULTS

For all studied detector configurations, the optimal DQE factor is 0.79-0.81, attained for an 1D grid of 0.1 mm thick lamellae with 1 mm spacing. Combined with the linear-systems model for typical detector configurations, so far ignoring pulse pileup and signal induction crosstalk but adding object scatter, this gives the 1.6 mm CdTe detector 5-25% higher zero-frequency DQE for detection and 44-54% lower DQE for two-material quantification compared to a 60 mm Si detector with interspersed W foils.

CONCLUSION

A geometric efficiency of 86-90% is optimal for photon-counting detectors, in contrast to the ~70% used in current CT scanners. Including interspersed W foils in the Si detector can reduce object scatter, and together with an orthogonal 1D anti-scatter grid can give an SPR comparable to that of a 2D grid without interspersed foils. This work is an important step towards a future, complete model for detector performance incorporating pileup and improved charge transport models.

CLINICAL RELEVANCE/APPLICATION

Photon-counting CT detectors promise better image quality. The improved performance model presented here will help developers optimize detector design and attain the best possible imaging performance.

SSG12-02 Innovative Methodology to Mimic Lung Parenchyma Based on Voronoi Models: Application to 3D-Printed Anthropomorphic CT Image Quality Phantoms

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S501ABC

Participants

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PURPOSE

To design and develop voronoi 3D-printed structures resembling lung parenchyma, to be used in realistic anthropomorphic lung vessel phantoms for CT image quality assessment.

METHOD AND MATERIALS

Voronoi grids were created using Rhino software (McNeel, Barcelona, Spain) to resemble lung parenchyma. The designs (eight samples, 2x2x1cm3) varied in number of cells and cell border thickness and were 3D printed (ProJet® MJP 2500+) with VisiJet Armor material (ρ=1.14 g·cm-3). The samples were placed in foam, inserted inside a thorax-shaped PMMA holder (300x200x2.5cm3), and scanned (Canon Aquilion Genesis CT). Comparisons were made to CT image volumes of interest (VOIs) of 3 patients parenchyma (5 samples per patient) using the same CT acquisition and reconstruction protocol (High Resolution-thorax). Analysis was performed in terms of attenuation (mean pixel value of VOIs), pixel value distribution (histograms) and visual comparison.

RESULTS

The CTDIvol for the thorax phantom was 2.1 mGy and for the 3 patients 2.1, 2.2 and 4.1 mGy. The attenuation of the voronoi samples (0.2mm cell border thickness) increased linearly with the number of cells [-972±3HU (200 cells);-953±2HU (350 cells);-941±3HU (500 cells);-921±3HU (800 cells);-916±5HU (900 cells)]. Attenuation also increased linearly with cell border thickness (samples with 350 cells) [-953±2HU (0.2mm);-924±3HU (0.3mm);-885±7HU (0.4mm);-837±5HU(0.5mm)]. For patients the average attenuation values were [(-859±7HU);(-849±5HU);(-902±4HU)]. The sample of 350 cells and 0.4mm cell border thickness resembled lung parenchyma most closely, according to visual comparison of CT images and histogram pixel distribution, by three human observers. The mean pixel value of this sample (-885±7HU) was within the HU value range for patients lung parenchyma (-870±27HU).

CONCLUSION

CT appearance and attenuation of human lung parenchyma was mimicked by CT scans of 3D printed voronoi grids. A sample of 350 cells and 0.4 mm cell border thickness showed best resemblance with patient CT images. These voronoi structures will be added to an in-house developed lung vessel phantom to create a more realistic anthropomorphic surrogate for patients in CT image quality assessment.

CLINICAL RELEVANCE/APPLICATION

Our method to 3D-print lung parenchyma (missing in most commercial CT image quality phantoms) can be used to create realistic patient surrogates, especially required with iterative reconstruction.

SSG12-03 Improving Visualization of Basilar Artery Branches by Combining Spectral CT Imaging and Adaptive Statistical Iterative Reconstruction-V Algorithm

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S501ABC

Participants
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PURPOSE

Improving visualization of basilar artery branches by combining spectral CT imaging and adaptive statistical iterative reconstruction-V algorithm

METHOD AND MATERIALS

A total of 15 patients with suspected posterior cerebral circulation ischemia underwent head-neck CT angiography (CTA) using a 256-row MDCT (Revolution CT, GE Healthcare). The scanning parameter were tube voltage of 80/140kVp fast switch and GSI Assist with a noise index of 6. The contrast medium was Iohexol (370mgI/ml) with amount of 50ml and injection rate of 5.0ml/s. 100 kVp-like with FBP (group A) and 40keV monochromatic energy image with 50% ASiR-V (group B) were reconstructed. For both image sets, the CT value and contrast to noise ratio (CNR) were measured at maximum diameter of the basilar artery. maximum intensity projection (MIP) images were used for evaluation the visualization of vertebrobasilar arteries and branch vessels (post-cerebral arteries, superior cerebellar arteries, anterior inferior cerebellar artery, and posterior inferior cerebellar artery). Vessel visibility was quantified by counting the number of artery branches. A five-point scale (from 1= poor to 5 = excellent) was used to evaluate the image quality.

RESULTS

40keV images had higher enhancement of basilar artery (664.95±106.11 vs 288.81±31.03, P=0.001) and higher CNR (27.36± 7.01 vs 20.49±6.48, P=0.009) than 100 kVp-like images. A total of 165 blood vessels was visible on 40keV images, compared to 160 vessels in 100 kVp-like image. The subjective image quality of 40keV images was better that of 100 kVp-like image (4.53±0.54 vs 3.38±0.81, P=0.012).

CONCLUSION

Combining 40keV images and 50% ASiR-V can significantly improve image quality of basilar artery branches, compared to 100 kVp-like images.

CLINICAL RELEVANCE/APPLICATION

Combining monochromatic image and ASiR-V can significantly improve image quality of artery. This protocol is expected to provide more reliable information for the diagnosis and treatment of patients with posterior cerebral circulation ischemia

SSG12-04 CT Protocol Optimization in Neck Imaging Using Anatomically Realistic 3D Printed Phantoms

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S501ABC

Participants
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PURPOSE

To simulate patient neck CT imaging with 3D printed phantoms for a systematic evaluation of CT acquisition protocol settings regarding dose and image quality.

METHOD AND MATERIALS

Radiopaque 3D printed patient head and neck phantoms manufactured with potassium iodide doped ink were used for simulation of patient imaging. Two tube voltage settings, six tube current settings, and three pitch settings were systematically combined. Images were reconstructed with filtered back projection (FBP) and iterative reconstruction (IR). Image quality was evaluated with rater experiments (ten radiologist readers) and contrast-to-noise ratios. Dose reduction was evaluated with multiple phantoms with different anatomies and compared with patients that were retrospectively identified from our clinical database. A protocol with fixed 120 kVp, AEC (SD 7.5), a pitch of 0.8, and iterative reconstruction was used as reference to illustrate protocol optimization potential.

RESULTS

54 data sets were acquired and analyzed. Inter-rater reliability of the image grading experiments was excellent (ICC = 0.921; 95%CI 0.882 to 0.950). The benefit-to-risk ratio in terms of achievable image quality and required dose exposure was optimal with ATVS, AEC (SD 14), a pitch of 0.8, and IR. However, image quality was limited (46% for subjective and 26% for objective image quality). An optimal balance between dose and high image quality was achieved with lower noise level AEC (SD 7.5). This protocol required 37% lower dose than the reference protocol. The retrospective analysis of patients that were imaged with different protocol settings yielded similar dose reduction.

CONCLUSION

Patient simulation with 3D printed phantoms provides opportunities for testing and optimization of CT acquisition protocols in a clinical context. The results from this study were in good agreement with clinical observations.

CLINICAL RELEVANCE/APPLICATION

CT protocol optimization entails significant dose reduction potential. Patient simulation with 3D printed phantoms provides opportunities for systematic and rapid protocol optimization.

SSG12-06 Analysis of the 3D Modulation Transfer Function (MTF) of a High-Resolution Diagnostic CT Scanner

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S501ABC

Participants
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PURPOSE

The spatial resolution characteristics of a recently introduced high-resolution diagnostic CT scanner (Precision, Canon Medical) is investigated using a multi-sphere phantom designed to probe the 3D modulation transfer function (MTF), quantifying performance among various scan protocols.

METHOD AND MATERIALS

The phantom presented an array of 9 acrylic spheres (25.4 mm diameter) as a basis for measurement of the oversampled edge-spread function (ESF) and presampling 3D MTF. Spherical edge profiles were converted to spherical coordinates and analyzed as a function of direction (elevation: \phi=0, axial, to \phi~90, z longitudinal). Directionality was held to \phi <= 80 to avoid cone-beam sampling effects. The 3D MTF was measured for 3 detector modes [normal-res NR (0.5x0.5mmx80slice), high-res HR (0.25x0.5mmx80slice), and super-high-res SHR (0.25x0.25mmx160slice)], filtered backprojection with 3 nominal filters [smooth Fc 18, bone Fc30, and high-res Fc81], 3 focal spot settings, and 3 pitch settings (0.57-1.38).

RESULTS

The 3D MTF provided quantitative insight on performance, limitations, tradeoffs, and the degree to which resolution was isotropic. The SHR detector mode increased the axial MTF (f50=1.03/mm) compared to NR (f50=0.84/mm) and improved z-resolution (f50=0.91/mm) compared to HR (f50=0.71/mm) for the Fc30 filter. SHR and HR modes gave the same axial MTF, as expected. Analysis of the 3D MTF characteristics showed that the 3 nominal filters acted primarily in the axial plane, imparting non-isotropic 3D resolution characteristics. Improvement in MTF with finer focal spot was quantified, and the 3D MTF was observed to be invariant with to helical pitch.

CONCLUSION

A multi-sphere phantom and ESF oversampling method provided an insightful probe of 3D MTF characteristics for a recently introduced ultra-high-res CT scanner, demonstrating the resolution advantages and limitations for various scan protocols. The SHR detector mode demonstrated improved axial and z direction MTF compared to NR mode, evident in clearer depiction of anatomical structure (e.g., temporal bone).

CLINICAL RELEVANCE/APPLICATION

Quantitative characterization of the 3D MTF is an important aspect of technical assessment for new CT scanner technology claiming high-resolution performance beyond that of previous systems.

SSG12-07 Whole-Body Low-Dose CT Combined with Model-Based Iterative Reconstruction Algorithm in the Follow-Up of Oncologic Patients: Image Quality and Dose Deduction

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S501ABC

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PURPOSE

To compare radiation dose and image quality of low-dose CT protocol combined with iterative model-based reconstruction algorithm (IMR) with standard-dose CT approach combined with hybrid-iterative reconstruction algorithm (iDose) in the follow-up of oncologic patients.

METHOD AND MATERIALS

We enrolled a hundred and thirty patients with known oncological diseases; all patients were examined, during their clinical follow-up, with both a low-dose CT performed on 256-row scanner,with 100 kV and automated mAs modulation (depending on patient weight),and a standard-dose CT performed on 256-row scanner, with 120 kV and automated mAs modulation. Images were reconstructed with IMR for the low-dose CT protocols and iDose algorithm for the standard-dose CT studies. In both studies we measured density values and image noise in liver and spleen and we calculated the signal-to-noise ratio(SNR) and the radiation dose exposure. The diagnostic quality evaluation was also performed with a 4-point scale.

RESULTS

Noise of images expressed as SD values, measured in liver and spleen, was significantly lower in IMR images (liver 11,63 vs 14,79, p<0,001) whereas SNR was statistically higher (liver 10,46 vs 7,86, p<0,001) compared to iDose reconstruction. Volumetric-CT-Dose-Index (CTDIvol) and Dose-Length-Product (DLP) were significantly lower in IMR compared to iDose studies (DLP 624,40 vs 1013,90 mGy*cm, p<0,001), with an overall dose reduction of 38,42%. The qualitative analysis did not reveal any significant differences in terms of diagnostic quality (p=0,04).

CONCLUSION

MAs modulation combined with IMR algorithm and low kV setting allows dose reduction of 45,72% in whole body CT imaging without loss of diagnostic quality. Therefore, it represents a useful diagnostic approach to reduce radiation dose exposure in oncologic patients who undergo several follow-up CT studies.

CLINICAL RELEVANCE/APPLICATION

CT has a main role in the follow-up of oncologic patients; therefore, lowering doses is desirable, according to the A.L.A.R.A. principle. Low-kV CT with IMR allows to significantly reduce doses, offering a high diagnostic image quality.

SSG12-08 Machine Learning and Deconvolution to Improve the Spatial Resolution of the Adaptive Statistical Iterative Reconstruction (ASir-V) at the Same Noise Level

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S501ABC

Participants
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PURPOSE

For the same noise reduction characterized by the noise power spectrum (NPS), the machine learning approach of PixelShine (PS) by AlgoMedica preserves better the central frequency ratio (CFR) in NPS than the adaptive statistical iterative reconstruction (ASir-V) by GE. CFR was taken between the central frequencies of the NPS of the noise reduction and the baseline CT images to indicate the degree of shift in central frequency after noise reduction. Smaller CFR means more shift of the NPS curve or more image blurring. As the noise texture is highly correlated with CFR, PS may be preferred over ASir-V. The purpose of this study is to improve ASir-V by deconvolution to decrease the blurry appearance of the ASir-V while maintaining the same level of noise reduction already achieved by ASir-V.

METHOD AND MATERIALS

The homogeneous module of the ACR CT phantom (model 464, Gammex-RMI, Wisconsin) was scanned on a GE revolution HD 64-slice CT at 3.6 mGy (CTDI-16 cm). Each scan was repeated twice for NPS calculation. Radiation exposure was increased from 3.6 to 72 mGy to simulate ideal noise reduction without PS or ASir-V. We designed a set of deconvolution filters for the various strengths of ASir-V, followed by PS and name this approach as ASir-VDPS. The images of the ASir-V and ASir-VDPS settings from 10 to 100% and the PS settings of 1 to 9 were compared. Noise magnitude ratio (NMR) was taken between the areas under the NPS curve of the noise reduction and the baseline FBP images to indicate the amount of noise removed by the reconstruction. Smaller NMR means more noise reduction. A desirable noise reduction shall maintain CFR of close to 1 and a NMR of close to 0.

RESULTS

When the radiation exposure was increased from 3.6 to 72 mGy, NMR can be reduced without any change of CFR for the ideal noise reduction. At 3.6 mGy, noise reduction was better achieved by either ASir-VDPS or PS, followed by ASir-V. However, the results of ASir-VDPS (80 to 100%) demonstrated that our current design of deconvolution was not sufficient for resolution recovery introduced by ASir-V.

CONCLUSION

Combination of deconvolution and machine learning can improve ASir-V in spatial resolution or image sharpness without sacrificing the noise reduction already achieved by ASir-V.

CLINICAL RELEVANCE/APPLICATION

ASir-V blurs the CT images during noise reduction. Our approach rectifies this issue without sacrificing the noise reduction already achieved by ASir-V.

SSG12-09 Investigating the Relationship between Image Noise and Noise Index of Dose Modulation Behavior

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S501ABC

Participants
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CONCLUSION

Save the efforts of clinical protocol development/management and improve the operational work flow.

Background

Purpose: To evaluate the behavior of dose modulation performance for optimizing clinical image acquisition protocols. Methods: Four tissue equivalent abdominal CT dose phantoms (CIRS 007TE) were scanned using a GE Revolution CT scanner. To simulate an extra-large size patient, a 5th phantom (60cm by 40cm) was assembled from a QRM-Abdomen phantom attached to two extension rings. Abdominal CT protocol: 120kVp, 0.6s rotation time, 80mm beam width, 0.508 pitch, 2.5 mm image thickness and Large Scan Field-of-View. With Auto-mA and Smart-mA enabled, Noise Index (NI) was varied resulting in various levels of image quality. Images were reconstructed using Standard algorithm. For each phantom size/NI combination, ROI (n=3/image) and noise measurements (standard deviation of ROI) in 5 consecutive images of the central portion of the phantom were performed. The relationship of noise versus NI was plotted for each phantom size.

Evaluation

Results: For the scans of each phantom size, the achieved mA values functioned as expected to the set NI values. For each phantom size, the measured noise increased linearly as NI value increased ($R2$ = 0.9981, 0.9978, 0.9980, 0.9963, for 15-yr old, small adult, medium adult, large adult, respectively). The noise values were within 7% of the mean noise values at a NI level among phantom of different sizes, indicating that the measured noise values were similar as a function of NI value regardless of the sizes of the phantoms. Moreover, the measured noise were within 12% of the 10 NI levels that were evaluated, at 2.5mm nominal image thickness; this suggests a direct correlation of the anticipated image noise to the NI value under this 2.5mm acquisition condition.

Discussion

Conclusion: The same NI value produced similar noise level in images across phantoms of different sizes. Unlike the multiple patient size-based approach for optimizing protocols of other GE scanner platforms, the one-size based protocol approach on the Revolution CT could save the efforts of clinical protocol development/management and improve the operational work flow.

Printed on: 10/29/20

SSG13

Physics (Deep Learning - Clinical Applications)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S502AB

AI PH

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

Participants
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Sub-Events

SSG13-01 Pre-Trained Deep Learning Convolutional Neural Network for Feature Extraction: Pitfalls and Potential

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S502AB

Participants
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PURPOSE

Pre-trained deep convolutional neural network (DCNN) are often used as feature extractor due to small data sets in medical imaging. We analyzed the pitfalls and potential of pre-trained DCNNs as feature extractor for mass classification in mammograms.

METHOD AND MATERIALS

With IRB approval, 4577 masses were collected and divided into 3222 training, 508 validation and 847 independent test sets. Pre-trained ImageNet-AlexNet DCNN without fine-tuning was deployed to the mammography data, a total of 4096 features from *F1* layer were extracted for each mass. Four types of analysis were studied: (#1) For a baseline study without feature selection, two classifiers: (#1a) random forest (RF) and (#1b) 5-layer neural network using the 4096 features as input were trained on the training set to optimize the classifier weights, and independently deployed on the validation and the test sets. (#2) Two feature selection methods: (#2a) genetic algorithm (GA) and (#2b) sequential forward selection (SFS), were studied using the validation set to guide feature selection and linear discriminant analysis (LDA) as the classifier. Area under the ROC curve (AUC) was used as performance measure. The trained classifiers with the selected features were applied to the test set for evaluation of generalizability.

RESULTS

Without feature selection, no over-fitting was observed for #1a and #1b, with validation and test AUCs between 0.71 and 0.73. GA evolved over 7000 feature combinations in 9 generations. SFS was analyzed with over 12 million selected feature combinations. With GA (#2a), moderate over-fitting was observed with AUC of 0.80 on the validation set and 0.73 on the test set. With SFS (#2b), severe over-fitting was observed with AUCs of >0.90 on the validation set and ~0.72 on the test set.

CONCLUSION

ImageNet-trained DCNNs without fine-tuning has moderate discriminative power for masses (AUC~0.7). Future studies could leverage this characteristic of pre-trained DCNNs when available data set is small. Reporting the performance on a data set that is used to guide feature or parameter selection can optimistically bias the result. It is important to evaluate the generalization performance using a truly independent test set.

CLINICAL RELEVANCE/APPLICATION

Feature selection from the large feature space extracted from DCNN risks the curse of dimensionality. The generalizability of classifiers with the selected features should be tested with unseen data.

SSG13-02 Do Different Deep Convolutional Neural Nets Learn Differently? An Analysis Using Lung Nodule Detection in Computed Tomography

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S502AB

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PURPOSE

Different types of deep neural nets (DCNNs) are used for a variety of medical imaging tasks. In this study we analyzed if different DCNNs learn differently for lung nodule detection in CT.

METHOD AND MATERIALS

From 1,010 LIDC-IDRI cases, we used 651 cases for training and cross-validation and 254 cases for independent testing. All nodules marked by at least one radiologist and of diameter > 3mm were included. Three popular DCNNs, VGG16, InceptionV1 (IC1), and Inception-ResNet (ICRes) pre-trained with ImageNet were studied. Top 200 lung nodule candidates detected in each CT volume using multiscale Hessian enhancement were used to extract 184 radiomics features and fine-tuning the DCNNs. Features from the first fully connected layer of the DCNNs and the output DCNN scores were analyzed with two methods: (a) feature embedding and (b) score ranking. Feature embedding was performed using uniform manifold approximation and projection (UMAP), which is a fast and highly scalable method to reduce high dimensional features to 2 dimensions. DCNN scores were analyzed using rank-rank hypergeometric overlap (RRHO) distributions to visualize the degree of correlation between scores from different DCNNs. Features extracted from the DCNNs fully connected layer were merged with radiomics features and used to train a random forest classifier. Competition Performance Metric (CPM) calculated from FROC curves used in the LUNA16 challenge was used for comparison.

RESULTS

UMAP analysis shows TPs and FPs have different distributions of overlap. RRHO maps show varied correlation for different levels of high to low ranking DCNN scores indicating potential complementary information if combined. Merging features from VGG16 (CPM=0.62) and IC1(CPM=0.65) improved the performance to CPM=0.69. Merging ICRes (CPM=0.70) and IC1(CPM=0.65) improved the performance to CPM=0.73. For comparison, the CPM obtained by 10-fold cross-validation ranged from 0.61 to 0.81 in the LUNA16 challenge for the LIDC-IDRI set.

CONCLUSION

Different DCNNs learn different feature representations for the same task, which may offer complementary information. Further research is needed to intelligently merge relevant information to improve performance.

CLINICAL RELEVANCE/APPLICATION

With the availability of large number of different DCNN structures, understanding their characteristics and leveraging the complementary information can potentially improve machine learning.

SSG13-03 Deep Learning for Automatic Landmark Localization in CTA for Transcatheter Aortic Valve Implantation

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S502AB

Participants
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PURPOSE

Fast and accurate automatic landmark localization in CT angiography (CTA) scans can aid treatment planning for patients undergoing transcatheter aortic valve implantation (TAVI). Manual localization of landmarks can be time-consuming and cumbersome. Automatic landmark localization can potentially reduce post-processing time and interobserver variability. Hence, this study evaluates the performance of deep learning for automatic aortic root landmark localization in CTA.

METHOD AND MATERIALS

This study included 672 retrospectively gated CTA scans acquired as part of clinical routine (Philips Brilliance iCT-256 scanner, 0.9mm slice thickness, 0.45mm increment, 80-140kVp, 210-300mAs, contrast). Reference standard was defined by manual localization of the left (LH), non-coronary (NCH) and right (RH) aortic valve hinge points, and the right (RO) and left (LO) coronary ostia. To develop and evaluate the automatic method, 412 training, 60 validation, and 200 test CTAs were randomly selected. 100/200 test CTAs were annotated twice by the same observer and once by a second observer to estimate intra- and interobserver agreement. Five CNNs with identical architectures were trained, one for the localization of each landmark. For treatment planning of TAVI, distances between landmark points are used, hence performance was evaluated on subvoxel level with the Euclidean distance between reference and automatically predicted landmark locations.

RESULTS

Median (IQR) distance errors for the LH, NCH and RH were 2.44 (1.79), 3.01 (1.82) and 2.98 (2.09)mm, respectively. Repeated annotation of the first observer led to distance errors of 2.06 (1.43), 2.57 (2.22) and 2.58 (2.30)mm, and for the second observer to 1.80 (1.32), 1.99 (1.28) and 1.81 (1.68)mm, respectively. Median (IQR) distance errors for the RO and LO were 1.65 (1.33) and 1.91 (1.58)mm, respectively. Repeated annotation of the first observer led to distance errors of 1.43 (1.05) and 1.92 (1.44)mm, and for the second observer to 1.78 (1.55) and 2.35 (1.56)mm, respectively. On average, analysis took 0.3s/CTA.

CONCLUSION

Automatic landmark localization in CTA approaches second observer performance and thus enables automatic, accurate and reproducible landmark localization without additional reading time.

CLINICAL RELEVANCE/APPLICATION

Automatic landmark localization in CTA can aid in reducing post-processing time and interobserver variability in treatment planning for patients undergoing TAVI.

SSG13-04 Improving Detection of Microcalcification Clusters in Low-Dose Digital Breast Tomosynthesis Using Deep Residual Learning

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S502AB

Participants
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PURPOSE

To improve the detectability of microcalcification (MC) clusters in low-dose digital breast tomosynthesis (DBT) by using very deep convolutional neural network (DCNN).

METHOD AND MATERIALS

To generate a synthesized high-dose (SHD) image from a low-dose image, we trained a 20-layer super-resolution CNN (SRCNN) to learn the residual image between the high-dose (HD) and low-dose (LD) images. The loss function is a weighted sum of the Euclidean distances between the gray levels over the image and between the contrast-to-noise ratios (CNR) of the MCs in the LD and HD patches. With IRB approval and informed consent, DBTs of human subjects were acquired with a GE prototype system at 21 projections over a 60º arc and reconstructed as HD DBT volume. LD DBTs were simulated by reconstructing with the central 9 projections over a 24º arc. The SRCNN was trained to generate SHD patches using 449 pairs of corresponding HD and LD MC patches extracted from the training DBT set. Each patch was 32 x 32 pixels at a pixel size of 0.1 mm x 0.1 mm and centered at an MC. A validation set of 191 LD MC patches was used to assess the improvement in CNR in the SHD patches. We previously developed a computer-aided detection (CAD) system that detects MCs in the HD DBT by using joint information from the reconstructed DBT volume and a 2D planar projection image generated from the same DBT volume. In this study, we adapted the joint-CAD system to MC detection in the LD DBT and compared the detection performances with and without deploying the trained SRCNN to the MC candidates detected at the pre-screening stage. The detection performance was evaluated by FROC analysis using an independent test set of 104 DBT volumes with MC clusters and 76 DBT volumes without MC clusters.

RESULTS

For MC cluster detection in the LD DBT, at 85% case-based sensitivity, the FP rate was reduced from 2.6 without to 1.1 FPs/DBT volume with the SRCNN for CNR enhancement. The improvement was statistically significant (p = 0.0001) by JAFROC analysis.

CONCLUSION

SRCNN significantly improves MC cluster detection by the CAD system in low-dose DBT, indicating a potential for reducing dose in DBT imaging.

CLINICAL RELEVANCE/APPLICATION

Improved performance of CAD in low-dose DBT has potential implications on reducing patient dose for DBT imaging particularly during screening.

SSG13-05 Fuzzy Edge Attentional Generative Adversarial Network for Automated Fibroglandular Tissue Segmentation in Breast MRI

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S502AB

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PURPOSE

To investigate the efficacy of a fuzzy edge attentional deep learning approach for automated fibroglandular tissue (FGT) segmentation in breast MRI as an essential step for FGT and background parenchymal enhancement (BPE) quantitative analysis.

METHOD AND MATERIALS

Previous research has shown that deep learning with U-Net outperformed the traditional image processing methods for FGT segmentation. However, U-Net segmentation performed poorly around the fuzzy edges of FGT region. In this study, we proposed a robust fuzzy edge attentional generative adversarial network(FEA-GAN) to overcome this difficulty. An improved U-Net was designed as generator to generate FGT candidate areas while a patch deep convolutional neural network (DCNN) was designed as discriminator. To reconcile the semantic features from different scales, the convolutional layers in generator were replaced by inception-like multiscale blocks. Residual convolutional layers were incorporated with the skip connections to reduce the semantic gap between encoder and decoder. To reduce false candidate areas caused by fuzzy edges, the patch DCNN restricts attention to edge structures in local image patches. With IRB approval, we retrospectively collected 100 patients aged 22-78 years old at an academic hospital. Axial T1-weighted fat-suppressed images from 200 breasts were acquired from 1.5T Siemens Magnetom Espree system. An experienced radiologist manually marked contours of FGT on 3D slices as the reference standard. Five-fold cross-validation was applied for training and testing. The results were evaluated in three measures: Dice similarity coefficient (DSC), Jaccard index (JI) and Hausdorff distance (HD).

RESULTS

With five-fold cross-validation, the DSC, JI and HD for segmentation with FEA-GAN were 87.0±7.0%, 77.6±10.1%, 3.69±0.71mm, respectively. With U-Net, the corresponding values were 81.1±8.7%, 69.0±11.3%, 4.18±0.77mm, respectively. Compared with U-Net, the improvement for all measures achieved statistically significant ($p<0.0001$).

CONCLUSION

The proposed FEA-GAN model significantly outperformed the U-Net model in terms of DSC, JI and HD. Further work is underway to apply the proposed FGT segmentation method for FGT and BPE quantitative analysis.

CLINICAL RELEVANCE/APPLICATION

Automated FGT segmentation is a crucial step for quantitative assessment of FGT and BPE in breast MRI, which are strong risk factors for breast cancer.

SSG13-06 Evaluation of the Performance of Deep Learning Models Trained on a Combination of Major Abnormal Patterns on Chest Radiographs for Major Chest Diseases at International Multi-Centers

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S502AB

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PURPOSE

To evaluate the abnormal classification performance for major chest diseases using a deep learning model that was trained on a combination of major abnormal patterns on chest radiographs.

METHOD AND MATERIALS

We experimented with the abnormal classification performance for a deep learning model for major diseases (tuberculosis and pneumonia) that was trained on a combination of different patterns (nodule, consolidation and interstitial opacity) on CRs. To evaluate the effect of each pattern combination on performance for major diseases, we tested five cases of patterns, which is composed of the nodule case, the consolidation case, the interstitial opacity case, the combination of consolidation and interstitial opacity case, and the combination of all three cases. When training each case, all normal data was used for training. CRs with three abnormal patterns and normal patterns were used as training datasets, which were received from two hospitals and consisted of 2095, 2401, 1290, and 3000 images for nodule, consolidation, interstitial opacity, and normal patterns, respectively. And all abnormal CRs were clinically confirmed by CT scans. For an explicit evaluation, the public dataset was used as the test dataset, which consists of the Shenzhen (normal: 326, tuberculosis: 336) and PadChest (normal: 300, pneumonia: 127, randomly selected) dataset, which was used to evaluate tuberculosis and pneumonia, respectively.

RESULTS

In the test dataset, for tuberculosis and pneumonia, the classification performance of the models trained with the five cases of patterns showed AUC 0.58 / 0.69 for nodule case, 0.76 / 0.82 for consolidation, 0.52 / 0.76 for interstitial opacity case, 0.79 / 0.83 for combination of consolidation and interstitial opacity case, 0.79 / 0.82 for combination of all three case, respectively.

CONCLUSION

We have shown through experimentations that the deep learning model trained from data with major patterns (nodule, consolidation, interstitial opacity) can classify major diseases (tuberculosis, pneumonia) as abnormal. Also, consolidation was highly correlated with tuberculosis and pneumonia. On the other hand, interstitial opacity and nodule were more correlated with pneumonia, tuberculosis, respectively.

CLINICAL RELEVANCE/APPLICATION

The diagnosis based on the patterns of abnormal findings allows detection of various diseases.

SSG13-07 Automatic Quantification of 3D Body Composition from Abdominal CT with an Ensemble of Convolutional Neural Networks

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S502AB

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PURPOSE

Analysis of body composition based on CT, primarily comprising quantification of fat and muscles, is an important prognostic factor in cardiovascular disease and cancer. However, manual segmentation is time consuming and in 3D practically infeasible. The purpose of this study is to investigate the use of a deep learning-based method for automatic segmentation of subcutaneous fat, visceral fat and psoas muscle from full abdomen CT scans.

METHOD AND MATERIALS

We included a dataset of 20 native CT scans of the entire abdomen (Siemens Somatom Volume Zoom / Siemens Somatom Definition, 120 kVp, 375 mAs, in-plane resolution 0.63-0.75 mm, slice thickness 5.0 mm, slice increment 5.0 mm). Trained observers defined the reference standard by voxel-wise manual annotation of subcutaneous fat, visceral fat and psoas muscle in all slices that visualize the psoas muscle. Images of 10 patients were used to train a dilated convolutional neural network with a receptive field of 131 × 131 voxels to distinguish between the three tissue classes. To ensure robust results, 5 different networks were trained and subsequently ensembled by averaging the probabilistic results. Voxels were assigned to the class with the highest probability. Images from the remaining 10 patients were used to evaluate the performance of the method. Performance was evaluated with Dice coefficients between the manual and automatic segmentations. Additionally, linear correlation coefficients (Pearson's r) were computed between the manual and automatic segmentation volumes.

RESULTS

The average Dice coefficients over 10 test scans were 0.89 ± 0.02 for subcutaneous fat, 0.92 ± 0.04 for visceral fat, and 0.76 ± 0.05 for psoas muscle. At the L3 vertebrae level, the average Dice coefficients were 0.92 ± 0.02 for subcutaneous fat, 0.93 ± 0.05 for visceral fat, and 0.87 ± 0.04 for psoas muscle. Pearson's r between the manual and automatic volumes were 0.996 for subcutaneous fat, 0.997 for visceral fat, and 0.941 for psoas muscle. On average, segmentation of a full scan was performed in about 15 seconds.

CONCLUSION

The results show that accurate fully automatic segmentation of subcutaneous fat, visceral fat and psoas muscle from full abdominal CT scans is feasible.

CLINICAL RELEVANCE/APPLICATION

The proposed method allows fast and fully automatic analysis of 3D body composition in abdominal CT that can aid in individualized risk assessment in cardiovascular disease and cancer.

SSG13-08 Perceptive Feature Learning with Deep Semantic Network for Breast Mass Diagnosis on Digital Mammography

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S502AB

Participants
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PURPOSE

Malignant/Benign classification on digital mammography (DM) remains challenging in current clinical practice. Our purpose of this study is to use a perceptive feature learning scheme for computerized breast mass diagnosis on DMs.

METHOD AND MATERIALS

Recently, deep learning (DL) has been widely used for computerized cancer diagnosis. However, most of the DL approaches have the poor clinical interpretation. Aimed to improve breast cancer diagnosis and increase DL's interpretability, we proposed a perceptive feature learning scheme with a deep semantic network (DSN) for breast mass diagnosis on DMs. With IRB approval, DMs of 220 Chinese women were retrospectively collected. In total, 220 biopsy-proven masses (108 benign and 112 malignant) were reviewed by an experienced breast radiologist. Shape and margin of each mass were assessed based on ACR's BI-RADs lexicon and the assessment results were empirically encoded into five labels: irregular shape, round/lobulated shape, microlobulated margin, speculated margin and circumscribed/obscured/indistinct margin. Our DSN with 5 encoded labels as target was designed to learn the human reader's visual perceptions of masses. A mass-centered patch and its corresponding segmentation mask were concatenated as an input of DSN (patch size of 288x288x2). The trained DSN without output layer was served as feature learning network for the extraction of 128 perceptive features. We compared the perceptive features with previously developed radiomics features. Ten-fold cross validation was used for model selection. At each fold, we applied stepwise linear discriminant analysis (LDA) for dimension reduction and malignant/benign classification. Area under the ROC curve (AUC) was used as a figure of merit for the performance evaluation.

RESULTS

In model selection, we selected an average of 30 features in each fold. It was found that the improvement of the classifier with radiomics+perceptive features (AUC of 0.95 ±0.03) to radiomics alone (AUC of 0.91±0.03) was statistically significant ($p < 0.05$).

CONCLUSION

The features learned by DSN with expert's visual perceptions of masses significantly improved the diagnostic performance of breast mass on DMs.

CLINICAL RELEVANCE/APPLICATION

Perceptive features learned from reader's visual perception have the added value for computerized breast mass diagnosis on DMs and such features have potential to increase the interpretability of CAD.

SSG13-09 A PIRADS Based Similar MRI Retrieval System for Prostate Cancer

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S502AB

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PURPOSE

To compare different deep learning algorithms to retrieve images with similar lesions in term of PIRADS score. In particular we evaluate the performance of a Siamese convolutional neural network (SIAM-CNN) against a standard convolutional Autoencoder (AE-CNN). We hypothesize that SIAM-CNN works better at retrieving similar images based on PIRADS score.

METHOD AND MATERIALS

We use a set of 601 consecutive multiparametric prostate MRIs from 2016 acquired in our hospital that contains 890 PIRADS reported lesions. The image similarity was based on the axial computed high b-value series. Both CNNs were designed to operate with 40x40x3 voxel ROIs selected around the reported lesion location. SIAM-CNN is a supervised algorithm that is trained to find the most similar images with the same PIRADS score. Instead, AE-CNN is unsupervised and assesses similarity only based on image appearance. We used 672, 90 and 128 images as training, validation and test set, respectively, and used a 3-fold cross validation for the performance estimation. The performance was quantified in terms of Mean Absolute Error (MAE) between the PIRADS of the query and that of the retrieved images. We provide the score for the TOP-1 and 3 retrieved lesions.Additionally, qualitative visual assessment was performed.

RESULTS

The TOP-1 MAE for the SIAM-CNN is 0.75±0.12 while the AE-CNN score is 0.87±0.02 (p-value=0.15). The TOP-3 score for the SIAM-CNN is 0.75±0.09 while the AE-CNN score is 0.97±0.05 (p-value=0.02).

CONCLUSION

The Siamese CNN is better than the Autoencoder CNN at retrieving similar images based on PIRADS, both quantitatively (MAE) and qualitatively based on visual assessment. Future work aims at integrating multi-parametric and/or multi-view MRI, in order to obtain further performance improvements.

CLINICAL RELEVANCE/APPLICATION

Siamese CNN can be a valuable aid in prostate cancer MRI assessment by retrieving similar images with similar PIRADS score. This could help reduce prostate MRI interpretation variability.

SSG14

Physics (MRI - Clinical Applications)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S504AB

MR PH

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

FDA Discussions may include off-label uses.

Participants
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Matthew A. Bernstein, PhD, Rochester, MN (*Moderator*) Former Employee, General Electric Company; Intellectual property, General Electric Company

Sub-Events

SSG14-01 Development of Respiratory Motion-Resolved Hepatobiliary Phase Cine-MRI Using Compressed SENSE for Stereotactic Body Radiotherapy in Liver Tumor

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S504AB

Participants
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CONCLUSION

The CS with denoising improved tumor-to-liver contrast and image quality in high temporal resolution HBP cine-MRI, which can be potentially applied for stereotactic body radiotherapy.

Background

For radiotherapy of the liver, cine-MRI has been used to track respiratory-induced motion of the liver and tumor, and to assist accurate delineation of tumor volume. However, tumor boundaries cannot be clearly defined when using balanced SSFP and single-shot T2-weighted sequences because of poor tumor-to-liver contrast. Recent development of Compressed SENSE (CS) enables to accelerate temporal resolution while maintaining contrast resolution. This study aimed to develop and assess hepatobiliary phase (HBP) cine-MRI using CS.

Evaluation

Twenty patients underwent HBP cine-MRI after gadoxetic acid injection, consisted of modified 2D-GRE T1-weighted TFE sequence with saturate recovery prepulse (TR/TE, 3.1/1.46 ms; FA, 30°; FOV, 380 mm; acquisition matrix, 112×201; slice thickness, 3mm) in every 0.5 second for one minute. The images were acquired with SENSE (factor, 4), CS (factor, 4) without denoising (CS-no), and CS with strong denoising level (CS-strong) to assess the capability of CS for image quality improvement. For quantitative analysis, signal noise ratio of the liver and tumor (SNRLiv, SNRTum) and liver-to-tumor contrast ratio (CRLiv/Tum) were measured. For qualitative analysis, two radiologists evaluated lesion conspicuity, contrast enhancement, image noise, motion smoothness, and overall quality on a 4-point scale. The SNRLiv and SNRTum were 6.8 ± 2.7 and 2.8 ± 0.8 for SENSE, 6.7 ± 2.8 and 3.0 ± 1.0 for CS-no, and 14.4 ± 3.9 and 5.7 ± 2.8 for CS-strong, respectively (P<.001, repeated measures ANOVA). The CRLiv/Tum was 0.47 ± 0.13 for SENSE, 0.43 ± 0.12 for CS-no, and 0.49 ± 0.16 for CS-strong (P>.05). The CS-strong showed significantly higher image quality (P<.01, Kruskal-wallis H test) except for motion smoothness (P=.11).

Discussion

The CS can suppress aliasing artifact using random undersampling of k-space trajectory, enabling to apply wavelet transformation and denoising. This algorithm substantially increased SNR, contributed to improvement of contrast ratio and image quality in HBP cine-MRI.

SSG14-02 Multi Band-SWeep Imaging with Fourier Transformation (MB-SWIFT) MRI Can Quantify Bone Mineral Density while Concurrently Characterizing Material-Level and Biochemical Changes in Bone In Vivo

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S504AB

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PURPOSE

Multi-Band SWeep Imaging with Fourier Transformation (MB-SWIFT) MRI could have novel and specific application in bone where capturing mineral and remaining 40% of the composite tissue that confers to bone quality and strength is desired. We describe a comprehensive set of biomarkers to characterize material-level and biochemical components that are "missed" when using gold-standard bone imaging approaches (clinical DXA, pre-clinical µCT). Further, we establish the efficacy of MB-SWIFT to measure bone mineral density (BMD) in comparison to µCT.

METHOD AND MATERIALS

In vivo µCT (Bruker SkyScan1176, 35 µm3) and MB-SWIFT MRI (Agilent 9.4T, 156 µm3) of the proximal tibiae were obtained at baseline and 2, 4, 10 and 12 wks post ovariectomy (OVX) in 7 rats (F, 6 wks old). µCTs were registered to corresponding MRIs per timepoint and resulting transforms were applied to µCT-derived cortical and trabecular VOIs guiding analysis across modalities. Cortical water fraction, marrow fat fraction and cortical matrix volumetric T1 relaxation using the variable flip angle method were quantified from MB-SWIFT images. Sensitivity to cortical water loss during sequential drying was confirmed in excised tibia. µCT and MRI images were converted to Hounsfield units and BMD was calculated using a concurrently imaged calcium hydroxyapatite standard. Pearson's correlation coefficients, simple linear regressions and RM-ANOVAs were employed and significant at $p <= 0.05$.

RESULTS

MB-SWIFT cortical and trabecular BMD correlated significantly with µCT BMD (cortical: $R=0.67$, $p<0.0001$; trabecular: $R=0.62$, $p<0.0001$) which significantly increased longitudinally. Growth appeared to overcome estrogen-deficient changes in bone mass yet MB-SWIFT distinguished significant decreases in cortical water, increases in marrow fat and increases cortical matrix volumetric T1 relaxation consistent with OVX by 10 weeks. MB-SWIFT cortical water fraction significantly correlated to cortical water loss (% by volume) during sequential drying ($R=-0.98$, $p=0.01$).

CONCLUSION

MB-SWIFT MRI could have a novel and specific application in bone where capturing information on both mineral and matrix properties that confer quality and strength is highly desired.

CLINICAL RELEVANCE/APPLICATION

MB-SWIFT can quantify biomarkers of bone quality and mineral phase of bone without the use of harmful ionizng radiation holding promise for clinical adaptation allowing for safe longitudinal analysis of bone.

SSG14-03 Quantitative Biliary Tree Imaging by MRI: A Novel Method of Assessing Change Over Time in Hepatobiliary Disease via MRCP

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S504AB

Participants
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CONCLUSION

We demonstrate that state-of-the-art quantitative MRCP enables the extraction of quantitative biomarkers of biliary anatomy able to objectively identify changes in ducts over time, which correlates with biliary disease that were not identified via biochemical markers. Quantitative biliary tree imaging warrants ongoing investigation prospectively as a means of a potential standardised application for disease and therapy monitoring in PSC.

Background

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive imaging technique for the evaluation of hepatobiliary disease. Despite widespread use there remains a lack of objective assessment of biliary duct changes, and detecting changes in scans can be difficult, hindering monitoring of disease progression. Furthermore, serum biomarkers for hepatobiliary disease lack sensitivity to longitudinal changes biliary disease status. Here we evaluate the utility of novel quantitative biomarkers of biliary anatomy, extracted from 3D MRCP scans, to assess changes in biliary ducts over 1 year in patients with autoimmune liver diseases.

Evaluation

Patients with primary sclerosing cholangitis (PSC, n=44), autoimmune hepatitis (AIH, n=35) and primary biliary cholangitis (PBC, n=59) were recruited for heavily T2-weighted MRCP imaging at base-line and 1-year follow-up. A total of 284 scans were processed with quantitative image analysis to enhance and quantify the tubular structures. The underlying algorithms combine multi-scale Hessian analysis, gradient vector flow analysis, intelligent path search algorithm and novel duct modelling algorithms.

Discussion

Quantitative imaging, evaluating MR-apparent biliary duct size and length distinguished PSC from AIH and PBC patients (p<0.001). At baseline, the number of strictures was a better classifier of PSC and AIH patients (AUC=0.72) than bilirubin (AUC=0.65). At 1 year follow up PSC patients contained significantly more strictures (p<0.01) and greater stricture severity (p<0.01) compared to AIH and PBC, whilst alkaline phosphatase (ALP) and bilirubin were found to exhibit no significant changes from baseline across the 3 cohorts. High risk PSC patients (ALP>1.5xULN) were found to have more dilatations (p<0.01) and greater stricture severity (p<0.01) than low risk at baseline. Abnormal length sum, stricture length sum (AUC=0.74, 0.73 respectively) were found to accurately classify high and low risk patients. Interestingly, metrics in high risk patients did not change from baseline at follow up, whilst low risk PSC patients were found have an enlarged tree volume (p<0.01), duct length (p<0.01) and stricture severity (p<0.01) at follow up.

SSG14-04 Validation of Highly Accelerated Wave-CAIPI 3D-T1 Sampling Perfection With Application Optimized Contrast Using Different Flip-Angle Evolutions (Wave-3D-T1 SPACE) with Conventional 3D-T1 SPACE for Post-Contrast Brain Imaging

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S504AB

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PURPOSE

To evaluate the image quality and diagnostic performance of highly-accelerated Wave-CAIPI 3D-T1 Sampling Perfection with Application-optimized Contrasts by using flip angle Evolution (Wave-T1 SPACE) compared to conventional 3D-T1 SPACE for the detection of intracranial enhancing lesions on post-contrast brain MRI.

METHOD AND MATERIALS

Consecutive patients (N=38) undergoing 3T clinical brain MRI with contrast were prospectively enrolled. The most common indications for MRI were screening for brain metastases (N=21), and evaluation of primary brain tumors (N=8). All MRI scans included a conventional post-contrast T1 SPACE (R=4, acquisition time TA=4min 19s) and resolution-matched (slice thickness = 0.9mm) post-contrast Wave-T1 SPACE sequence (R=9, TA=1min 40s). Studies were performed on a clinical 3T MRI scanners (MAGNETOM Prisma; Siemens, Erlangen). Two neuroradiologists evaluated the images head-to-head for the visualization of enhancing lesions and nonenhancing pathology, grading of motion artifacts and noise, and diagnostic quality using a predefined 5-point scale. Discrepancies were adjudicated by a third reader. Wave-T1 SPACE was tested for non-inferiority compared to conventional T1 SPACE using a 10% non-inferiority margin.

RESULTS

Compared to conventional post-contrast T1 SPACE, Wave-T1 SPACE showed no difference in the visualization of enhancing lesions (P<0.001) and non-enhancing pathology (P=0.003), and no difference in diagnostic quality (P<0.001). Wave-T1 SPACE images demonstrated comparable or reduced motion artifact in the majority of cases and slightly greater image noise, with no impact on overall diagnostic quality. The figure shows representative examples demonstrating the comparable image quality of the post-contrast Wave- and conventional T1 SPACE sequences in delineating leptomeningeal disease and brain tumor.

CONCLUSION

A 1.6-minute Wave-T1 SPACE acquisition demonstrates comparable performance to a 4.3-minute resolution-matched conventional T1 SPACE sequence in identifying enhancing lesions, with an approximate 3-fold reduction in acquisition time. The findings support clinical application of Wave-T1 SPACE over conventional T1 SPACE for routine post-contrast clinical brain imaging.

CLINICAL RELEVANCE/APPLICATION

Wave-T1 SPACE is comparable to conventional T1 SPACE in detecting enhancing lesions with up to 3-fold reduced scan time and less motion, supporting its clinical application in routine brain imaging.

SSG14-05 Application of Magnetic Resonance Imaging with Free-Breathing T1-Weighted Star-VIBE for Improving Image Quality in Chest: A Study Compared with T1-Weighted Conventional Breath-Hold VIBE

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S504AB

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PURPOSE

To explore the application of free-breathing T1-weighted Star-VIBE sequence for improving image quality in chest compared with T1-weighted conventional breath-hold VIBE sequence in magnetic resonance(MR) imaging.

METHOD AND MATERIALS

Twenty patients underwent MR chest examination on a 3.0T scanner (MAGNETOM Skyra, Siemens Healthcare, Erlangen, Germany). The scan sequences included T1-weighted conventional breath-hold VIBE(group A: TE 1.29 ms, TR 3.97 ms) and free-breathing T1-weighted Star-VIBE (group B: TE 1.39 ms, TR 2.79 ms). The signal intensity (SI) and standard deviation (SD) of ascending aorta, main pulmonary artery and descending aorta were measured at the level of main pulmonary artery. The signal-to-noise ratio (SNR=SI/SD) and coefficient of variation (CV=SD/SI) of signal intensity were calculated. The image quality was subjectively scored double-blindly using a 5-point scoring system by two radiologists who had five or more years of working experience (5 point, the image quality is best; 4 point, the image quality is better; 3 point, the image quality is general; 2 point, the image quality is poor; 1 point, the image can not be evaluated).

RESULTS

There was no significant difference in population characteristics between the two groups (P>0.05). The signal-to-noise ratio (SNR) of ascending aorta, main pulmonary artery and descending aorta in group B were significantly higher than those of group A(P<0.05), while the coefficient of variation of signal intensity about group B were significantly lower than those of group A(P < 0.05). The subjective scores of image quality by the two MR radiologists had excellent consistence (kappa value>0.80, P<0.05), the subjective score of group B were significantly higher thangroup A (P < 0.05).

CONCLUSION

Magnetic resonance imaging with free-breathing T1-weighted Star-VIBE sequence can significantly improve image quality in chest compared with T1-weighted conventional breath-hold VIBE sequence.

CLINICAL RELEVANCE/APPLICATION

In thoracic magnetic resonance imaging, free-breathing T1-weighted Star-VIBE sequence can be used to improve image quality, which can obtain better image quality compared with T1-weighted conventional breath-hold VIBE sequence.

SSG14-06 Design Your MSK MRI: It Needs to be Planned by Radiologist

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S504AB

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PURPOSE

To evaluation the recall rate and causes of musculoskeletal MRI scanned at a tertiary center

METHOD AND MATERIALS

From January to July 2018, 1639 musculoskeletal MRI were performed in our institution. Two musculoskeletal radiologists reviewed, recalled, and rescanned cases. Evaluation for reasons of recalled cases by consensus were in the following categories: resolution issue, field of view issue, coil issue, artifact issue, missed sequence issue, newly detected lesion issue, and miscellaneous. Then radiologists reviewed the rescanned images and assessed a 4-point confidence level before and after an additional scan. Finally, they were asked if a rescan could have been avoidable if they were asked to designed the protocol before scanning (yes, not sure, no).

RESULTS

The total recalled cases were 47 out of 1639 (2.8%). The causes of recall were FOV issue (14), adding the sequence (9), resolution issue (8), coil issue (3), metal artifact control (3), incidental lesion (2), changing position (2), and miscellaneous (5). The confidence score significantly increased after a rescan compared with the initial image (3.2 vs. 2.7, respectively, P<0.05). Two radiologists reported 33 out of 47 cases would not need a rescan if the radiologist were able to design the protocol prior to the scan.

CONCLUSION

Musculoskeletal MRI can offer insufficient information at an initial scan for various reasons; and for a better diagnosis, a rescan is necessary. However, the number of rescans may decrease when radiologists design the protocol prior to the scan

CLINICAL RELEVANCE/APPLICATION

Musculoskeletal MRI is complex when designing the protocol compared to other MRI (e.g., brain, breast, liver, etc.). Hence, musculoskeletal MRI needs planning well before scanning, and this is best done by a radiologist.

SSG14-07 Dynamic Contrast-Enhanced Magnetic Resonance Imaging during Free Breathing for Hepatic Lesions: Clinical Applicably and Limitations

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S504AB

Participants
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PURPOSE

To evaluate the clinical applicability and limitations of this new prototype volume-interpolated breath-hold examination (VIBE) with compressed sensing (VIBEcs) for rapid multiphase MRI with free selectable variable temporal resolution for hypervascularized hepatic lesions.

METHOD AND MATERIALS

Twenty patients with hypervascularized hepatic lesions were included in this study and underwent contrast-enhanced liver MRI at 3 T. In all patients, VIBEcs was used for rapid arterial multiphase imaging. Results were analyzed regarding image quality and clinical applicability of the dynamic lesion evaluation. Evaluation of image quality, visibility and conspicuity was performed by three independent radiologist, each with more than 5 years of experience in oncology imaging, based on a 5-point Likert scale (5=excellent). Results were correlated with the lesion entity. Limitations for the use of VIBEcs in image acquisition were defined. Time curves of dynamic contrast enhancement were plotted for each patient and quantification of attenuation performed to isolate the optimal time-point for image acquisition.

RESULTS

All patients were successfully evaluated. Individual setting of acquisition time point (best point 8 seconds) instead of fixed delay allowed high reading scores for image quality, visibility and conspicuity for all lesions (mean score >4). Lesion entity showed no significant impact on the reading performance ($p=0.765$). Limitation were defined as following: small lesion size (<8 mm), subdiaphragmatic localization, large necrotic area (>80% of lesion).

CONCLUSION

Free-breathing MRI with VIBEcs allows image acquisition with high temporal and spatial resolution using individual acquisition time points during contrast phase to gain optimal results with a robust acquisition protocol.

CLINICAL RELEVANCE/APPLICATION

VIBEcs allows image acquisition with high temporal and spatial resolution for variable time points with a robust acquisition protocol and is recommended quantitavie measurements of hypervascularized liver lesions.

SSG14-08 Myocardial Extracellular Volume from T1 Mapping Measurements by Magnetic Resonance Imaging in Healthy Volunteers

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S504AB

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PURPOSE

To investigate the characteristics of myocardial extracellular volume fraction (ECV) derived from pre- and post-contrast T1 measurements among healthy volunteers.

METHOD AND MATERIALS

A total of 57 healthy volunteers underwent standard CMR imaging with administration of gadolinium. T1 measurements were performed with a Look-Locker sequence followed by gradient-echo acquisition (GRE). We tested the segmental, interslice,inter-, intra-, and test-retest characteristics of the ECV ,as well as the association of the ECV with other variables.

RESULTS

57 healthy volunteers were recruited and were included in the analysis. There were 26 men (46%) and 31 women. The mean age of volunteers was 47±17 years(range 21 to 78 years). The average body mass index was 27±4kg/m2,systolic blood pressure was 119±11mmHg,diastolic blood pressure was 74±4mmHg,heart rate was 67±6 beats/min, and hematocrit was 43±2%. The ECV

averaged 0.27±0.04(range 0.21 to 0.34). The intraclass coefficients for the intraobserver, interobserver and test-retest absolute agreements of the ECV were 0.95 (95% confidence interval: 0.85 to 0.98), 0.87 (95% confidence interval: 0.64 to 0.96), and 0.97(95% confidence interval: 0.84 to 0.99), respectively. In volunteers, the ECV was associate with age ($r=0.81$, $P<0.001$), maximal left atrial volume index ($r=0.38$, $P=0.00036$($P<0.01$)), and indexed left ventricular mass. There were no differences in the ECV between segments in a slice or between slices.

CONCLUSION

In summary, the ECV is a novel and potentially useful index for quantification of the myocardial extracellular volume fraction. The findings suggest that in healthy volunteers, the myocardial ECV ranges from 0.21 to 0.34, In humans, the myocardial ECV increases with age, is associated with left ventricular mass and left atrial volume, and has reliable test characteristics. Further work will need to be done to test the application of this technique to patients with cardiovascular disease associated with the development of myocardial fibrosis.

CLINICAL RELEVANCE/APPLICATION

In cardiac magnetic resonance (CMR) imaging, the T1 relaxation time for the 1H magnetization in myocardial tissue may represent a valuable biomarker for a variety of pathological conditions

SSG14-09 CAIPIRINHA-Dixon-TWIST (CDT)-Volume-Interpolated Breath-Hold Examination (VIBE) Imaging of the Abdomen at 3.0 Tesla: Optimization and Comparison of Time Resolution and Image Quality

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S504AB

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PURPOSE

In order to get a higher time resolution or spatial resolution of CAIPIRINHA-Dixon-TWIST (CDT)-Volume-Interpolated Breath-Hold Examination (VIBE) imaging of abdomen at 3.0 Tesla, we optimized the scanning parameters at three conditions and evaluated the time resolution and image's quality of them.

METHOD AND MATERIALS

Twelve patients (8 males, age 42±3.52; 4 females, 39±2.35) with focal liver lesions and eight healthy volunteers (5 males, age36±4.23; 3 females, 40±3.89) were enrolled and underwent abdomen CDT-VIBE imaging MR exam with breath-hold mode before and after contrast-enhancement. The scanning sequences, which included 4 phases within a breath hold, include three optimized sequence with time resolution of 0.4s/phase, 0.6s/phase and 1.5s/phase. The quantitative evaluation index included the signal-to-noise ratio (SNR) of spleen, left and right liver lobe, and the contrast to noise ratio (CNR) of left and right liver lobe. All quantitative indexes were measured in in-phase, opp-phase and water-phase images before and after contrast enhancement. Finally, the homogeneity, the sharpness and the artifacts of whole image was scored by two radiologists independently on the basis of a three-point scale, and the average of data was used as the final scores. All the quantitative and quality parameters were analyzed with One-way ANOVA and Kruskal-Wallis One-way ANOVA were applied for group comparison with Bonferroni correction.

RESULTS

After optimization of the parameters of CDT-VIBE, the highest time resolution can reach 0.4s/phase, and when compared with the optimized protocols with time resolution of 0.6s/phase and 1.5s/phase, no significant difference was found for CNR and SNR at spleen, left and right liver lobe ($p>0.05$) (Table 2-7). About subject evaluation scores, the average scores of image quality for sharpness in sequence with time resolution of 1.5s/phase was significantly higher than the other two optimized sequence ($p<0.001$). No significant difference was found for the homogeneity and the artifacts of image quality among three optimized conditions

CONCLUSION

Through optimization of the parameters of CDT-VIBE in abdomen imaging, a higher time resolution (0.4s/phase) or a higher spatial resolution can be acquired, which means a wider clinical application in abdomen imaging of the CDT-VIBE sequence.

CLINICAL RELEVANCE/APPLICATION

CDT-VIBE sequence will be a wider clinical application in abdomen imaging

SSG15

Radiation Oncology (Lung, Mediastinum, Pleura)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S503AB

CH RO

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

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Sub-Events

SSG15-01 Radiographic Patterns of Symptomatic Radiation Pneumonitis in Lung Cancer Patients: Imaging Predictors for Clinical Severity and Outcome

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S503AB

Participants
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PURPOSE

To investigate the imaging characteristics of radiation pneumonitis (RP) in lung cancer patients and define radiographic patterns associated with high-grade RP and RP-related death.

METHOD AND MATERIALS

Eighty-two patients with lung cancer (35 males, 47 females, median age 68) treated with conventional chest radiotherapy who had symptomatic RP (CTCAE Grade 2 in 60, Grade 3 in 15, Grade 5 in 7 patients) were identified from the radiation oncology database. Chest CT scans at the time of RP were retrospectively reviewed by a consensus of 2 chest radiologists. The imaging features of RP were studied for association with high-grade RP (Grade >=3) and RP-related death.

RESULTS

The CT findings of RP extended beyond the radiation field in 67 patients (82%) and were confined to the radiation field in 15 (18%). Both lungs were involved in 48 patients (59%). All lobes were involved in 28 patients (34%). CT findings included ground glass and reticular opacities in all patients, with traction bronchiectasis in 77 (94%) and consolidation in 74 (90%). In 67 patients with findings beyond the radiation field, the most common pattern was cryptogenic organizing pneumonia (COP) pattern with multifocal/focal distribution (n=54; 81%), followed by acute interstitial pneumonia (AIP)/acute respiratory distress syndrome (ARDS) pattern with diffuse distribution (n=10; 15%), nonspecific interstitial pneumonia (NSIP) pattern with peripheral distribution (n=2; 3%) and hypersensitivity pneumonitis (HP) pattern with diffuse distribution (n=1; 1%). High-grade RP was associated with higher extent of lung involvement (p=0.0025), diffuse distribution (p<0.001), AIP/ARDS pattern (p<0.001) and COP pattern (p=0.03). RP-related death was associated with higher extent (p=0.003), all lobe involvement (p=0.006), diffuse distribution (p=0.0003), AIP/ARDS pattern (p=0.0001) and COP pattern (p=0.04).

CONCLUSION

CT findings of symptomatic RP were noted to extend beyond the radiation field in most cases. COP pattern with multifocal distribution was most common. Higher extent of lung involvement, diffuse distribution, AIP/ARDS pattern and COP pattern were associated with high grade RP and RP-related deaths.

CLINICAL RELEVANCE/APPLICATION

Awareness of the imaging features of RP and radiographic patterns associated with high-grade RP and RP-related death is important for accurate image interpretation and optimal patient management.

SSG15-02 First Report of Salvage Stereotactic Body Radiotherapy after Prior Thermal Ablation for Primary and Secondary Lung Cancers

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S503AB

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PURPOSE

Stereotactic body radiotherapy (SBRT) and thermal ablation (TA) are both techniques to treat small lung tumors. To this date, there is no report of salvage SBRT after thermal ablation. We therefore aim to describe the efficacy and toxicity of SBRT for recurrent primary or secondary lung tumors after prior thermal ablation.

METHOD AND MATERIALS

We retrospectively reviewed patients from 2007 to 2018 who were initially treated with microwave thermal or radiofrequency ablation, who later developed local recurrence within the ablation cavity for which salvage SBRT was then performed. Dose and fractionation were based on tumor size and location. Toxicity was standardized using the Common Terminology Criteria for Adverse Events v5.0. Local control (LC) was estimated using the Kaplan-Meier method.

RESULTS

We identified 33 consecutive patients with 34 lesions with a median follow-up time of 21.6 months. Thirty patients (91%) had primary non-small cell lung cancers and 3 patients (9%) had lung metastases from non-lung primaries. The majority of lesions (82%) underwent initial microwave TA. Eleven lesions (32%) received additional local therapy prior to SBRT including 8 lesions (24%) receiving prior salvage TA and 3 (9%) receiving adjuvant radiation therapy with initial TA. Salvage SBRT was delivered with a median prescription dose of 50 Gy (range 28-54 Gy in 3-5 fractions). Median time to recurrence after TA was 10.1 months (interquartile range [IQR] 6.4-18.1). Median recurrence size was 1.95 cm (IQR 1.35-2.9) within a median ablation cavity size of 2.9 cm (IQR 2.5-3.75). After salvage SBRT, two in-field local failures occurred at 10.7 and 26.2 months resulting in an crude LC rate of 94%. The 2-year actuarial LC rate was 95.2% (95% CI, 70.7%-99.3%). One patient (3%) developed grade 2 symptomatic radiation pneumonitis and another patient (3%) developed grade 3 chest wall pain.

CONCLUSION

Salvage SBRT after prior TA for locally recurrent primary and secondary lung cancer is safe and effective.

CLINICAL RELEVANCE/APPLICATION

We report the first analysis of the toxicity and efficacy of salvage SBRT after initial TA. SBRT allows for potential disease cure in patients with local recurrence.

SSG15-03 Quantifying Anatomic Changes for Radiation Therapy Lung Patients to Predict the Benefit for Mid-Treatment Adaptive Radiation Therapy

Tuesday, Dec. 3 10:50AM - 11:00AM Room: S503AB

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PURPOSE

To evaluate the efficacy of quantifying mid-treatment anatomic changes in Stage III lung cancer patients being treated with radiation therapy to predict when adaptive radiotherapy (ART) may benefit the patient.

METHOD AND MATERIALS

Simulation CT and daily on-treatment conebeam CT (CBCT) images for fifteen patients treated with radiation therapy (45Gy/15fx to 66Gy/33fx) from 2014-2018 were evaluate. All CBCTs were classified into ART/non-ART following published guidelines for on-treatment anatomic changes, including tumor regression, tumor misalignment, surrogate misalignment, and lung density changes. Six regions of interest (ROI) were defined around the tumor, carina, spinal cord, and lungs by geometrically expanding contours used in the treatment planning process. Daily anatomic change was quantified on each axial slice of the CBCTs within each defined ROI using six common deformable image registration metrics. The median, 75th percentile, and 90th percentile of the daily quantified changes across all axial slices were evaluated as thresholds to automatically delineate between ART and non-ART classified patients.

RESULTS

Seven patients were classified as benefitting from ART, divided between tumor regression (7), lung density changes (4), surrogate alignment (4), tumor alignment (2). Boxplots for each calculated metric within the ITV+15mm ROI for all patients and daily CBCTs were produced, with the lower/upper box borders representing the 25th/75th percentile across all axial slices. Treatment days benefitting from ART for tumor regression had a correlation with the mean squared error metric. The average±stdev for the median, 75th, and 90th percentiles occurring on the first classified ART fraction for the 7 patients were 10.8±3.8, 15.3±6.6, and 20.5±9.5, respectively. The 75th percentile for two non-ART daily CBCTs exceeded the 75th percentile ART threshold. A similar range of results were observed for other combinations of ART classifications, ROIs, and quantifiable metrics.

CONCLUSION

Automatically triggering on-treatment lung patients for ART by quantifying anatomic changes on daily CBCTs is feasible and would be ideally suited for development of machine learning algorithms.

CLINICAL RELEVANCE/APPLICATION

Predictive ART models utilizing quantifiable metrics generated from daily CBCT imaging can improve theefficacy of identifying when ART would benefit patients treated for lung cancer.

SSG15-04 Quantification of Image-Guidance Benefit in Image-Guided Radiotherapy of Cancers

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S503AB

Participants
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PURPOSE

Image-guidance has been widely used in the clinic for accurate radiotherapy. However, a practical and effective method to evaluate the effect of image-guidance in the radiotherapeutic management of cancers is absent. The goal of this study is to quantify the benefit of image-guidance in image-guided radiotherapy (IGRT) of cancers.

METHOD AND MATERIALS

In this study, a new metric termed image-guidance index (IGI), has been proposed to quantify the benefit of image-guidance in cancer radiotherapy. It is calculated as a ratio of the square sum of dose differences between planning dose matrix and actual delivery dose matrix to the square sum of dose summation between the two matrixes, summing over all dose scoring voxels. Ranging from 0 to 1, larger IGI values indicate larger benefit out of image-guidance. An in-house MATLAB code with matrix operation was developed for the calculation of IGI. With IRB approval, IGI values were calculated based on the DICOM RT files of 716 patients with chest cancer. The patients were divided into 12 groups according to cancer sites including esophagus (upper, middle, lower, upper & middle, middle & lower, and whole), breast (left & supine, right & supine, left & prostrate, and right & prostrate) and lung (with or without mediastinum). Finally, the IGI values were calculated and compared among the various site groups and various techniques of SBRT, 3DCRT, IMRT and VMAT.

RESULTS

Overall, IGI increases monotonously as shift increases, with different slopes among various directions and various groups. With a shift of 1, 2 and 3 mm, respectively in each of the AP, RL and SI directions, the medians of IGI were 0.0002, 0.0009, 0.0017 in AP, 0.0002, 0.0008, 0.0017 in RL, and 0.0002, 0.0008, 0.0018 in SI for esophagus, 0.0008, 0.0030, 0.0061 in AP, 0.0006, 0.0026, 0.0052 in RL, and 0.0004, 0.0016, 0.0034 in SI for breast, and 0.0002, 0.0009, 0.0019 in AP, 0.0002, 0.0007, 0.0016 in RL, and 0.0005, 0.0021, 0.0045 in SI for lung, respectively. With a shift of 1 mm, except for lung in SI, the IGI values are different significantly among sub-groups for esophagus, breast and lung groups ($P = <0.003$).

CONCLUSION

IGI values vary significantly among various cancer types and IGRT techniques. Our results indicate that IGI can be used as an effective tool to quantify the benefit of image guidance in IGRT.

CLINICAL RELEVANCE/APPLICATION

IGI can be used as an effective tool to quantify the benefit of image guidance in IGRT.

SSG15-05 Evaluation of High-Risk Imaging Features for Detection of Local Progression After Pulmonary Stereotactic Body Radiotherapy

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S503AB

Participants
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Ursula Nestle, MD,PhD, Monchengladbach, Germany (*Presenter*) Nothing to Disclose

PURPOSE

Detection of local progression (LP) after stereotactic body radiotherapy (SBRT) for lung lesions can be difficult because of radiation-induced lung changes in CT scans. High-risk CT-features (HRF-CT) for prediction of LP have been proposed, the role of 18F-FDG-PET remains unclear. Here HRF-CT and 18F-FDG-PET-imaging features (HRF-PET) were evaluated in a prospective SBRT-trial cohort under "real-life conditions".

METHOD AND MATERIALS

Four independent and blinded observers scored follow-up (FU)-CT and 18F-FDG-PET/CT images of 65 pulmonary lesions after SBRT with a structured questionnaire assessing RECIST and HRF-CT ((sequential) enlarging opacity, bulging margin, linear margin disappearance, loss of air bronchogram, craniocaudal growth). If LP was suspected, the respective 18F-FDG-PET images were analyzed qualitatively, then quantitatively. Inter-observer Agreement (IOA) was determined using Cohen's kappa. Sensitivity and specificity of HRFs for detecting LP were calculated using the reference standard defined by clinical long term courses, including information on imaging and biopsy.

RESULTS

IOA for presence of individual HRF-CT were "slight" (k=0.119 to k=0.288), for overall suspicion on LP after CT assessment k= 0.308 for HRF-CT, k= 0.289 for RECIST and k= 0.604 after qualitative additional PET assessment. Sensitivity and specificity were 0.22-0.46 and 0.73-0.92 for HRF-CT, 0.30 and 0.94 for RECIST. Qualitative 18F-FDG-PET/CT analysis was highly sensitive (1.0; specificity 0.79), semi-quantitative evaluation using SUVmax revealed no further diagnostic benefit (sensitivity 1.0; specificity 0.67). Sensitivity / specificity of CT-assessment versus qualitative PET-assessment for detection of LP were 0.43 / 0,86 and 1,0 / 0,85, respectively.

CONCLUSION

While we could neither confirm RECIST nor defined HRF-CT as reliable predictors of LP, qualitative 18F-FDG-PET/CT assessment seems to offer more diagnostically accurate information about local progression after SBRT, not being improved by quantitative 18F-FDG uptake analysis.

CLINICAL RELEVANCE/APPLICATION

Qualitative 18F-FDG-PET/CT assessment seems to offer more diagnostically accurate information about local progression after SBRT than CT assessment, not being improved by semi-quantitative 18F-FDG uptake analysis.

SSG15-06 Preliminary Evaluation of Inhale/Exhale Quantitative CT for Functional Avoidance Radiotherapy Treatment Planning in Non-Small Cell Lung Cancer Patients

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S503AB

Participants
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Martha M. Matuszak, PhD, Ann Arbor, MI (*Abstract Co-Author*) Research funded, Varian Medical Systems, Inc; Consultant, Varian Medical Systems, Inc

PURPOSE

Minimizing severe pulmonary toxicity has become a major therapeutic aim for radiation treatment (RT) for non-small cell lung cancer (NSCLC) patients. While V/Q SPECT is a valuable tool for functional lung assessment, it has not been adopted for use in routine radiation treatment planning. In this study, we evaluate our quantitative CT technique as an alternative to V/Q SPECT for functional treatment planning in NSCLC patients undergoing RT.

METHOD AND MATERIALS

Paired inhale/exhale CT scans were acquired from 6 NSCLC patients at pre-tx as part of single site clinical trials. CT scans were co-registered and analyzed using the Parametric Response Mapping (PRM) technique, which classifies local lung parenchyma as normal or diseased. A Jacobian map (Jm), a measure of local deformation between inflation levels, was also calculated. The Jacobian map and PRM data were compared over the whole lung and locally to V/Q SPECT functional maps.

RESULTS

As seen in Figure 1, regions of high ventilation as identified by SPECT had high Jm values. In contrast, regions of low ventilation consisted of small airways disease (SAD) and parenchymal disease (PD). Jm was positively and negatively correlated to percent volume of PRM-derived normal ($R2=0.924$) and PD ($R2=0.878$), respectively, but not SAD ($R2=0.088$). Patients with elevated PD (40-90% of lung volume) were found to have low normalized ventilation (<0.95).

CONCLUSION

Classification of lung parenchyma by PRM and Jacobian maps offer the ability to quantify local estimates of healthy lung and various forms of pulmonary dysfunction. The comparison of PRM- and SPECT-based functional metrics showed similar spatial features. Quantitative CT techniques may improve functional treatment planning by more readily providing functional and descriptive lung information for RT planning.

CLINICAL RELEVANCE/APPLICATION

Patients treated for non-small cell lung cancer (NSCLC) often suffer from respiratory comorbidities. PRM of high-resolution inhale/exhale CT scans offers the ability to quantify various chronic pulmonary disease phenotypes. By identifying regions of normal and diseased lung through CT imaging, which is more readily available than V/Q SPECT, PRM has the potential to be adapted for use in functional radiation treatment planning. As such, this study sought to investigate the use of PRM in radiation treatment planning by comparing PRM-based functional metrics with SPECT-based functional metrics.

SSG15-07 Quality of Life After Pulmonary Stereotactic Fractionated Radiotherapy: Long-Term Results of the Phase II STRIPE Trial

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S503AB

Participants
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PURPOSE

Preserving health related quality of life (HRQOL) plays an important role in considering stereotactic body fractionated radiotherapy (SBRT). The prospective monocenter phase II STRIPE trial investigated long-term HRQOL after SBRT, efficacy and toxicity.

METHOD AND MATERIALS

Patients with <= 2 pulmonary lesions <= 5cm were treated with 4DPET/CT-based SBRT (3X12.5Gy or risk-adapted 5X7Gy, to the 60% isodose). Follow up (FU) was performed 2 and 7 weeks after SBRT, then 3monthly for 2 years with assessment of response (primary endpoint: 2-year cumulative incidence of local progression (LP); secondary endpoints: local progression free (LPFS), overall survival (OS) and toxicity (CTCAE)). Impact of predefined patient and treatment related factors on HRQOL (EORTC QLQ-C30 and EORTC QLQ-LC13) was evaluated.

RESULTS

Between 02/2011 and11/2014, 100 patients were given SBRT for 56 NSCLC and 44 pulmonary metastases. Long-term FU overall revealed stable Quality of Life (QoL)/Global health status (GHS), functions-scores and symptoms. For QoL/GHS, patients with low initial QoL/GHS-Score below the median of 50, revealed significantly stronger improvement than those with good QoL/GHS-scores (p< 0.001). Probability for LP, LPFS and OS 2 years after SBRT was 8.1%, 53.3% and 62.2%. Lower risk for LP was revealed for 3X12.5Gy (p=0.043) and for Dmin (Biological Effective Dose10) in the Planning Target Volume>100Gy (p=0.023). >=G3-Toxicity was < 4%, except dyspnea: >=G3 dyspnea was 6% at baseline and 14.5% 2 years after SBRT.

CONCLUSION

These prospective data on a representative cohort of pulmonary SBRT patients confirm a stable preservation of HRQOL after SBRT and furthermore demonstrate a QoL/GHS-benefit for patients with low initial QoL/GHS-scores, the regimen of 3x12.5 Gy SBRT being efficient and well tolerated. This result may inform shared decision making when discussing SBRT for frail patients.

CLINICAL RELEVANCE/APPLICATION

Pulmonary SBRT can lead to long lasting QoL/GHS improvemnt in patients with low initial QoL/GHS-scores.

SSG15-08 Survival Outcomes of Patients Receiving Systemic Therapy With and Without Definitive-Dose Thoracic Radiotherapy for Metastatic Non-Small Cell Lung Cancer

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S503AB

Participants
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PURPOSE

We aimed to investigate the overall survival (OS) outcomes of patients with metastatic non-small cell lung cancer (mNSCLC) who received definitive-dose thoracic radiotherapy (RT) in conjunction with systemic therapy (ST) compared to those who received lower-dose RT with ST or ST alone using the National Cancer Database (NCDB).

METHOD AND MATERIALS

We identified 46,315 mNSCLC patients in the NCDB who received ST and thoracic RT diagnosed between 2004 and 2014. RT patients were grouped by BED: <40 Gy and 40-70 Gy (LD-RT), 70-100 Gy and >100 Gy (HD-RT). Our comparison cohort was composed of 113,009 m NSCLC patients who received ST and did not receive thoracic RT, or RT to another body site as part of their initial treatment course (ST-only). OS outcomes were compared using the Kaplan-Meier method and Cox proportional hazards models accounting for clinical and demographic co-variables. Propensity score matching (PSM) balanced across co-variables was used to confirm the impact of BED on OS.

RESULTS

Median follow up was 9.1 months overall, and 25.8 months among survivors. The most common RT regimen was 30 Gy in 10 fractions (n=7,181, 17.15% of RT patients). HD-RT patients comprised 19.2% of the study cohort (BED 70-100 Gy; n=7806, 16.9%, and BED >100 Gy; n=1046, 2.3%). Compared to those in the ST-only group, HD-RT patients receiving BED of 70-100 Gy (HR 0.69, p<0.001) or >100 Gy (HR 0.69, p<0.001) had improved OS versus LD-RT patients receiving BED <40 Gy (HR 1.40, P<0.001) or 40-70 Gy (HR 0.95, p<0.001) on multivariable analysis. Patients in HD-RT had improved survival compared to PS matched controls in ST-only (HR 0.68, p<0.001).

CONCLUSION

The HD-RT group regimens were associated with improved OS compared to the LD-RT regimens and ST-only on multivariable and PSM analyses. These findings are limited by the retrospective nature of the NCDB data but are in line with the results of recently resulted phase II data suggesting a survival advantage with aggressive local therapy added to systemic therapy for limited metastatic burden in patients with NSCLC.

CLINICAL RELEVANCE/APPLICATION

Definitive-dose thoracic RT in conjunction with systemic therapy is associated with improved OS compared to systemic therapy alone with or without lower-dose thoracic RT in metastatic NSCLC.

SSG15-09 Chemical Exchange Saturation Transfer (CEST) Imaging versus FDG-PET/CT: Capability for Therapeutic Effect Prediction of Chemoradiotherapy in Non-Small Cell Lung Cancer

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S503AB

Participants
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PURPOSE

To directly and prospectively compare the capability for prediction of therapeutic effect for chemoradiotherapy between chemical exchange saturation transfer (CEST) imaging and FDG-PET/CT in non-small cell lung cancer (NSCLC) patients.

METHOD AND MATERIALS

32 consecutive and pathologically diagnosed stage III NSCLC patients (18 males and 14 females; mean age 73 year) underwent CEST imaging at a 3T MR system, FDG-PET/CT, and chemoradiotherapy and follow-up examinations. According to the results of follow-up examination, all patients were divided into recurrence (n=7) and non-recurrence (n=25) groups. In each patient, magnetization transfer ratio asymmetry (MTRasym) was calculated from z-spectra at 3.5ppm in each pixel, and MTRasym map was computationally generated from CEST data. In each lesion, MTRasym and SUVmax were assessed by ROI measurements. To compare all indexes between two groups, Student's t-test was performed. Then, multivariate logistic regression analyses were performed to investigate the discriminating factors of two groups. ROC-based positive test was performed to determine each feasible threshold value, and diagnostic performance was compared between two indexes by McNemar's test. Finally, disease free and overall survivals between responders and non-responders assessed by each index were compared by Kaplan-Meier method followed by log-rank test.

RESULTS

MTRasym and SUVmax had significant difference between two groups ($p<0.05$). Multivariate regression analyses identified MTRasym (Odds ratio [OR]: 0.23, $p=0.04$) and SUVmax (OR: 0.09, $p=0.008$) as significant differentiators. There were no significant differences of sensitivity, specificity and accuracy between MTRasm and SUVmax ($p>0.05$). MTRasym and SUVmax had significant difference of disease free survival between responder and non-responder groups (MTRasym: 23.4±3.5 [mean±standard error] month vs. 14.4±1.5 month, $p=0.01$; SUVmax: 28.5±3.8 month vs. 14.2±1.3 month, $p=0.0006$).

CONCLUSION

CEST imaging has a potential for predicting therapeutic effect of chemoradiotherapy and considered at least as valuable as FDG-PET/CT in NSCLC patients.

CLINICAL RELEVANCE/APPLICATION

CEST imaging has a potential for predicting therapeutic effect of chemoradiotherapy and considered at least as valuable as FDG-PET/CT in NSCLC patients.

SSG16

Vascular/Interventional (Liver Cancer)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E260

GI IR VA

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

FDA Discussions may include off-label uses.

Participants
Ronald S. Arellano, MD, Boston, MA (*Moderator*) Nothing to Disclose
Juan C. Camacho, MD, Charleston, SC (*Moderator*) Research Grant, El.en.
Paula Novelli, MD, Pittsburgh, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSG16-01 Ultrasound-Guided Percutaneous Brachytherapy for the Treatment of Hepatocellular Carcinoma with Portal Vein Branch Tumor Thrombus

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E260

Participants
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PURPOSE

To evaluate the safety and efficacy of ultrasound guided iodine-125 implantation for the treatment of hepatocellular carcinoma with portal vein branch tumor thrombus (PVBTT).

METHOD AND MATERIALS

From June 2013 to August 2018, a total of 69 HCC patients complicated with PVBTT were included in this single-center retrospective study. 34 patients underwent iodine-125 seeds implantation combined with transarterial chemoembolization (TACE), while 35 patients underwent TACE alone. Outcomes were measured in terms of tumor response, overall survival (OS), progress free survival (PFS) and adverse events.

RESULTS

The technique was successfully performed in all patients. No complications grade 3 or higher according to Common Terminology Criteria for Adverse Events (CTCAE) version 3.0 occurred. In the analysis for PVTT response 1 month after treatment, TACE-Iodine125 group, 5 patients (14.7%) achieved CR, 15 patients (44.1%) achieved PR. Whereas in the TACE group, no patient achieved CR, 2 patients (5.7%) achieved PR. Patients receiving TACE-Iodine125 had a median OS and PFS of 11 months (95% CI: 8.5, 13.5) and 9 (95% CI: 6.0, 12.0), compared with 7 months (95% CI: 5.9, 8.1) and 3 months (95% CI: 1.7, 4.3) for those who receiving TACE only. Treatment strategy, type of PVTT were significant predictors of OS.

CONCLUSION

Ultrasound guided iodine-125 seed implantation is a safe and effective treatment for HCC patients with PVBTT.

CLINICAL RELEVANCE/APPLICATION

This study provide a convenient and efficient method in addition to Sorafenib and radiotherapy for unresectable HCC with PVBTT.

SSG16-03 Predictors of Successful Bridging to Liver Transplantation in Patients with Hepatocellular Carcinoma Undergoing Yttrium-90 Radioembolization Therapy

Tuesday, Dec. 3 10:50AM - 11:00AM Room: E260

Participants
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PURPOSE

To identify key clinical and imaging predictors of successful bridging to liver transplantation (LT) in patients undergoing Yttrium-90 radioembolization (Y90 RE) therapy for hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

A retrospective analysis was conducted in patients with HCC who were deemed by a multidisciplinary tumor board as candidates or potential candidates for LT by Milan Criteria (MC) and underwent Y90 RE as bridging therapy. Patients were divided into favorable and unfavorable Y90 RE response groups based on changes to their MC eligibility, with maintained or achieved eligibility defined as favorable, and unchanged or lost eligibility defined as unfavorable. Pre Y90 baseline prognostic factors were compared between favorable and unfavorable responders using chi-square, Fisher's exact test, and student's t-test analysis.

RESULTS

Between 2014 and 2018, 144 patients were deemed candidates or potential candidates for LT by MC and underwent Y90 RE bridging. Out of the 56 (39%) patients within MC, eligibility was maintained in 45 (80%) and lost in 6 (11%) patients. Out of the 88 (61%) patients outside MC, eligibility was achieved in 40 (45%) patients and remained unchanged in 45 (51%) patients. Among the 85 (59%) patients who experienced a favorable therapy response, 22 (26%) patients went on to receive LT. Comparison analysis between the favorable and unfavorable response groups suggested that younger age ($p=0.0461$), female gender ($p=0.0095$), unilobar distribution ($p=0.0238$), <=4 viable tumors ($p=0.0058$), smaller dominant lesion diameter ($p=0.0058$), lower tumor burden ($p=<0.0001$), lower Barcelona Clinic Liver Criteria (BCLC) stage ($p=<0.0001$), lower alkaline phosphatase ($p=0.0456$) and higher sodium blood levels ($p=0.0084$) were all associated with successful bridging to liver transplantation.

CONCLUSION

Certain favorable clinical and imaging characteristics in patients with HCC appear to be positive prognostic factors for the successful bridging to liver transplantation using Y-90 Radioembolization.

CLINICAL RELEVANCE/APPLICATION

Positive prognostic factors in patients with HCC can provide clinicians with opportunities to personalize Y-90 radioembolization treatments for potential liver transplant patients in need of maintaining or achieving transplantability status.

SSG16-04 Long-Term Outcomes of Combined Radiofrequency Ablation and Multipronged Ethanol Ablation for the Treatment of Unfavorable Hepatocellular Carcinoma

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E260

Participants
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PURPOSE

To evaluate the local efficacy, safety and long-term outcomes of combining radiofrequency ablation (RFA) and multipronged ethanol ablation (EA) in the treatment of unfavourable hepatocellular carcinoma (HCC) and determine the prognostic factors for survival.

METHOD AND MATERIALS

Between August 2009 and December 2017, 98 patients with 110 unfavourable HCC nodules who underwent combining RFA and multipronged EA were enrolled retrospectively in this study. Unfavourable HCC is defined as medium (3.1-5.0 cm) or large (5.1-7.0 cm) HCC, tumour located at a high-risk site or perivascular tumour. Treatment response, overall survival (OS) and recurrence-free survival (RFS) were analysed. The Kaplan-Meier method and Cox proportional hazards regression model were used to evaluate the prognostic factors.

RESULTS

Complete ablation (CA) was obtained in 80.9% (89/110) of the tumours after initial treatment. Major complications were observed in 3 (3.1%) patients. The cumulative incidence of local tumour progression (LTP) was 23.5% at 5 years, and no variable was found to be an independent predict factor for LTP. The five-year OS and RFS rates were 41.9% and 18.6%, respectively. Multivariate analysis showed that the serum alpha-fetoprotein (AFP) level and number of tumours were significant prognostic factors for OS ($P= 0.017$ and $P< 0.001$, respectively) and RFS ($P= 0.014$ and $P= 0.001$, respectively). Perivascular tumour was not an independent factor predicting OS or RFS.

CONCLUSION

Combining RFA and multipronged EA is a safe and effective treatment for unfavourable HCC, especially for perivascular tumours. A high serum AFP level and multiple tumours had significant negative effects on OS and RFS.

CLINICAL RELEVANCE/APPLICATION

Combined RFA and multipronged EA is a safe and effective modality for unfavorable HCC. Combined RFA and multipronged EA expand the indication of thermal ablation to tumors in diameter of 5cm. High serum AFP level and multiple tumours had a significant negative effect on OS and RFS.

SSG16-05 Ultrasound-Guided Percutaneous RFA in 287 Patients with Isolated Recurrent Hepatocellular Carcinoma: 10-Year Survival Rates and Prognostic Analysis - The Effect of Primary Treatment Modalities on Outcomes

Tuesday, Dec. 3 11:10AM - 11:20AM Room: E260

Participants
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PURPOSE

The therapeutic outcomes of RFA for recurrent hepatocellular carcinoma (RHCC) after different primary treatment modalities have not been compared. The aim of this study was to assess the long-term outcome of RFA in RHCC and evaluate the effect of primary treatment modalities on outcomes.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. Between January 2005 to December 2016, 287 patients who underwent ultrasound guided percutaneous RFA for single RHCC (mean diameter 2.9 cm) were enrolled. Of these 287 patients, 134 patients had RHCC from previous hepatectomy, 128 patients from TACE and the other 25 patients from local ablation therapy. There were 235 males and 52 females with mean age of 60.5 years.

RESULTS

For 287 patients, 336 sessions of RFA were performed. Major complications were observed in 5 patients (2.0%). The technical success was achieved in 95.1% of lesions. Local tumor progression was detected in 42 lesions (14.6%). Local tumor progression rate in RHCC with previous local ablation was significant higher than that in RHCC with previous hepatic resection (28.0% vs 11.9%, P=0.036). The estimated 1-, 3-, 5-, and 10-year OS for RHCC patients after RFA were 92.3%, 73.1%, 58.8%, and 39.6%, respectively. There was no significant difference in OS among the three different primary treatment groups (P=0.777). Based on multivariate analysis, tumor size (P=0.017), Child-Pugh class (P=0.045), portal vein hypertension (P=0.036), and serum alpha fetoprotein level (P=0.018) were associated with OS.

CONCLUSION

RFA is a safe and effective modality with an overall 10-year survival rate of 39.6 % in patients with single RHCC. The primary treatment modality had significant effect on the local tumor progression and OS (only for patient with RHCC > 3cm).

CLINICAL RELEVANCE/APPLICATION

The RHCC patients accounted for more than one of third of RFA cases in our center, most of them received one of the three main treatments, including hepatectomy, TACE or local ablation. So far, few studies reported 10-year survival rates of RFA for RHCC treatment. Also, it is not clear if the primary treatment modalities would impact the long-term outcomes. In our study, the primary objective was to analyze the long-term survival and prognostic factors of RFA in RHCC, and the second objective was to compare the difference in outcome after RFA among different primary treatments.

SSG16-06 Impact of Post-Therapy Prophylaxis on Radiation-Induced Liver Disease

Tuesday, Dec. 3 11:20AM - 11:30AM Room: E260

Participants
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PURPOSE

Radioembolization (RE) with yttrium-90 (90Y) resin microspheres is an effective treatment in patients with primary or secondary liver cancer. Radiation-induced liver disease (RILD) is a potentially life-threatening complication with higher prevalence in cirrhotics or patients exposed to previous chemotherapies. This study aimed to evaluate the impact of post-therapeutic RILD-prophylaxis in a relatively homogeneous cohort of liver metastatic breast cancer patients.

METHOD AND MATERIALS

Ninety-three patients with liver metastases of breast cancer received RE between 2007 and 2016. Patients received RILD prophylaxis for 8 weeks post-RE. From January 2014, RILD prophylaxis was changed from ursodeoxycholic acid (UDCA) and prednisolone (standard prophylaxis [SP]; n=59) to pentoxifylline (PTX), UDCA and low-dose low molecular weight heparin (LMWH) (intensified prophylaxis [IP]; n=34). The primary endpoint was toxicity including symptoms of RILD, secondary endpoints included overall survival (OS).

RESULTS

Median OS (95% CI) after RE was 8.0 (6.2-9.8) months. IP (HR 0.47; p=0.033;) and pre-RE alkaline phosphatase >=2 µmol/s.L (HR 2.01; p=0.013) were independent predictors of survival. Subclinical RILD events (bilirubin >=21 µmol/L [but < 30 µmol/L] or ascites) or treatment discontinuations were observed more frequently in the SP group, albeit without significance (5 vs. 1; p=0.397). Symptomatic RILD (bilirubin >=30 µmol/L and ascites) occurred in the SP group only (n=2; p>0.1).

CONCLUSION

Intensified post-therapeutic RILD prophylaxis with PTX, UDCA and LMWH has an independent positive impact on OS in patients with metastatic breast cancer and may reduce RILD frequency and severity.

CLINICAL RELEVANCE/APPLICATION

Radioembolization is an effective treatment in patients with chemotherapy-resistant liver metastases of different primary tumours as well as primary liver cancer. However, radioembolization may cause injury to the healthy tissues of the liver leading to radiation-induced liver disease (RILD); a potentially life-threatening complication which pathophysiologically resembles venous occlusive disease. Intensive prophylactic (preventative) treatment, with a combination of ursodeoxycholic acid (UDCA) pentoxifylline (PTX), and low-dose low molecular weight heparin (LMWH), has a positive impact on patients' survival and might reduce RILD frequency and severity.

SSG16-07 Local Tumor Control and Survival Rates in Unresectable or Recurrent Hepatic Cholangiocarcinoma (CCC): Transarterial Chemoembolization (TACE) versus Combined TACE and Microwave Ablation (MWA)

Tuesday, Dec. 3 11:30AM - 11:40AM Room: E260

Participants
Thomas J. Vogl, MD, PhD, Frankfurt , Germany (*Presenter*) Nothing to Disclose
Elsayed M. Elhawash, BMedSc,MS, Frankfurt am Main , Germany (*Abstract Co-Author*) Nothing to Disclose
Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Nour-eldin A. Nour-Eldin, MD,PhD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the effect of local targeted liver therapy using transarterial chemoembolization (TACE) with or without microwave ablation (MWA) in patients with unresectable or recurrent cholangiocarcinoma (CCC) regarding overall survival and local tumor control.

METHOD AND MATERIALS

In this retrospective study from January 2007 to December 2017 152 patients (69 males/83 females; mean 58.7 years; range 25-86) with CCC with either unresectable (123/152=80.2%) or recurrent (29/152=19.8%) lesions were treated with at least three sessions (range 3-26) of TACE. Patients were subclassified into non-metastatic (86/152=56.5%), nodal metastatic (39/152=25.7%), systemic metastatic (18/152=11.8%) and both nodal and systemic metastatic (9/152=5.9%). 30 patients received combined TACE and MWA. Follow-up was performed using MRI and CT to evaluate local tumor control according to the modified RECIST criteria and survival was evaluated using the Kaplan-Meier method.

RESULTS

Mean survival for all patients was 28.7 months (CI 21.8-35.7). The survival for patients with non-metastatic, nodal, systemic metastatic and combined metastases was 37, 23.4, 17.5 and 12.4 months, respectively (p value = 0.006). Tumor response after three cycles of TACE was either stable (35.5%), partial response (41.4%) or progressive (23%) and the response at the last follow up was 25.7%, 15.2%, 59.2% and 3.5%, respectively. Patients who received additional MWA showed significantly longer survival vs those with only TACE (median 28 momths and 18 months, respectively, $p<0.007$). Significant prognostic factors for local tumor control and survival were nodal and/or systemic metastases, pre-therapeutic tumor size, initial local tumor response and additional application of MWA. However, no significant correlation was found between recurrent and unresectable tumors.

CONCLUSION

Local targeted liver therapy of unresectable or recurrent hepatic CCC using TACE or combined TACE and MWA provides an adequate therapeutic option for loca tumor control and improves patient survival

CLINICAL RELEVANCE/APPLICATION

TACE with additional MWA is a promising therapeutic tool in patients with advanced CCC involvement.

SSG16-08 Automated Pattern-Based and Voxelwise Analysis of Lipiodol Deposits on Computed Tomography after Conventional Transarterial Chemoembolization and their Effect on Tumor Response

Tuesday, Dec. 3 11:40AM - 11:50AM Room: E260

Participants
Sophie Stark, Freiburg, Germany (*Presenter*) Nothing to Disclose
Clinton Wang, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Lynn J. Savic, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Brian S. Letzen, MD, Orange, CT (*Abstract Co-Author*) Nothing to Disclose
Isabel T. Schobert, BS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Milena A. Miszczuk, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Nikitha Murali, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Paula Marie Oestmann, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Ming de Lin, PhD, North Haven , CT (*Abstract Co-Author*) Employee, Visage Imaging, Inc; Former Employee, Koninklijke Philips NV
Todd Schlachter, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA
Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA; Consultant, Guerbet SA; Research Grant, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Research Grant, Boston Scientific Corporation;

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PURPOSE

To establish Lipiodol as a theranostic imaging biomarker for therapeutic efficiency of conventional transarterial chemoembolization (cTACE) using automated quantitative and pattern-based image analysis techniques on 24h post cTACE computed tomography (CT).

METHOD AND MATERIALS

This was a retrospective review of prospectively collected clinical trial data including 42 primary and secondary liver cancer patients with 65 tumors treated using cTACE (2012-2018). Hounsfield Unit (HU) thresholds were used to automatically characterize the presence and density of Lipiodol on 24h post cTACE CT scans. Additionally, Lipiodol deposition patterns within a volumetric tumor mask were automatically assessed with regards to homogeneity, sparsity, rim, and peripheral deposition of Lipiodol. Following 3D image registration of baseline (BL) and 1-month follow-up (F/U) MRI to post-TACE CT, Lipiodol deposition was correlated with enhancing tumor volume (ETV) on BL MRI and F/U MRI, using Wilcoxon signed-rank test, Mann-Whitney U test, Kruskal Wallis test, Spearman's rank correlation, and linear regression.

RESULTS

Cut-off values of 87 HU, 155 HU, and 241 HU were found to achieve good separation of areas with low, mid and high Lipiodol density. ETV on BL MRI was significantly correlated with Lipiodol deposition on 24h CT ($p<0.0001$). Tumor regions where Lipiodol was present became necrotic at a higher rate on F/U MRI than areas without Lipiodol ($p=0.0475$). Specifically, ETV decrease in tumor areas with low, mid and high density Lipiodol compared to areas without Lipiodol was -0.87% ± -15.98 ($p=0.3393$), -9.32% ± -22.20 ($p=0.0066$) and -17.91% ± -23.42 ($p=0.0003$), respectively. Moreover, homogeneous ($p=0.0006$), non-sparse ($p<0.0001$), rim deposition within sparse tumors ($p=0.045$), and peripheral deposition ($p<0.0001$) of Lipiodol showed improved response on F/U MRI.

CONCLUSION

In this study, a quantitative automated threshold-based technique was developed and applied to characterize Lipiodol patterns and densities on post-cTACE CT. Strong correlation with radiographic tumor response supports the prognostic value of Lipiodol as an imaging biomarker that can be easily incorporated into the management of liver cancer patients treated using cTACE.

CLINICAL RELEVANCE/APPLICATION

Automated tools to characterize Lipiodol deposition may improve clinical workflow efficiency and allow for a more personalized treatment by earlier identification of non-responders to cTACE.

SSG16-09 Comparison between Percutaneous and Laparoscopic Microwave Ablation of Hepatocellular Carcinoma

Tuesday, Dec. 3 11:50AM - 12:00PM Room: E260

Participants
Angelo Della Corte, MD, Vimodrone, Italy (*Presenter*) Nothing to Disclose
Paolo Marra, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Lorenzo Monfardini, Brescia, Italy (*Abstract Co-Author*) Nothing to Disclose
Simone Gusmini, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Luca Aldrighetti, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco A. De Cobelli, MD, Bergamo, Italy (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

Based on patient and nodule characteristics, some authors favor laparoscopic over percutaneous HCC microwave ablation (MWA) , however data are controversial. We compared the two approaches in terms of technical success, complication and local tumor control rates.

METHOD AND MATERIALS

From October 2014 to February 2019, 86 consecutive patients underwent percutaneous or laparoscopic MWA of 98 HCC nodules with a 2450MHz/100W Microwave generator (Emprint, Medtronic). Complete ablation (technical success) and Local Tumor Progression (LTP) at follow-up were assessed by contrast-enhanced CT/MRI. Seventy patients (79 HCC nodules) satisfied inclusion criteria, of which 49 (52 nodules) underwent percutaneous MWA and 21 (27 nodules) underwent laparoscopic MWA.

RESULTS

Baseline analysis showed higher rates of multifocal disease in the laparoscopic group ($p=0.0001$) and higher rates of patients previously treated for HCC in the percutaneous group ($p=0.034$). All other patient and nodules characteristics were homogeneous. Technical success did not significantly differ between the two groups ($p= 0.3$). 7/64 patients (10.9%) suffered procedure-related complications (CIRSE classification grade-3): 2 cases (abscess, haematoma) in the percutaneous group (3.4%) and 5 (pneumothorax, respiratory failure, fever, portal thrombosis, hematoma) in the laparoscopic group (18.5%) ($p=0.02$). 6/79 (7.6%) HCC nodules showed local progression with 1- and 2-year LTPFS rates of 95% and 83.8%, respectively. Five LTPs occurred in the percutaneous group (9.6%), while 1 LTP in the laparoscopic one (3.7%) ($p=0.9$). At logrank analysis, operative approach was not a statistically significant predictor of LTPFS ($p=0.48$). Subgroup analysis showed a trend toward worse LTPFS after percutaneous procedures of subcapsular nodules (2-year LTPFS 100% laparoscopic vs 65.2% percutaneous, $p=0.15$)

CONCLUSION

Higher complication rate in the Laparoscopic group can be explained by the greater technical invasiveness and by the higher rate of multifocal disease treated in one session. Tendency toward better local tumor control in the laparoscopic group when dealing with subcapsular nodules is possibly due to the better visualization and monitoring of the ablation area achieved through laparoscopic guidance.

CLINICAL RELEVANCE/APPLICATION

Despite its higher complication rate, laparoscopic MWA is a an effective therapeutic option and should be considered for treatment of subcapsular HCC.

RCA33

Hands-on Artificial Intelligence for Non-coders: Object Localization and Image Segmentation (Hands-on)

Tuesday, Dec. 3 12:30PM - 2:00PM Room: S401AB

AI IN

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

Participants

Peter Chang, MD, San Francisco, CA (*Moderator*) Nothing to Disclose
Peter Chang, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Simukayi Mutasa, MD, New York, NY (*Presenter*) Nothing to Disclose
Jae Ho Sohn, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Michelle Bardis, MS, Orange, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify the difference between image classification, object localization and image segmentation. 2) Explain the steps required in data collection and annotation for object localization and image segmentation tasks. 3) Assess the benefits and drawbacks of utilizing object detection and image segmentation methods as opposed to object classification. 4) Examine the current state of the art base neural network architectures for object detection and image segmentation at a qualitative level. 5) Run a previously trained object detection and segmentation network for localizing intracranial hemorrhage.

Printed on: 10/29/20

RCC33

Medical 3D Printing: How to Start?

Tuesday, Dec. 3 12:30PM - 2:00PM Room: E351

IN

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

Participants
Peter C. Liacouras, PhD, North Potomac, MD (*Moderator*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the basic concepts of 3D printing. 2) Explain the basic workflow from scan to 3D printed model. 3) Be able to differentiate between 3D printing technologies and be able to identify the best 3D printing technology to use for the intended medical application.

Sub-Events

RCC33A How to Start a 3D Printing Lab

Participants
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose

RCC33B Image Segmentation

Participants
Nicole Wake, PhD, Bronx, NY (*Presenter*) In-kind support, Stratasys, Ltd; Consultant, General Electric Company

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LEARNING OBJECTIVES

1) Understand the principal goal of image segmentation. 2) Describe applications of image segmentation including partitioning images into regions of interest. 3) Learn about different segmentation techniques (i.e. manual/automatic, thresholding, and edge-based methods). 4) Understand why image segmentation is required for 3D printing anatomic models.

RCC33C 3D Printing Technologies

Participants
Peter C. Liacouras, PhD, North Potomac, MD (*Presenter*) Nothing to Disclose

ABSTRACT

This course will focus on understand the basic concepts of 3D printing. The first step for producing 3D printing from medical images is to medicine basic procedures for producing digital 3D medical models from radiographic images (segmentation). In addition in many cases segmentation is not sufficient, therefore, digital design becomes essential. After the models, guide, or device is ready to print one must be able to differentiate between 3D printing technologies and be able to identify the best 3D printing technology to use for the intended medical application

RCC33D Optimization, Maintenance, Timing, and Quality Measures

Participants
Philipp Brantner, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Examine the 3D printing workflow to identify optimization potential. 2) Develop maintenance routines to save resources in the 3D print lab. 3) Explain the relevance of timing each workflow step. 4) Describe common quality measures to ensure model fidelity.

RCC33E NIOSH Field Studies and Engineering Control Strategies for 3D Printing

Participants
Kevin Dunn, MS, Cincinnati, OH (*Presenter*) Nothing to Disclose

MSRP31

RSNA Resident and Fellow Symposium 2019 (Interactive Session)

Tuesday, Dec. 3 1:00PM - 4:00PM Room: E451A

ED PR

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credit: 0

Sub-Events

MSRP31A Welcome: Membership Benefits for Trainees

Tuesday, Dec. 3 1:00PM - 1:10PM Room: E451A

Participants
Courtney P. Raybon, MD, Nashville, TN (*Presenter*) Nothing to Disclose
Casey Reed, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Inform trainees of the opportunities available to them through RSNA.

ABSTRACT

Inform trainees of the opportunities available to them through RSNA.

MSRP31B Job Market Update: Changing Practice Patterns

Tuesday, Dec. 3 1:15PM - 1:35PM Room: E451A

Participants
Eric R. Smith, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose
Darcy J. Wolfman, MD, Washington, DC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To present an overview of the 2019 Human Resources Commission Report. 2) An approach to help land a job after residency / fellowship. 3) Private practice positions - questions to consider. 4) Academic positions - questions to consider.

ABSTRACT

Landing a job after residency or fellowship can be challenging. The 2019 ACR Human Resources Commission Report will be reviewed to gain an overview of the current job market. A systematic approach to help residents and fellows land a job will be described. Considerations for both private practice and academic positions will be presented.

MSRP31C Making Major Career Decisions

Tuesday, Dec. 3 1:40PM - 2:00PM Room: E451A

Participants
Daryl T. Goldman, MD , New York , NY (*Presenter*) Nothing to Disclose
Matthew S. Davenport, MD, Ann Arbor, MI (*Presenter*) Royalties, Wolters Kluwer nv

LEARNING OBJECTIVES

1) Learn strategies for making major career decisions. 2) Understand that differentiation brings feelings of loss that require pre-emptive attention. 3) Recognize that making sound career decisions requires self reflection.

MSRP31D Transition to Early Career

Tuesday, Dec. 3 2:05PM - 2:25PM Room: E451A

Participants
Mariam A. Malik, MD, Washington, DC (*Presenter*) Nothing to Disclose
Ann L. Brown, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

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ann.brown2@uc.edu

LEARNING OBJECTIVES

1) Understand the unique challenges facing new radiologists as they begin practicing independently. 2) Identify opportunities for career development and practice improvement. 3) Realize the importance of establishing and maintaining good working relationships with colleagues, staff, and referring providers.

ABSTRACT

We will focus on tips and advice to successfully navigate the transition from trainee to junior attending in radiology.

We will focus on tips and advice to successfully navigate the transition from trainee to junior attending in radiology.

MSRP31E Personal Finance Essentials

Tuesday, Dec. 3 2:30PM - 2:50PM Room: E451A

Participants
Tanner K. Jugler, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose
Kurt A. Schoppe, MD, Grapevine, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the various practice models, and analyze these based on changing physician demographics. 2) Identify evolving trends in radiology practices and examine the impact of consolidation and private equity on career options. 3) Establish the importance of self-care and work-life balance. 4) Define physician burnout and introduce the concept of career longevity. 5) Develop effective negotiation skills.

MSRP31F Q&A

Tuesday, Dec. 3 2:50PM - 3:05PM Room: E451A

Participants
Casey Reed, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose

MSRP31G Career Practice Panel

Tuesday, Dec. 3 3:05PM - 3:50PM Room: E451A

Participants
David H. Ballard, MD, Ballwin, MO (*Moderator*) Nothing to Disclose
Alexander M. Norbash, MD, San Diego, CA (*Presenter*) Scientific Advisor, Penumbra, Inc; Scientific Advisor, IBM Corporation; Scientific Advisor, General Electric Company; Stockholder, Boston Imaging Core Lab, LLC; ; ; ; ;
Amy K. Patel, MD, Liberty, MO (*Presenter*) Nothing to Disclose
Laura W. Bancroft, MD, Venice, FL (*Presenter*) Nothing to Disclose
Eric J. Ledermann, MBA,DO, Tampa, FL (*Presenter*) Employee, Envision Healthcare

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Discuss advantages and disadvantages of different career pathways within radiology. 2) Specifically address the challenges and benefits associated with transitioning from one practice style to another. 3) Address questions and concerns of trainees pertaining to practice type and career transitions during question and answer session.

ABSTRACT

Academic and private practices hold similarities and differences, even though there are wide spectrums of practices within each and significant cultural differences from practice to practice. Individuals who have spent considerable portions of their careers in one or the other can characterize considerations that may assist trainees in finding the better option for themselves.

MSRP31H Closing Remarks

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E451A

SPAI32

RSNA AI Deep Learning Lab: Segmentation

Tuesday, Dec. 3 1:00PM - 2:30PM Room: AI Showcase, North Building, Level 2, Booth 10342

AI CT MR NR

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

Participants

George L. Shih, MD, New York, NY (*Presenter*) Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;

Special Information

In order to get the best experience for this session, it is highly recommended that attendees bring a laptop with a keyboard, a decent-sized screen, and the latest version of Google Chrome. Additionally, it is recommended that attendees have a basic knowledge of deep learning programming and some experience running a Google CoLab notebook. Having a Gmail account is also helpful. Here are instructions for creating and deleting a Gmail account.

ABSTRACT

This session will focus on the use of deep learning methods for image segmentation, applied to the challenge of CT or MR brain segmentation. While focused on this particular problem, the concepts should generalize to other organs and image types.

Printed on: 10/29/20

SPFF31

Fast 5

Tuesday, Dec. 3 1:00PM - 1:30PM Room: Arie Crown Theater

CME credit is not available for this session.
ARRT Category A+ Credit: 0

Participants
Richard E. Heller III, MD, Chicago, IL (*Moderator*) Nothing to Disclose

ABSTRACT

Moderator

Sub-Events

SPFF31A Bridging the Gap: Patient-Centered Radiology Reports

Participants
Teresa Martin-Carreras, MD , Philadelphia, PA (*Presenter*) Nothing to Disclose

ABSTRACT

Patients are increasingly accessing their radiology reports using online health portals. While radiology results are one the most frequently accessed portions of the clinical record, they are also one of the most difficult portions for patients to understand. Radiologists have historically authored reports with the referring provider as the intended reader, but today's broader audience calls for an innovative solution which simultaneously meets the needs of the patient, the referrer, and the radiologist. To address this challenge, we developed a system named PORTER (Patient-Oriented Radiology Reporter) which augments radiology reports with illustrations and lay-language definitions. PORTER has been expanded to comprise nearly 14,000 terms across all subspecialties and modalities in radiology. We envision a future where systems such as PORTER propel patient empowerment, enhance communication between patients and members of their healthcare team, and ultimately highlight the fundamental role that radiologists play in the delivery of high-quality patient care.

SPFF31B Patient-centered Lung Cancer Screening CT Clinic: Imagine What You Can Achieve

Participants
Samir J. Parikh, MD, Okemos, MI (*Presenter*) Nothing to Disclose

ABSTRACT

A radiologist has always been known as the "doctor's doctor", but what if the radiologist WAS the patient's doctor? I have embraced this role by discussing the results of every lung cancer screening CT face-to-face with every new patient that enters our lung cancer clinic and taking a primary role in managing the health of my patients. While in our clinic, the patient will also be counseled for smoking cessation. These same-day appointments, made possible by great nurse navigators, have significantly earned our relevance and respect in our community and, at the same time, decreased our detection-to-diagnosis times. By placing the patient at the center and the radiologist in the front seat, we have re-imagined imaging in a way that must become increasingly prevalent to protect radiology in the current healthcare climate.

SPFF31C Master the Next Level of Science Communication

Participants
Reto Sutter, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

ABSTRACT

Countless high-quality research studies are published every year. Most are only read by a small number of people and have no impact on public discussion. Radiology researchers can employ simple and effective techniques such as visual abstracts, infographics and key images in order to present their scientific discoveries and they can successfully shape the public profile of the radiological profession. Employ these communicative elements on journal websites, social media channels and traditional media to make yourself heard. By mastering the next level of science communication, radiologists can successfully educate their peers, patients, as well as funding bodies and the general public about why their research is relevant and how new discoveries in radiology make a difference in patient care.

SPFF31D From Science Fiction to Science Fact: Imaging's Evolving Role in Monitoring & Modifying Mental Health and Social Identity

Participants
Michael H. Lev, MD, Boston, MA (*Presenter*) Consultant, General Electric Company; Research Grant, General Electric Company; Research support, Siemens AG; Consultant, Takeda Pharmaceutical Company Limited;

ABSTRACT

From "Science Fiction to Science Fact: Imaging's Evolving Role in Monitoring & Modifying Mental Health and Social Identity", explores the role of cutting edge brain mapping techniques in *detecting & decoding* patterns of brain activity relevant to mental health, wellness, and human social connection. This talk will tie together how imaging informs the commonalities of such diverse

topics as criminal behavior, resilience, depression, anxiety, social dysfunction, exercise & meditation, and even playing a better golf game - culminating in speculation on what the future holds for neuro-technologies such as brain implants, as well as for human social identity.

SPFF31E Child Care Services and Women in Radiology

Participants
Sherry S. Wang, MBBS, Seattle, WA (*Presenter*) Nothing to Disclose

ABSTRACT

How child care services at radiology meetings and possibly extended to the workplace is needed for better inclusion and diversity. The importance of child care services to help females become more engaged at radiological meetings and why this is important to help current female radiologists and in the recruitment of more females into radiology.

VSIO31

Interventional Oncology Series: From Bench to Bedside

Tuesday, Dec. 3 1:00PM - 3:00PM Room: S405AB

BQ IR OI RO

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

FDA Discussions may include off-label uses.

Participants
Muneeb Ahmed, MD, Boston, MA (*Moderator*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc

LEARNING OBJECTIVES

1) Appreciate the mechanistic basis for improving interventional oncologic procedures based upon a better understanding of molecular interactions. 2) Understand how molecular knowledge can be used to better image patients and predict outcomes. 3) Gain awareness of the extent of potentially beneficial and harmful systemic effects of "focal" interventional oncologic therapy. 4) Learn how immuno-oncologic techniques can be combined with both percutaneous and transcatheter interventional oncologic therapies to potentially achieve better clinical outcomes.

ABSTRACT

This session has been organized into a thematic unit thatwill provide a series of six lectures by leaders in the field each dedicated to discussing basic science advances that currently impact upon or are likely to impact upon interventional oncologic practice in the near future. This will include lectures providing the scientific rationale behind combination approaches between interventional oncologic platforms and other conventional and immuno-oncologic therapies. Moreover, two lectures will highlight the latest advances in our understanding and potentiating of systemic effects of interventional oncologic procedures - including both potentially positive abscopal, immunogenic effects and less desired pro-tumorigenic phenomena. Finally, the session will conclude with two lectures addressing the ever expanding role of molecular imaging and biomarkers for stratification and prognosis and the potential roles that IO may serve in the future oncologic platforms. The session will further include selected complementary abstract presentations that highlight innovative research in these thematic areas.

Sub-Events

VSIO31-01 Combination Therapies

Tuesday, Dec. 3 1:00PM - 1:15PM Room: S405AB

Participants
S. Nahum Goldberg, MD, Efrat, Israel (*Presenter*) Consultant, AngioDynamics, Inc; Consultant, Cosman Medical, Inc; Consultant, XACT Robotics;

VSIO31-02 Immuno-oncology: Basic Principles

Tuesday, Dec. 3 1:15PM - 1:30PM Room: S405AB

Participants
Rony Avritscher, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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VSIO31-03 Irreversible Electroporation Combined with Poly-ICLC Immunogenic Adjuvant Improves Tumoral Response in Preclinical Animal Models of Hepatocellular Carcinoma

Tuesday, Dec. 3 1:30PM - 1:40PM Room: S405AB

Participants
David Cano, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose
Ana Ezponda, MD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Marta Calvo-Imirizaldu, MD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Ignacio Gonzalez Crespo, MD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Juan J. Lasarte, PhD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Isabel Vivas Perez, MD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Irreversible electroporation (IRE) is an ablation technique that induces non-immunogenic tumor cell death. Indeed, IRE doesn´t promote inflammation that might help to activate antitumor immunity and get better long-term control of tumor growth. The purpose was to evaluate the therapeutic efficacy of IRE combined with an immunogenic adjuvant Poly-ICLC (dsRNA analog mimicking viral RNA) to induce an antitumor immune response after death of the electroporated cells.

METHOD AND MATERIALS

Antitumor efficacy of IRE+Poly-ICLC was evaluated in models of hepatocarcinoma. Mice and rabbits bearing hepatocellular carcinoma tumors (Hepa.129 and VX2 tumor models, respectively) were treated with IRE (2 pulses of 2500V), with poly-ICLC, or with the combination IRE+poly-ICLC. Tumor growth in mice was monitored using a digital caliper and by computed tomography in rabbits. Histologic studies and statistical analysis (parametric (Student´s t test and one-way ANOVA) and non-parametric (Mann-Whitney U and Kruskal-Wallis) were carried on.

RESULTS

Intratumoral administration of poly-ICLC immediately before IRE elicited shrinkage of Hepat.129 cell-derived tumors in 70% of mice compared to 30% and 26% by poly-ICLC or IRE alone, respectively (p=.0004). This combined therapy induced the shrinkage of VX-2-based hepatocellular tumors in 40% of rabbits, whereas no response was achieved by either individual treatment (p=.045). The combined therapy activated a systemic antitumor response able to inhibit the growth of other untreated tumors (abscopal effect). In two rabbits a complete radiological response was achieved.

CONCLUSION

IRE treatment, immediately preceded by the intratumoral administration of an immunogenic adjuvant such as poly-ICLC, might enhance the antitumor effect of the IRE procedure. This combination might facilitate the induction of a long-term systemic response to prevent tumor relapses and the appearance of metastases.

CLINICAL RELEVANCE/APPLICATION

Intratumoral administration of poly-ICLC before IRE increases the antitumor efficacy of IRE, favoring the activation of a systemic immunity and enabling therapeutic control of untreated tumor. In clinical setting it has been described that patients with big tumors treated with IRE exhibited a considerably shorter lifespan probably because of the growth of non-ablated cells. The potential synergistic effect of PolyICLC+IRE might provide a therapeutic option for patients whose tumor >3 cm.

VSIO31-04 Immuno-oncology: Clinical Studies

Tuesday, Dec. 3 1:40PM - 1:55PM Room: S405AB

Participants
Bradford J. Wood, MD, Bethesda, MD (*Presenter*) Researcher, Koninklijke Philips NV; Researcher, Celsion Corporation; Researcher, BTG International Ltd; Researcher, Siemens AG; Researcher, XAct Robotics; Researcher, NVIDIA Corporation; Intellectual property, Koninklijke Philips NV; Intellectual property, BTG International Ltd; Royalties, Invivo Corporation; Royalties, Koninklijke Philips NV; Equipment support, AngioDynamics, Inc; Researcher, Profound Medical Inc; Researcher, Canon Medical Systems Corporation; Researcher, AstraZeneca PLC; Researcher, Exact Imaging Inc

For information about this presentation, contact:

bwood@nih.gov

LEARNING OBJECTIVES

1) Review clinical trial rationale and general concepts and research avenues for immuno-oncologic techniques in interventional oncology & interventional radiology. 2) Analyze clinical examples in HCC of percutaneous ablative and transcatheter embolization interventional oncologic therapies combined with checkpoint inhibitor drugs with molecular immune correlates. 3) Apply iRECIST and review pseudo-progression. 4) Ask relevant unanswered research questions within the space of immuno-oncology and image guided minimally invasive IR oncology therapies.

VSIO31-05 Post-ablation Tumorigenesis

Tuesday, Dec. 3 1:55PM - 2:10PM Room: S405AB

Participants
Muneeb Ahmed, MD, Boston, MA (*Presenter*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc

VSIO31-06 Novel MR-Based Molecular Imaging Biomarkers to Monitor Local Anti-Tumoral Immune Cell Response in an Animal Model of Liver Cancer

Tuesday, Dec. 3 2:10PM - 2:20PM Room: S405AB

Awards
Trainee Research Prize - Resident

Participants
Lynn J. Savic, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Isabel T. Schobert, BS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Luzie A. Doemel, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Ruth R. Montgomery, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Nikhil Joshi, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
James S. Duncan, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Lin Leng, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Richard J. Bucala, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Daniel Coman, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Fahmeed Hyder, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA; Consultant, Guerbet SA; Research Grant, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Research Grant, Boston Scientific Corporation;

For information about this presentation, contact:

julius.chapiro@yale.edu

PURPOSE

To establish molecular imaging probes for the non-invasive MR-based monitoring of local immune cell activity within the tumor microenvironment (TME) in a translational animal model for liver cancer.

METHOD AND MATERIALS

VX2 liver tumor-bearing New Zealand White rabbits were assigned to undergo a) systemic intravenous infusion of rhodamine-conjugated small iron oxide nanoparticles (SPION) (n=3) or b) locoregional intraarterial infusion of gadolinium-labeled anti-HLA-DR antibodies (n=3) to allow for in vivo immune cell labeling. Twenty-four hours after contrast administration, animals were subjected to imaging using a human-size 3T MRI scanner, which included T1- and T2-weighted sequences and biosensor imaging of redundant deviation in shifts for extracellular pH (pHe) mapping. Radiological-pathological correlation comprised immunohistochemistry (IHC), Prussian blue staining of iron and fluorescence microscopy. Additionally, spatial distribution of gadolinium-conjugated antibodies was validated ex vivo using imaging mass cytometry (IMC) on paraffin-embedded tissue.

RESULTS

pHe mapping and IHC of VX2 liver tumors revealed relative tumor acidosis (pHe=6.79±0.09) compared to liver parenchyma (7.18±0.02, $p<0.001$) and immune cell infiltration into the peritumoral stroma. T2-weighted MRI with SPION showed curvilinear signal hypointensity surrounding the tumor, indicating selective SPION deposition in the peritumoral rim. Prussian blue staining and rhodamine fluorescence ex vivo confirmed the presence of SPION deposited in macrophages. T1-weighted MRI after administration of gadolinium-labeled anti-HLA-DR antibodies revealed localized ring enhancement in the peritumoral rim. IMC on tissue harvested from the same rabbits confirmed gadolinium-labeling of macrophages in the peritumoral rim corresponding with the signal distribution pattern on MRI.

CONCLUSION

The peritumoral MR signal from both SPION and gadolinium-tagged anti-HLA-DR antibodies correlated well with histopathological immune cell accumulation in an acidic TME. This translational study establishes MR-based molecular imaging instruments that allow for in vivo monitoring of specific immune cell populations with high three-dimensional spatial resolution.

CLINICAL RELEVANCE/APPLICATION

The results provide proof of concept for non-invasive immunophenotyping, which may serve as a monitoring tool for individual susceptibility and response to immuno-oncological and locoregional therapies.

VSIO31-07 Molecular Imaging for IO

Tuesday, Dec. 3 2:20PM - 2:35PM Room: S405AB

Participants
Terrance Gade, Philadelphia, PA (*Presenter*) Consultant, Trisalus Life Sciences

VSIO31-08 Predictive Biomarkers

Tuesday, Dec. 3 2:35PM - 2:50PM Room: S405AB

Participants
Etay Ziv, MD,PhD, New York, NY (*Presenter*) Research Grant, Johnson & Johnson;

VSIO31-09 Panel Discussion

Tuesday, Dec. 3 2:50PM - 3:00PM Room: S405AB

MSAS33

The Importance of the Patient Voice in Informing 'Patient-centered' Service Development (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Dec. 3 1:30PM - 3:00PM Room: S105AB

OT

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

Participants
Charlotte Beardmore, MBA, London, United Kingdom (*Moderator*) Nothing to Disclose
Catherine Gunn, MBA,RT, Halifax, NS (*Moderator*) Nothing to Disclose

Sub-Events

MSAS33A Guiding Principles for Patient, Public, and Practitioner Partnerships within Radiography

Participants
Leslie Robinson, PhD, Cheadle, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the difference between a paternalistic and partnership approach to patient care in radiography. 2) Explain the benefits of Patient, Public and Practitioner Partnerships in radiography practice. 3) Identify a range of resources to support their move towards partnership working.

ABSTRACT

Historically, communication in radiography has been predicated on a paternalistic model; i.e. the practitioner determines what it is that the patient needs to know. This is at odds with the current patient engagement movement which promotes partnership working and shared decision-making. In 2018, the UK Society and College of Radiographers convened a group of patients and practitioners to address this mismatch. The outcome was a set of Guiding Principles, written in the patient voice, which establish what patients perceive to be effective communication and partnership working within diagnostic imaging and radiotherapy services. Using real life stories of patient experiences within radiography, this course will outline the need to develop partnership working. It will then explain how the Guiding Principles document was developed and how it can be used as a resource to move towards a more patient-centred model of care within radiography. The Guiding Principles document can be found here https://www.sor.org/sites/default/files/document-versions/guiding_principles_final_proofed_0.pdf

Active Handout:Leslie Robinson

http://abstract.rsna.org/uploads/2019/19000353/guiding_principles_final_proofed_0.pdf

MSAS33B Engaging Patients to Inform Service Development

Participants
Julie Schmittdiel, BSN,RN, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Julie.Schmittdiel@nm.org

LEARNING OBJECTIVES

1) Identify ways caregivers can leverage teamwork, communication, and compassion to improve the radiology patient experience. 2) Describe common issues that negatively impact the radiology patient experience. 3) Explain how to engage radiology caregivers in patient experience improvement efforts.

MSCC33

Case-based Review of Nuclear Medicine: PET/CT Workshop-Abdomen/Pelvis & Pediatrics (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Dec. 3 1:30PM - 3:00PM Room: E450B

CT GI GU NM PD

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

Participants
Medhat M. Osman, MD, Saint Louis, MO (*Moderator*) Speakers Bureau, Advanced Accelerator Applications SA

Sub-Events

MSCC33A Adult Abdomen/Pelvis

Participants
Don C. Yoo, MD, Lexington, MA (*Presenter*) Consultant, inviCRO, LLC
Terence Z. Wong, MD, PhD, Chapel Hill, NC (*Presenter*) Consultant, Lucerno Dynamics, LLC;

For information about this presentation, contact:

donyoo@brown.edu

LEARNING OBJECTIVES

1) Review challenging and instructive cases PET/CT scans in the abdomen and pelvis which will help with interpretation of PET/CT scans.

ABSTRACT

For oncologic studies, F18-FDG is an outstanding tracer with wide applications. However, there are many pitfalls which can make interpretation challenging. The purpose of this educational activity is to familiarize the audience with the normal biodistribution of FDG in the body and learn various pitfalls in the abdomen and pelvis that can occur when interpreting oncologic PET/CT scans.

MSCC33B Pediatrics

Participants
Helen R. Nadel, MD, Palo Alto, CA (*Presenter*) Consultant, ICON plc

For information about this presentation, contact:

hnadel@stanford.edu

LEARNING OBJECTIVES

1) Be able to identify indications for pediatric PET /CT or PET/MRI imaging. 2) Be familiar with protocols used for pediatric PET/MRI.

MSES33

Essentials of Musculoskeletal Imaging

Tuesday, Dec. 3 1:30PM - 3:00PM Room: S100AB

MK

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

Sub-Events

MSES33A Imaging of Shoulder Arthroplasty

Participants
Jonelle M. Petscavage-Thomas, MD,MPH, Hummelstown, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe normal postoperative imaging appearance of shoulder arthroplasty. 2) Recognize shoulder arthroplasty complications on radiographs. 3) Define indications for use of cross-sectional imaging of shoulder arthroplasty.

MSES33B MRI of Traumatic Lower Extremity Emergencies

Participants
Jonathan C. Baker, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

bakerjo@mir.wustl.edu

LEARNING OBJECTIVES

1) Describe the role of MRI in the diagnosis of traumatic injuries to the lower extremities. 2) Compare the appearances of bone contusion, occult fracture, and chondral injury. 3) Highlight the differences between muscle strain and contusion. 4) Classify tendon tears and lacerations. 5) Illustrate the normal anatomy and injury patterns of the Lisfranc ligament complex.

ABSTRACT

Radiography and CT are commonly used for the diagnosis of acute traumatic injuries in the lower extremities. However, MRI plays an important in diagnosing injuries to the bone marrow, articular cartilage, tendons, and ligaments due to its superior soft tissue contrast resolution. This course will review the MR imaging features of these radiographically-occult lower extremity injuries and their impact on patient management.

MSES33C Imaging of the Wrist and Hand

Participants
Jonathan A. Flug, MD, MBA, Phoenix, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Flug.jonathan@mayo.edu

LEARNING OBJECTIVES

1) Detect imaging abnormalities commonly seen in the hand and wrist. 2) Identify commonly encountered hand and wrist pathology in general practice. 3) Recommend appropriate follow up for various findings in the hand and wrist.

ABSTRACT

The hand is the most commonly injured body part with long term consequences if diagnosis is delayed or incorrect. For many injuries, x-ray imaging is the first line in diagnosis and these studies may reflect a significant proportion of the workflow of a radiologist in a general or subspecialty practice. However, these injuries are often missed or have a delay in diagnosis. The purpose of this course is to review normal anatomy in the hand and wrist as well as commonly encountered pathology to improve diagnosis and provide strategies when x-ray imaging cannot sufficiently establish a diagnosis.

MSES33D Staying on Top of New Hardware

Participants
Kirkland W. Davis, MD, Madison, WI (*Presenter*) Author with royalties, Reed Elsevier; Editor with royalties, Reed Elsevier

For information about this presentation, contact:

kdavis@uwhealth.org

LEARNING OBJECTIVES

1) Understand the concepts of minimally invasive fixation. 2) Be aware of new fixation plates and devices. 3) Identify imaging features of new hardware that should not be misinterpreted as complications

MSQI33

Quality Improvement Symposium: Quality Program in Radiology

Tuesday, Dec. 3 1:30PM - 3:00PM Room: S402AB

LM SQ

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

Participants
Lane F. Donnelly, MD, Palo Alto , CA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

lane.donnelly@stanford.edu

ABSTRACT

None - not a speaker, just moderating.

Sub-Events

MSQI33A Developing a QI Leader

Participants
David B. Larson, MD, MBA, Stanford, CA (*Presenter*) Grant, Siemens AG Grant, Koninklijke Philips NV

MSQI33B Avoiding Pitfalls When Starting a Quality and Safety Program

Participants
Jennifer C. Broder, MD, Burlington, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe obstacles that may impede the development of a Q/S program. 2) Identify activities which can help avoid those obstacles. 3) List resources that can be used to support the development of a radiology Q/S program.

ABSTRACT

Physician leaders face common obstacles in quality and safety program development and management. Prospective awareness of those shared challenges, understanding of potential solutions, and knowledge of available resources can help programs avoid pitfalls and succeed.

MSQI33C Development of Operational Plan for Quality

Participants
Alex Towbin, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Cystic Fibrosis Foundation; Consultant, Reed Elsevier; Advisory Board, IBM Corporation; Advisory Board, KLAS Enterprises LLC;

For information about this presentation, contact:

alexander.towbin@cchmc.org

LEARNING OBJECTIVES

1) List three differences between strategic planning and operational planning. 2) List three differences between operational planning and project planning. 3) Describe a process for operational planning.

ABSTRACT

Creating a yearly operational plan provides departmental employees with a roadmap for the upcoming year and helps to tie their daily activities to the larger strategic vision of the organization. In this lecture, the differences between a strategic plan, an operational plan, and a project plan will be discussed followed by a step-wise process for building an operational plan.

MSQI33D Branding Quality and Value Added

Participants
Samir B. Patel, MD, Granger, IN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

spatel@rad-inc.com

LEARNING OBJECTIVES

1) Describe quality in the context of a radiology value-added matrix for non-interpretative radiologist activities. 2) Provide examples of branding of the quality and value-added activities performed by radiologists.

ABSTRACT

Quality can be defined in many ways but is a critical component of the many non-interpretative activities performed by radiologists. A radiology value-added matrix is a way to define and categorize non-interpretative activities performed by radiologists. Once quality and other non-interpretative radiology activities are performed, branding is essential to demonstrate the value-added actions of radiologists.

MSQI33E **Q&A**

Printed on: 10/29/20

MSRO33

BOOST: Gastrointestinal

Tuesday, Dec. 3 1:30PM - 2:30PM Room: S103AB

GI RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 0

Participants
Navesh K. Sharma, PhD,DO, Hershey, PA (*Presenter*) Consultant, Sirtex Medical Ltd; Speaker, Sirtex Medical Ltd

Printed on: 10/29/20

MSRO37

BOOST: Lung, Mediastinum & Pleura

Tuesday, Dec. 3 1:30PM - 2:30PM Room: S103CD

CH RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 0

Participants
Jeffrey A. Bogart, MD, Syracuse, NY (*Presenter*) Shareholder, Mobius Imaging

Printed on: 10/29/20

PS30

Tuesday Afternoon Plenary Session

Tuesday, Dec. 3 1:30PM - 2:45PM Room: Arie Crown Theater

OT

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credit: .75

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

Sub-Events

PS30A Presentation of the Gold Medal of the Radiological Society of North America

Participants
N. Reed Dunnick, MD, Ann Arbor, MI (*Recipient*) Nothing to Disclose
J. Anthony Seibert, PhD, Sacramento, CA (*Recipient*) Nothing to Disclose
D. David Dershaw, MD, New York, NY (*Recipient*) Nothing to Disclose

For information about this presentation, contact:

jaseibert@ucdavis.edu

PS30B Annual Oration in Diagnostic Radiology: Next Generation Technologies and Strategies for Precision Health

Participants
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (*Presenter*) Board Member, Enlight Biosciences Board Member, ImaginAb, Inc Board Member, FUJIFILM Holdings Corporation Board Member, ClickDiagnostics, Inc Consultant, FUJIFILM Holdings Corporation Consultant, Gamma Medica, Inc Speaker, ImaginAb, Inc Stock, Enlight Biosciences Stock options, Enlight Biosciences Travel support, Gamma Medica, Inc
David H. Kim, MD, Middleton, WI (*Presenter*) Shareholder, Cellectar Biosciences, Inc; Shareholder, Elucent Medical;

For information about this presentation, contact:

sgambhir@stanford.edu

Abstract

Precision health in contrast to precision medicine is focused on addressing disease at the earliest possible point in time if we are not able to prevent it. Although much of health care is focused on precision medicine, this talk will highlight how we can move the needle towards the exciting future of precision health. Technologies and strategies to monitor healthy people and to intercept disease at the earliest possible point in time will be discussed. Technologies in the home such as smart toilets and smart mirrors will be highlighted. The way in which Radiology as a field will have to adjust to the new world of precision health will be also presented.

Printed on: 10/29/20

RCA34

Hands-on Artificial Intelligence for Non-coders: How is an Intracranial Hemorrhage Detection Algorithm Created? (Hands-on)

Tuesday, Dec. 3 2:30PM - 4:00PM Room: S401AB

AI ER IN NR

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

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Moderator*) Nothing to Disclose
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose
Felipe C. Kitamura, MD, MSC, Sao Paulo, Brazil (*Presenter*) Consultant, MD.ai, Inc
Igor R. Dos Santos, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
Ian Pan, MA , Providence, RI (*Presenter*) Consultant, MD.ai

For information about this presentation, contact:

ianpan358@gmail.com

igor.msantos@fidi.org.br

kitamura.felipe@gmail.com

LEARNING OBJECTIVES

1) Understand some of the important steps in the development of Deep Learning algorithms in Radiology including: a) Data Curation: How to organize the dataset into training/validation/test sets and create appropriate classes and labels; b) Training: Important considerations related to algorithm development including image pre-processing and data-augmentation; c) Inference: Understand how to measure algorithm performance.

ABSTRACT

The resurgence of neural networks, and more specifically deep learning, applied to computer vision tasks has been revolutionizing many industry verticles. The technique will likely positively impact Medical Imaging and augment radiologists capabilities to provide excellent patient care. Having an intuition of how these techniques work will be key to interpret its results. In this session, attendees will learn, through practical hands-on examples, how current state-of-the-art artificial intelligence algorithms are created and how they can be used to enhance workflow, augment image interpretation and ultimately improve patient care.

RCC34

Reimbursement Topics in 3D Printing

Tuesday, Dec. 3 2:30PM - 4:00PM Room: E351

HP IN

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

Participants
Frank J. Rybicki III, MD, PhD, Sudbury, MA (*Moderator*) Director, Imagia Cybernetics Inc
Andy Christensen, BS, Littleton, CO (*Moderator*) Consultant, Integrum AB; Board Member, Integrum AB; Stockholder, Somaden LLC

Sub-Events

RCC34A Reimbursement: Roadmap for Anatomic Models

Participants
Frank J. Rybicki III, MD, PhD, Sudbury, MA (*Presenter*) Director, Imagia Cybernetics Inc

RCC34B Anatomic Model CPT Codes Overview

Participants
Andy Christensen, BS, Littleton, CO (*Presenter*) Consultant, Integrum AB; Board Member, Integrum AB; Stockholder, Somaden LLC

LEARNING OBJECTIVES

1) Review the recently established Category III CPT Codes for anatomic models and anatomic guides. 2) Understand how the codes should be applied for certain 3D printing clinical indications. 3) Learn how major institutions throughout the US are implementing the new codes in clinical practice.

RCC34C Anatomic Model Registry

Participants
Kenneth C. Wang, MD, PhD, Ellicott City, MD (*Presenter*) Co-founder, DexNote, LLC

LEARNING OBJECTIVES

1. Define the need for a registry in clinical 3D printing. 2. Describe the RSNA-ACR 3D Printing Registry project. 3. Explain the types of analyses which will be enabled by registry data.

RCC34D Applying 3D Printing Codes to a Medical Practice

Participants
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose

MSRO34

BOOST: Genitourinary-Case-based Multidisciplinary Review (Interactive Session)

Tuesday, Dec. 3 3:00PM - 4:15PM Room: S103AB

GU **OI** **RO**

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Nicole Curci, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Arvin K. George, MD, Ann Arbor , MI (*Presenter*) Research Consultant, TROD Medical
Stanley L. Liauw, MD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

arvigeor@med.umich.edu

LEARNING OBJECTIVES

1) Understand the utility of Prostate MRI in clinical decision-making in the following areas: A) Primary diagnosis, B) Active Surveillance for Prostate Cancer, C) Surgical Planning, D) Treatment Failure, E) Selection for focal therapy candidacy.

Printed on: 10/29/20

MSRO38

BOOST: Lung, Mediastinum, Pleura-Case-based Multidisciplinary Review (Interactive Session)

Tuesday, Dec. 3 3:00PM - 4:15PM Room: S103CD

CH **OI** **RO**

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Simon S. Lo, MD, Seattle, WA (*Presenter*) Editor, Springer Nature; Member, ICON plc; Member, Elekta AB;
Subba R. Digumarthy, MD, Boston, MA (*Presenter*) Speaker, Siemens AG; Research Grant, Lunit Inc; Researcher, Merck & Co, Inc; Researcher, Pfizer Inc; Researcher, Bristol-Myers Squibb Company; Researcher, Novartis AG; Researcher, F. Hoffmann-La Roche Ltd; Researcher, Polaris Pharmaceuticals, Inc; Researcher, Cascadia Healthcare, LLC; Researcher, AbbVie Inc; Researcher, Gradalis, Inc; Researcher, Clinical Bay; Researcher, Zai Lab
David W. Johnstone, Milwaukee, WI (*Presenter*) Nothing to Disclose
Jyoti D. Patel, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Feng-Ming Kong, MD,PhD, Cleveland, OH (*Presenter*) Speakers Bureau, Varian Medical Systems, Inc

LEARNING OBJECTIVES

1) Describe the multidisciplinary management of lung cancer. 2) Describe the multidisciplinary management of mesothelioma. 3) Describe the multidisciplinary management of thymic tumors.

ABSTRACT

In this modern era, treatment outcomes of lung cancer, mesothelioma, and thymic tumors can be improved by using a multidisciplinary approach. This session will cover the multidisciplinary management of thoracic malignancies in a case-base format.

Printed on: 10/29/20

RC402

Developing a Flipped Classroom Workshop: From Soup to Nuts (Interactive Session)

Tuesday, Dec. 3 3:00PM - 6:00PM Room: S504AB

ED

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.50

For information about this presentation, contact:

petra.lewis@hitchcock.org

LEARNING OBJECTIVES

1) Compare and contrast traditional and flipped classroom teaching. 2) Explain potential challenges involved in developing and deploying flipped teaching sessions. 3) Identify learning objectives that are more suitable for prelearning material. 4) Create an example prelearning video using 'Explain Everything'. 5) Create active learning exercises for specified learning objectives. 6) Describe how active annotation with apps such as 'Doceri' can aid audience interactivity. 7) Develop example questions using Diagnosis Live.

Sub-Events

RC402A Flipping the Classroom - Introduction

Participants
Petra J. Lewis, MBBS, Lebanon, NH (*Moderator*) Committee member, CairnSurgical

For information about this presentation, contact:

petra.lewis@hitchcock.org

LEARNING OBJECTIVES

1) Compare and contrast flipped classroom with traditional teaching methods. 2) List 3 advantages of using flipped classroom teaching. 3) Describe the general structure of a flipped classroom session. 4) List 4 types of prelearning material that can be provided to learners.

RC402B Active Learning Exercises

Participants
Petra J. Lewis, MBBS, Lebanon, NH (*Presenter*) Committee member, CairnSurgical

For information about this presentation, contact:

petra.lewis@hitchcock.org

LEARNING OBJECTIVES

1) Differentiate between active and passive learning techniques. 2) Describe 5 different active learning methods. 3) Create an active learning curriculum for a flipped classroom session.

RC402C Recording Lectures

Participants
Jonathan O. Swanson, MD, Seattle, WA (*Moderator*) Nothing to Disclose
Jessica G. Fried, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Eric M. Goodman, MD, Mineola, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

egoodman2@northwell.edu

RC402D Using an iPad to Teach Wirelessly

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

For information about this presentation, contact:

Harprit.Bedi@bmc.org

LEARNING OBJECTIVES

1) Discuss the benefits of using an iPad to create a more interactive teaching session. 2) Demonstrate the use of teaching wirelessly with an iPad.

RC402E Writing Learning Objectives

Participants
Nancy J. McNulty, MD, Lebanon, NH (*Presenter*) Book contract, Oxford University Press

RC402F Using RSNA Diagnosis Live™

Participants
Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
Sheryl G. Jordan, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose
Tara M. Catanzano, MD, Springfield, MA (*Presenter*) Nothing to Disclose
Martha B. Mainiero, MD, Providence, RI (*Presenter*) Nothing to Disclose
Monica M. Sheth, MD, Manhasset, NY (*Presenter*) Nothing to Disclose
Priscilla J. Slanetz, MD,MPH, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the methods of audience engagement that are possible using RSNA Diagnosis Live™. 2) Engage the audience in a radiology teaching conference using one or more of the methods available in RSNA Diagnosis Live™ software.

Printed on: 10/29/20

RC413

Pediatric Series: Gastrointestinal/Genitourinary

Tuesday, Dec. 3 3:00PM - 6:00PM Room: E353B

GI GU PD

AMA PRA Category 1 Credits ™: 2.75
ARRT Category A+ Credits: 3.25

FDA Discussions may include off-label uses.

Participants

Jonathan R. Dillman, MD, MSc, Cincinnati, OH (*Moderator*) Research Grant, Siemens AG; Research Grant, Guerbet SA; Travel support, Koninklijke Philips NV; Research Grant, Canon Medical Systems Corporation; Research Grant, Bracco Group
Ethan A. Smith, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose
Brandon P. Brown, MD, Indianapolis, IN (*Moderator*) Nothing to Disclose
Sabah Servaes, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

RC413-01 Pediatric Liver Malignancies

Tuesday, Dec. 3 3:00PM - 3:20PM Room: E353B

Participants
Gary R. Schooler, MD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify clinical and imaging characteristics of the two most common primary pediatric hepatic malignancies: hepatoblastoma and hepatocellular carcinoma. 2) Apply an up-to-date imaging strategy for pediatric patients with hepatoblastoma and hepatocellular carcinoma.

RC413-02 Diagnosis of Pediatric Liver Diseases with Multiparametric MRI and Quantitative Magnetic Resonance Cholangiopancreatography (MRCP) Analysis

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E353B

Participants
Lin Cheng, Oxford, United Kingdom (*Presenter*) Employee, Perspectum Diagnostics Ltd
Sofia Mouchti, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics Ltd
Ged Ridgway, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics Ltd; Stockholder, Perspectum Diagnostics Ltd
Marc H. Goldfinger, Msc, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Researcher, Perspectum Diagnostics Ltd
Carlos D. Ferreira, Oxford, United Kingdom (*Abstract Co-Author*) Shareholder, Perspectum Diagnostics Ltd; Employee, Perspectum Diagnostics Ltd
Andrea Borghetto, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics Ltd
Andrea Dennis, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics Ltd
Matt Kelly, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics Ltd
Kamil Janowski, Warsaw, Poland (*Abstract Co-Author*) Nothing to Disclose
Elzbieta Jurkiewicz, MD, Warsaw, Poland (*Abstract Co-Author*) Nothing to Disclose
MacIej Pronicki, Warsaw, Poland (*Abstract Co-Author*) Nothing to Disclose
Ma?Gorzata Wozniak, Warsaw , Poland (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Non-invasive objective diagnostic methods are urgently needed in paediatric liver diseases, such as autoimmune hepatitis (AIH) and primary sclerosing cholangitis (PSC). Iron-corrected T1 (cT1) generated from a multiparametric MRI method *LiverMultiScan*TM (LMS) has been shown to correlate with biopsy-assessed inflammation and fibrosis in adults [1]. The biliary tree can be analysed by a novel quantitative MRCP method, *MRCP+*, quantifying biliary tree volume, local duct diameters, and dilated/strictured regions. Here, we investigate whether biomarkers from LMS and MRCP+ can differentiate AIH, PSC and healthy controls in the paediatric setting.

METHOD AND MATERIALS

In this prospective study, 49 paediatric patients (6-18 yrs.; AIH: n=41; PSC/AIH overlap syndrome: n=8) and 20 healthy age-matched controls underwent LMS and T2w MRCP imaging on 1.5T Siemens Avanto-fit. cT1(median, interquartile range), T2*, fat fraction, etc. were generated from LMS, and 20 biliary system metrics were generated from MRCP+; in total 25 variables were fit to logistic regression models to discriminate healthy, AIH and PSC patients. Stepwise logistic regression was used to select optimal combinations of variables to stratify individuals by disease. ROC analysis was performed for the selected predictors and their combinations.

RESULTS

Median cT1 and the sum of dilation severity are the optimal predictors for classifying healthy from disease group (p=0.015 and 0.013, respectively), and their combination yields the strongest predictor (AUC=0.86). Four individual predictors: fat fraction, median cT1, number of ducts with candidate strictures, and length percentage of strictured or dilated ducts, can significantly differentiate AIH from non-AIH (p=0.038, 0.003, 0.024 and 0.023, respectively); ROC curves indicate that their combination is the strongest predictor for AIH (AUC=0.83). The number of ducts with candidate strictures is the strongest predictor for discriminating PSC (p=0.003) and yields AUC of 0.85, which shows MRCP+ has the potential to objectively differentiate PSC from non-PSC.

CONCLUSION

LiverMultiScan and quantitative MRCP have the potential to aid radiologists with the assessment of paediatric liver diseases including AIH and PSC.

CLINICAL RELEVANCE/APPLICATION

A novel non-invasive method using multiparametric MRI and quantitative MRCP (*MRCP+*) can predict healthy/AIH/PSC objectively, thus aid clinicians with the diagnosis of paediatric liver diseases.

RC413-03 Assessment of Normal Values of GSI Spectroscopy in Children's Liver Based on Fixed-time Contrast Medium Injection

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E353B

Participants
Chunxiang Wang, Tianjin, China (*Presenter*) Nothing to Disclose
Nan Yang, Tianjin , China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Objective: Spectral CT can provide meaningful multi-parameter diagnostic information for clinic. However, the normal values of liver energy spectrum analysis in children are still unclear. In this study, the normal range of liver energy spectrum analysis in children with enhanced GSI was assessed by fixed-time injection of iodine contrast agent based on their body weight.

METHOD AND MATERIALS

MATERIALS: Thirty children with body mass greater than 20 kg and non-hepatic lesions underwent abdominal CT enhancement from January to February 2019 were selected. All children underwent abdominal CT enhancement using the Revolution GSI model. All patients were given iodine contrast medium of 300 mg I/ml at 1.5 ml/kg and fixed contrast medium injection time of 24 seconds. (Table 1)Portal vein phase was selected for evaluation, and the delay time was fixed at 56 seconds after injection. The values of 70 KeV, iodine water value(mg/ml), water iodine value(mg/ml)and Effective-Z atomic number of 8 segments of liver were measured by Couinaud liver segmentation method(Fig.1). All data were tested by single sample T test, and the 70 KeV, iodine water value, iodine water value, Effective-Z atomic sequence value and body weight of each segment were displayed by scatter plot.

RESULTS

Results: The body weight of 30 samples ranged from 20.1 kg to 65.0 kg, with an average of 29.60 + 12.26 kg. Single sample T test showed no significant changes in liver energy spectrum 70 keV, iodine water value, water iodine value and Effective-Z atomic number of children with different body weight (Table 2). The scatter plot showed that the 70 keV value of each liver segment increased with the increase of body weight, while the trend lines of iodine water value, water iodine value and atomic sequence value showed a steady trend(Fig.2).

CONCLUSION

CONCLUSION: The normal CT value of children's liver parenchyma obtained by traditional enhanced examination is not reliable, but the normal values of iodine water, water iodine and Effective-Z atomic number of children's liver obtained by fixed time injection of iodine contrast agent can be trusted.

CLINICAL RELEVANCE/APPLICATION

CLINICAL RELEVANCE/APPLICATION:The determination of normal values of multi-parameters of children's liver energy spectrum CT can reflect the characteristics and functional status of children's liver more comprehensively, so as to obtain more accurate and comprehensive diagnosis.

RC413-04 CT and MR Imaging of Pancreatic Trauma in Children

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E353B

Participants
Ala Y. Ibrahim, Toronto, ON (*Presenter*) Nothing to Disclose
Paul Wales, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Michael R. Aquino, MD, MS, Toronto, ON (*Abstract Co-Author*) Co-author, Reed Elsevier
Govind B. Chavhan, MD, Toronto, ON (*Abstract Co-Author*) Speaker, Bayer AG

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PURPOSE

To evaluate the type and grade of pancreatic injury in children on CT and correlate it with management and outcome. To evaluate MRI findings of pancreatic trauma and correlate it with CT grades of pancreatic injury.

METHOD AND MATERIALS

Retrospective review of children with pancreatic injury over 16 years period was performed to note mechanism of injury, injury severity score(ISS), associated abdominal injuries, management and interventions performed, and outcome. All CT and MR images were re-reviewed by two radiologists and pancreatic injuries were classified according to the American Association for the Surgery of Trauma (AAST)

RESULTS

Of 3,265 children presented with trauma during the study period, only 28 (0.86%) children (M:F 19:9; mean age 7.14 yrs; age range1-15yrs) had pancreatic injury. 27 had CT of the abdomen with 26 of them performed on the day of trauma. According to AAST, there were 5 (19%) grade I, 9 (33%) grade II, 8 (30%) grade III, and 3 (11%) grade IV. No pancreatic parenchymal injury was identified in 2 (7%) patients with isolated fluid around the pancreas and mesentery. Associated injuries were seen in 93% cases. MRI was performed in 10 children on day 0-330 (median 41 day) of trauma. Pancreatic duct injury was seen on 5/10 and pseudocyst on 4/10. Signal intensity difference in pancreatic parenchyma (SIDPP) and caliber difference in duct (CDD) proximal and distal to the injury site was seen in 5/10 children, 2/10 showed only SIDPP, 1/10 showed only CDD and 1/10 showed atrophy of body and tail with ductal dilatation. Two patients died because of multiorgan injuries, 9 patients (mainly with grade III and IV injuries)underwent surgery and/or ERCP and 16 patients (mostly grade I&II)were treated conservatively. AAST grading of pancreatic injury on CT correlated with type of management ($p=0.0001$).

CONCLUSION

CT grading of injury correlates with management and guides intervention and/or surgery versus conservative treatment. MRI is useful for assessing ductal injury and secondary changes in pancreatic parenchyma and the PD, and it should be performed when the status of the PD is not clear on CT

CLINICAL RELEVANCE/APPLICATION

CT grading of pediatric pancreatic injury is crucial as it correlates with subsequent management. MRI is useful for assessing ductal injury and secondary changes in pancreatic parenchyma.

RC413-05 DTI of the Kidney in Children: Comparison between Normal Kidneys and Those with Ureteropelvic Junction (UPJ) Obstruction

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E353B

Participants
Suraj D. Serai, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Juan Calle Toro, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
J. C. Edgar, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Hansel J. Otero, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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PURPOSE

To compare renal diffusion tensor imaging (DTI) parameters in patients with or without ureteropelvic junction (UPJ) obstruction.

METHOD AND MATERIALS

Patients that underwent functional MR urography (MRU) with renal DTI were retrospectively selected. Kidneys deemed normal on T2-weighted images and functional parameters (i.e. time to peak, calyceal transit time and renal transit time) were used as control kidneyss and compared to kidneys with morphologic findings of UPJ obstruction and renal transit time >490 seconds. DTI included a 20-direction DTI with b-values of b=0 s/mm2 and b=400 s/mm2. Diffusion Toolkit and TrackVis were used for analysis and segmentation. TrackVis was used to draw regions of interest (ROI) covering the entire volume of the renal parenchyma, excluding the collecting system. Fibers were reconstructed using a deterministic fiber tracking algorithm. Whole kidney ROI based analysis was performed to obtain cortico-medullary measurements (Fractional anisotropy (FA), ADC and track length) for each kidney. T-tests compared means with statistical significance defined at $p<0.05$.

RESULTS

118 normal kidneys from 102 patients (mean age 8.0 ± 5.8 years; 58 males and 44 females) were compared to 18 kidneys from 16 patients (10.4 ± 6.8 years; 9 males and 7 females) with UPJ Obstruction. Mean FA values were significantly lower (0.31 ± 0.07; n=18) in kidneys with UPJ obstruction than normal kidneys (0.40 ± 0.08; n=118) ($p<0.001$). ADC was marginally significantly different ($p= 0.01$) and track length was not significantly different ($p= 0.24$).

CONCLUSION

DTI derived fractional anisotropy (FA) appears to discriminate between normal kidneys and those with UPJ obstruction, in the future, FA could potentially be used to monitor renal damage in patients with UPJ obstruction obviating the need for contrast administration and thus shortening exam length.

CLINICAL RELEVANCE/APPLICATION

DTI of the kidney is feasible in a clinical setting and can provide complementary functional information in patients with UPJ obstruction.

RC413-06 Imaging Features and Clinical Decision-making in Pediatric Focal Nodular Hyperplasia

Tuesday, Dec. 3 4:00PM - 4:10PM Room: E353B

Participants
Greg Chambers, MBBS, MSc, Paris, France (*Presenter*) Nothing to Disclose
Angelo Zarfati, Paris, France (*Abstract Co-Author*) Nothing to Disclose
Cecile Cellier, Rouen, France (*Abstract Co-Author*) Nothing to Disclose
Catherine Adamsbaum, Paris, France (*Abstract Co-Author*) Nothing to Disclose
Sophie Branchereau, Paris, France (*Abstract Co-Author*) Nothing to Disclose
Stephanie Franchi-Abella, MD, Le Kremlin-Bicetre, France (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Describe imaging features of pediatric focal nodular hyperplasia (pFNH) in a large cohort and propose clinical, radiological and surgical management

METHOD AND MATERIALS

Imaging of 87 children with 105 pFNH lesions from 1977-2018 were evaluated by 2 radiologists for features such as size, number, echogenicity/density/intensity, presence of central scar and enhancement pattern. All patients referred from 1996 were assessed for symptoms, risk factors, initial management, follow up and outcome. Results were used to form management guidelines for future patients.

RESULTS

87 patients (70% female) with 105 lesions were analysed. 8 patients (9.2%) had multiple pFNH. Size ranged from 1-13.7cm. Ultrasound (US) imaging was available for 82 patients, CT in 32 patients and MRI in 44 patients. pFNH are iso-/hyperechoic on US (68/82) with arterial Doppler flow in 75% (36/48). Contrast US shows typical enhancement in 86% (6/7). On CT, pFNH are iso-/hypodense (30/32) pre-contrast with typical enhancement in 79.5% (31/39). On MRI, pFNH are iso-/hypointense on T1 (37/44), iso-/hyperintense on T2 (42/44), hyperintense on diffusion (23/28) and show typical enhancement in 71.8% (28/39). 50 patients were referred after 1996: 74% females, mean age 8.9 years old with 46% symptomatic. Mean length of follow-up was 5.2 years. Mean long axis diameter pFNH lesion at diagnosis was 5.9cm. 74% of patients underwent watchful waiting and 26% surgical resection. Of the watchful waiting patients 25 (67.5%) had lesional growth, 6 (16.2%) showed stability and 6 (16.2%) showed lesional decrease. 9 (24.3%) of the observed patients eventually had surgery. 92% of patients were asymptomatic at the end of follow-up with no significant difference in the surgical and observational groups.

CONCLUSION

pFNH is a rare tumour which can be large, multiple, atypical on imaging and a weaker predisposition for females than in adults. Atypical cases require histological confirmation to exclude differential diagnoses such as adenoma. We propose a conservative approach to treatment given that surgery has risks and complications. Surgery should be considered first line in patients presenting with compressive abdominal symptoms.

CLINICAL RELEVANCE/APPLICATION

These results offer a clinico-radiological strategy for the diagnosis and management of these rare pediatric liver tumours, which will help clinicians triage their patients towards wathcful wating, radiological intervention or surgery.

RC413-07 CEUS of Pediatric Liver Masses

Tuesday, Dec. 3 4:10PM - 4:30PM Room: E353B

Participants
Judy H. Squires, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learn basic principles for performing contrast-enhanced ultrasounds for focal liver lesion evaluation. 2) Identify imaging characteristics of common focal liver lesions, including how to distinguish benign from malignant lesions.

RC413-08 Imaging of Pediatric Pancreatitis

Tuesday, Dec. 3 4:40PM - 5:00PM Room: E353B

Participants
Sudha A. Anupindi, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Define the current terminology of subtypes of pancreatitis in children. 2) Describe the current and emerging imaging techniques for pediatric pancreatitis. 3) Examine the common congenital anomalies which lead topancreatitis.

RC413-09 Imaging Diagnosis and Differential Diagnosis of Pancreatoblastoma (PB) and Solid Pseudopapillary Tumors (SPTs) of Children

Tuesday, Dec. 3 5:00PM - 5:10PM Room: E353B

Participants
Zhaoxia Yang, Shanghai , China (*Presenter*) Nothing to Disclose
Ying Gong, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Zhongwei Qiao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine if characteristic features on computed tomographic and (or) magnetic resonance imaging can differentiate pancreatoblastoma(PB) and solid pseudopapillary tumours (SPTs) of the pancreas in children.

METHOD AND MATERIALS

The clinical and imaging data of 34 children with pancreatoblastoma(PB) and solid pseudopapillary tumours (SPTs) that were confirmed by surgeries were retrospectively analyzed,including 20 cases of SPTs and 14 cases of PB. The size, margin, calcification, hemorrhage, proportion of solid component, intratumoral vessels, encapsulation of the tumor, dilatation of pancreatic duct, peripancreatic vessel invasion, distance metastasis status, and the apparent diffusion coefficient(ADC) values of the two groups were analyzed and key diagnostic points were identified. Statistical analysis was performed using the $\chi 2$ test and the Student's t test.

RESULTS

All children with SPTs were more than 5 years old which was significant older than children with PB(p=0.000);There was no significant sex differential between SPTs and PB(p=0.148). Mean maxisimum tumour size in PB was signifcantly larger than SPTs (p=0.001). PB presented with more calcification(p=0.002), intratumoral vessels(p=0.000), vascular invasion(p=0.000) and distant metastasis(p=0.003) comparison with SPTs, while SPTs were more prone to hemorrhage(p=0.033) and had a higher mean ADC value(p=0.019). There were no significant statistical differentiation in tumor capsule(p=0.442), dilatation of pancreatic duct(p=1.000), and cystic degeneration area over than 50% of tumor volume(p=0.719) between two groups of tumors.

CONCLUSION

CT and (or) MRI is helpful in the differential diagnosis of pancreatoblastoma(PB) and solid pseudopapillary tumors (SPTs) of pancreas in children.Pancreatoblastomas were usually presented as large tumors with calcification,intratumoral vessel,vascular invasion and distant metastasis comparison with SPTs,while SPTs had a tendency to intratumoral hemorrhage and higher ADC values.

CLINICAL RELEVANCE/APPLICATION

SPT is the most common pancreatic tumor in children; And pancreatoblastoma(PB) is considered the most common malignant tumor in children in the first decade. Differential diagnosis of these two tumors is very important for clinical because of different prognosis. Our result demonstrated that CT and (or) MRI is helpful in the differential diagnosis of PB and SPTs of the pancreas in children.

RC413-10 Study on Normal Range of GSI Energy Spectrum Analysis of Children's Pancreas Based on Contrast Agent Fixed-Time Injection Method

Tuesday, Dec. 3 5:10PM - 5:20PM Room: E353B

Participants
Sipei Xing, Tianjin , China (*Presenter*) Nothing to Disclose
Nan Yang, Tianjin , China (*Abstract Co-Author*) Nothing to Disclose
Chunxiang Wang, Tianjin, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

This study used a fixed-time injection of iodine contrast agent based on the body mass of the child to evaluate the normal range of the analysis of the pancreatic energy spectrum of the children in the GSI spectrum enhancement examination.

METHOD AND MATERIALS

Thirty children with a body mass greater than 20 kg and a non-pancreatic lesion with abdominal CT enhancement were selected from 2019.1 to 2019.2. All patients underwent GSI spectroscopy CT enhancement examination using GE revolution CT. Four scan protocols (four groups) were scanned according to body weight (Table 1), and a uniform contrast protocol was used: 300 mgI was given according to the weight of the child per ml Iodine contrast agent 1.5ml/kg, and use 24s fixed contrast injection time method. All patients underwent an image evaluation of the portal vein phase. The phase delay time was 56s after the contrast agent injection. The ROI of the head, body and tail of the pancreas was selected (Fig. 1), and the four energy spectrum analysis values of 70KeV, iodine water value, water iodine value and atomic number were measured. The single sample statistics were drawn using SPSS software. (Table 2).

RESULTS

This indicates that the four energy spectrum analysis values of 70KeV, iodine water value, water iodine value and atomic number obtained are relatively fixed in children with pancreatic energy spectrum GSI enhanced CT examination using fixed-time injection of iodine contrast agent.

CONCLUSION

Contrast fixed injection time method according to different body weight to give different doses of iodine contrast agent, can ensure that children of different body weight under the contrast agent program and relatively fixed weight of iodine contrast agent, iodine contrast agent dose absorbed by human tissue Not affected by weight. Under the scanning scheme and the contrast agent scheme, the iodine dose is relatively constant, and is not affected by body weight, and the energy spectrum analysis value is relatively fixed, and the result has credibility under the scheme.

CLINICAL RELEVANCE/APPLICATION

Therefore, under this method, the energy spectrum analysis value can be used as a reference value for the normal energy spectrum analysis of the GSI enhanced CT examination of the pancreatic energy spectrum for the clinician to perform functional and component diagnosis based on the numerical value.

RC413-11 Quantified Terminal Ileal Motility during MR Enterography as a Biomarker of Crohn's Disease Activity in a Pediatric Population: A Retrospective Study

Tuesday, Dec. 3 5:20PM - 5:30PM Room: E353B

Participants
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Shankar Kumar, BSC,MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Stuart A. Taylor, MBBS, Great Missenden, United Kingdom (*Abstract Co-Author*) Research Consultant, Robarts Clinical Trials, Inc; Shareholder, Motilent
Fevronia Kiparissi, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Tom A. Watson, MBChB, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

A relationship between small bowel motility and inflammatory activity in Crohn's Disease is now well described in adults against endoscopic and histopathological measures of activity. This retrospective study explores this relationship between terminal ileal (TI) motility in children against a symptomatic endpoint.

METHOD AND MATERIALS

A review of a pediatric hospitals imaging database was performed to identify subjects with good quality MRE studies and a clinical appointment ±1mo to determine a clinical score for disease activity (PGA, a 4 point score 1 = no disease to 4 = severe). 68 subjects were identified (mean age 13.2, range 6 to 19) with dynamic 'cine' imaging through the terminal ileum. The dynamic imaging was processed, blind to any clinical data, with a previously validated motility assessment algorithm (GIQuant®, Motilent, London, UK). A consultant radiologist delineated the TI on each subject within 5cm of the ileocecal valve and the motility score derived. The TI was used as an repeatably identifiable reference to enable comparison between subjects. The TI motility score was correlated against the symptom score and the cohort split into clinically active disease PGA >1 and non-active = 1. The mean difference between groups was assessed with U-Test.

RESULTS

The median TI motility was 0.2 (range 0 to 0.6) and the median PGA symptom score was 1 (range 1 to 4). The correlation between the two measures was R = -0.32, P = 0.011. The mean motility score of those with active disease was 0.18 , compared to 0.26 for those without active disease, a statistically significant difference of 0.08, P = 0.003.

CONCLUSION

Subjects with reduced terminal ileal motility appeared to have a higher symptom load. These findings broadly support results in adult populations and comparison with an endoscopic or histopathological endpoint at the TI represents an important next step.

CLINICAL RELEVANCE/APPLICATION

MRI is non-invasive, safe and widely available option for monitoring Crohn's Disease activity making it an ideal test for subjects destined to undergo scanning for the rest of their lives. Biological therapy is now widely used in children to control inflammation. These drugs are very expensive. A rapid and objective biomarker of disease response like motility, espeically one that does not require gadolinium, is imporant to driving efficient spending in IBD.

RC413-12 Contrast-Enhanced Ultrasound in Pediatric Crohn's Patients: Comparative Study with MRI

Tuesday, Dec. 3 5:30PM - 5:40PM Room: E353B

Participants
Jesse K. Sandberg, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose
Kiran Mudambi, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Dorsey Bass, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Erika Rubesova, MD, MSc, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Current standard of practice for evaluating bowel inflammation in Crohn's disease (CD) includes magnetic resonance imaging (MRI). Despite MRI having a high sensitivity/specificity for detecting bowel wall inflammation; it requires oral contrast, long scan times, high costs and sedation in younger patients. Alternatively, contrast enhanced ultrasound (CEUS) provides quick evaluation of bowel at bedside without the need for sedation. The purpose of our study is to compare CEUS to MRI for evaluation of bowel inflammation in Crohn's disease in pediatric patients.

METHOD AND MATERIALS

Between April 2018 and January 2019, 20 patients, 11 females and 9 males (mean 14.2yr [8mo-20.7yr]) with biopsy proven CD, underwent contrast enhanced MRI (GE Discovery) and CEUS. Greyscale US (Philips, GE or Siemens machine, 9-18L probes) was performed to identify thickened bowel loops, followed by injection of Lumason contrast (Bracco Imaging). CEUS was interpreted by a single radiologist with 15 years experience while the MRIs were interpreted by numerous pediatric radiologists. Enhancement, mucosal disruption, mucosal/submucosal wall thickness, and pericolonic inflammation were noted. Concordance between MRI and CEUS was assessed retrospectively.

RESULTS

CEUS sensitivity to detect bowel inflammation when seen on MRI was 100%. Enhancement concordance was 85% (17/20). The 3 discordant biopsy proven CD cases showed no enhancement or wall thickening on MRI but had thickened enhancing bowel loops on CEUS. Wall thickness was not statistically significant between MRI and CEUS ($p=0.25$), confidence in accurately measuring mucosal/submucosal layers was possible only with US. Mucosal disruption was more often seen with US ($n=10$) than MRI ($n=2$). Pericolonic inflammation was found equally ($n=13$).

CONCLUSION

In this small sample of pediatric patients, CEUS was superior to MRI in detecting bowel inflammation in CD patients. Bowel US involves using high frequency linear US probes providing detailed evaluation and visualization of bowel wall layers. MRI remains essential for initial diagnosis of CD as CEUS has a limited field of view. Thus, CEUS may have great potential for follow-up.

CLINICAL RELEVANCE/APPLICATION

Contrast enhanced ultrasound has the potential to enhance our ability to detect bowel inflammation and avoid inherent limitations of MRI.

RC413-13 Abdominal Imaging in Children with Failing Fontan Circuits

Tuesday, Dec. 3 5:40PM - 6:00PM Room: E353B

Participants
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LEARNING OBJECTIVES

1) To explain hemodynamic disturbances associated with elevated systemic venous pressure in children with Fontan surgery. 2) To discuss abdominal complications in children with failing Fontan circuit. 3) To discuss role of imaging and strategies to optimally image these complications.

SPAI33

RSNA AI Deep Learning Lab: Beginner Class: Classification Task (Intro)

Tuesday, Dec. 3 3:00PM - 4:30PM Room: AI Showcase, North Building, Level 2, Booth 10342

AI BR CH CT GI HN IN MR NR

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

Participants
Bradley J. Erickson, MD, PhD, Rochester, MN (*Presenter*) Board of Directors, VoiceIt Technologies, LLC; Stockholder, VoiceIt Technologies, LLC; Board of Directors, FlowSigma, LLC; Officer, FlowSigma, LLC ; Stockholder, FlowSigma, LLC

Special Information

In order to get the best experience for this session, it is highly recommended that attendees bring a laptop with a keyboard and decent-sized screen. Having a Gmail account will be helpful. Here are instructions for creating and deleting a Gmail account.

ABSTRACT

This class will focus on basic concepts of convolutional neural networks (CNNs) and walk the attendee through a working example. A popular training example is the MNIST data set which consists of hand-written digits. This course will use a data set we created, that we call 'MedNIST', and consists of images of 6 different classes: Chest X-ray, Chest CT, Abdomen CT, Head CT, Head MR and Breast MRI. The task is to identify the image class. This will be used to train attendees on the basic principles and some pitfalls in training a CNN. • Intro to CNNs • Data preparation: DICOM to jpeg, intensity normalization, train vs test • How do we choose the labels? Inconsistencies... Use Fast.AI routines to classify; Validation of results: Are the performance metrics reliable? 'Extra Credit': if there is time, explore data augmentation options, effect of batch size, training set size.

Printed on: 10/29/20

SSJ01

Breast Imaging (Quantitative Imaging and CAD)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E450A

BQ BR

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

FDA Discussions may include off-label uses.

Participants

Shandong Wu, PhD, MSc, Philadelphia, PA (*Moderator*) Nothing to Disclose
Matthias Dietzel, MBA,MD, Erlangen, Germany (*Moderator*) Nothing to Disclose

Sub-Events

SSJ01-01 Multiparametric Preoperative Breast MRI for Predicting Ki-67 and Histologic Grade in Early-Stage Luminal Breast Cancer

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E450A

Participants
Sung Eun Song, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation; Research Grant, Guerbet SA; Research Grant, Koninklijke Philips NV;
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PURPOSE

To investigate whether 3T multiparametric magnetic resonance imaging (mpMRI) can predict Ki-67 proliferation index and histologic grade in stage I-II luminal breast cancer

METHOD AND MATERIALS

In this retropective study, 239 consecutive women with luminal cancers underwent mpMRI and surgery. For mpMRI model, morphologic characteristics using Breast Imaging Reporting and Data system lexicon, kinetic feature using a computer-aided diagnosis (CAD), and apparent diffusion coefficient (ADC) at diffusion-weighted imaging were evaluated by two radiologists. Performance for predicting Ki-67 and histologic grade were assessed by using logistic regression analysis and the receiver operating characteristic curve (ROC) analysis.

RESULTS

Among 239 cancers, 166 (69.5%) had low Ki-67 and 73 (30.5%) had high ki-67, and 193 (80.8%) were low grade and 46 (19.2%) were high grade. Multivariate analysis showed that intratumoral high signal intensity (odds radio [OR] = 1.844; *P* = .046), and higher washout component (OR = 1.024; *P* = .001) were associated with higher Ki-67, and the presence of axillary adenopathy (OR = 2.719; *P* = .033), intratumoral high signal intensity (OR = 2.338; *P* = .028), larger angio-volume (OR = 1.186; *P* = .001), and higher washout component (OR = 1.033; *P* = < .001) were associated with higher histologic grade. The median ADC value was 0.95 ± 0.18 x 10 -3 mm2/s and ROC analysis showed that it was impossible to differentiate Ki-67 and histologic grade using ADC values (*P* = .701 and *P* = .056).

CONCLUSION

The mpMRI- derived biomarkers using tumor morphology and kinetic feature can be used for predicting proliferation activity and histologic grade in early-stage luminal breast cancer.

CLINICAL RELEVANCE/APPLICATION

Preoperative mpMRI-derived features may be used as biomarkers that help predict proliferation index and grade in patients with luminal breast cancers, thereby enabling improved personalized treatment.

SSJ01-02 Computer-Aided Diagnosis - Extracted Kinetic Heterogeneity of Breast Cancer at Preoperative MR Imaging: Relationship to Distant Metastasis-Free Survival

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E450A

Participants
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PURPOSE

To investigate whether computer-aided diagnosis (CAD)-extracted kinetic features of breast cancer at preoperative magnetic resonance (MR) imaging are associated with distant metastasis-free survival in women with invasive breast cancer.

METHOD AND MATERIALS

Between November 2011 and November 2012, 283 consecutive women (mean age, 52.9 years; age range, 32-88 years) with newly diagnosed invasive breast cancer who underwent preoperative breast MR imaging were evaluated. A commercially available CAD system was used to extract the peak enhancement (highest pixel signal intensity in the first post-contrast series) and delayed enhancement profiles (washout, plateau, and persistent components of a tumor) of each breast cancer from preoperative MRI, and kinetic heterogeneity (a measure irregularities in the proportions of washout, plateau, and persistently enhancing components within a tumor) was calculated to evaluate the intratumoral heterogeneity. Cox proportional hazards models were used to reveal the associations between CAD-extracted kinetic features and distant metastasis-free survival after adjusting for clinicopathological factors.

RESULTS

In 28 (9.9%) women, distant metastasis developed at a median follow-up of 76.7 months. CAD-extracted kinetic heterogeneity was higher in women with distant metastasis than in those without distant metastasis (0.702 ± 0.197 vs 0.434 ± 0.297, $P < 0.001$). Multivariable Cox proportional hazards analysis showed that a higher kinetic heterogeneity (hazard ratio [HR], 17.582; 95% confidence interval [CI]: 3.852; 80.263; $P = 0.009$), a higher peak enhancement (HR, 1.001; 95% CI: 1.000, 1.002; $P = 0.039$), the presence of lymphovascular invasion (HR, 3.442; 95% CI: 1.529, 7.750; $P = 0.003$), and a higher histological grade (HR, 2.285; 95% CI: 1.043, 5.009; $P = 0.039$) were associated with poorer distant metastasis-free survival.

CONCLUSION

Higher values of CAD-extracted kinetic heterogeneity and peak enhancement at preoperative breast MR imaging are associated with poorer distant metastasis-free survival of women with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION

Kinetic heterogeneity assessed by computer-aided diagnostic (CAD) at preoperative MR imaging might serve as a quantitative biomarker of distant metastasis-free survival in women with breast cancer.

SSJ01-03 Quantitative Analysis of Ultrasonographic Feature of Invasive Breast Cancer: Correlation with Molecular Subtypes

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E450A

Participants
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PURPOSE

To investigate the correlations between ultrasonographic features quantitatively assessed by a computer-aided quantification system (S-DetectTM) and molecular subtypes of breast cancer.

METHOD AND MATERIALS

An IRB-approved retrospective review was performed for 282 invasive breast cancers (<5cm) in 282 women (mean age, 53.5 years; range, 29-85 years) who underwent surgery between February 2016 and April 2017. Morphologic characteristics of breast cancer on B-mode ultrasonography (US) with respect to shape of mass, margin, orientation, echogenicity, and posterior features were measured using S-DetectTM software, and quantitative scores (0-1) of each descriptor of breast cancer were recorded. The associations between quantitative scores and tumor subtype, tumor size, and lymph node status were compared using the one-way analysis of variance test or Student's T-test.

RESULTS

Of the 282 breast cancers, 144 (51.1%) were classified as luminal A tumors, 77 (27.3%) as luminal B tumors, 22 (7.8%) as HER2-enriched tumors, and 39 (13.8%) as triple-negative tumors (ER, PR, and HER2 negative). Luminal A tumors exhibited higher irregularity scores than triple-negative tumors (mean 0.6328 vs. 0.4679, $p=0.031$). Luminal B tumors exhibited higher spiculated margin scores than triple-negative tumors (mean 0.1654 vs. 0.0276, $p=0.026$). In addition, tumors larger than 2cm in size had higher scores for irregular shape ($p=0.000$-0.004) than tumors smaller than 2 cm in size all tumor subtype except for HER2-enriched tumors.

CONCLUSION

Luminal A tumors and Luminal B tumors were more likely to exhibit irregular shapes and spiculated margins than triple-negative tumors. Smaller tumors tended to be rounder and more oval-shaped and to have more circumscribed margins than larger tumors in most tumors except for HER2-enriched tumors.

CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of morphologic characteristics using B-mode US with the S-DetectTM software can provide useful information regarding imaging phenotypes of breast cancer.

SSJ01-04 Quantitative Analysis of MRI Response to Preoperative Stereotactic Ablative Body Radiotherapy (SABR) in Early Stage ER+ HER2- Breast Cancer Correlates with Histologic Tumor Bed Cellularity

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E450A

Participants
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PURPOSE

The purpose of this study is to evaluate breast MRI response to pre-operative SABR for ER+ HER2- breast cancer and determine quantitative imaging predictors of pathologic response.

METHOD AND MATERIALS

Enrolled subjects in this phase II trial of early stage ER+ HER2- breast cancer patients underwent baseline breast MRI, SABR treatment (28.5 Gy in 3 fractions), follow-up MRI 6 weeks post-SABR, and breast conserving surgery. Pre and post-SABR MRIs were individually compared. The % tumor volume remaining (%VR) and % long diameter remaining (%DR) were calculated using quantitative metrics to evaluate MRI Response. This was correlated with pathologic response, defined by % tumor bed cellularity (%TC) in the surgical specimen. MRI analysis included 3D orthogonal measurements, semi-automated segmentation volume, and quantitative microcluster segmentation analysis of the dynamic constrast T1-weighted images. Microcluster voxel analysis of the segmented tumor was performed, assigning clusters based on binary high or low maximum enhancement intensity using Otsu algorithm and by dynamic sequence of maximum enhancement. This yielded 8 microcluster volumes within the tumor for each MRI. Statistical analysis was performed using Pearson's correlation coefficients.

RESULTS

Twelve patients completed the trial, and %TC ranged from 20-80%. For MRI response, analysis of %VR using various methods had stronger correlation with %TC (R=0.788-0.892) than %DR (R=0.727, p=0.007). The %VR by 3D measurements (R=0.844, p=0.0006) and by semi-automated segmentation (R=0.829, p=0.0009) were both very strongly correlative. For quantitative microcluster analysis, while total cluster %VR had strong correlation with %TC (R=0.747, p=0.005), correlation was stronger for %VR of the high enhancement clusters (R=0.86, p=0.0003) and even higher for %VR of the first three dynamic phase high enhancement clusters (R=0.892, p=0.0001).

CONCLUSION

In patients undergoing pre-operative SABR treatment for ER+ HER2- breast cancer, quantitative analysis of %VR on MRI, including microcluster segmentation analysis, very strongly correlates with pathologic response.

CLINICAL RELEVANCE/APPLICATION

Quantitative MRI tumor analysis, including microcluster segmentation analysis comparing pre and post SABR-treated ER+ HER2- breast cancer can help predict pathologic response to preoperative radiation in low risk tumors for which pathologic complete response to neoadjuvant treatment is rare.

SSJ01-05 Pharmacokinetic Quantitative Parameters with Histogram and Texture Features on Preoperative Dynamic Contrast-Enhanced Magnetic Resonance Imaging Differentiate between Luminal A and B Molecular Subtypes of Breast Cancer

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E450A

Participants
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PURPOSE

The aim of the present study was to use pharmacokinetic quantitative parameters with histogram and texture features on dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) to differentiate between the luminal A and luminal B molecular subtypes of breast cancer.

METHOD AND MATERIALS

We retrospectively reviewed the data of 94 patients with histopathologically proven breast cancer. The pharmacokinetic quantitative parameters (Ktrans, Kep, and Ve) with their corresponding histogram and texture features based on preoperative DCE-MRI were obtained. The parameters were compared using the Mann-Whitney U-test between the luminal A and luminal B groups, the HER2-positive luminal B and HER2-negative luminal B groups, and the lymph node metastasis (LNM)-positive and LNM-negative groups. Receiver operating characteristic (ROC) curves were generated for parameters that presented significant between-group differences.

RESULTS

The maximum values of Ktrans, Kep, and Ve, and the mean and 90th percentile values of Ve were significantly higher in the luminal B group than in the luminal A group. Among the texture features, only skewness of Ktrans significantly differed between the luminal A and B groups. All histogram features of Ktrans were higher in the HER2-positive luminal B group than in the HER2-negative luminal B group. No parameter differed between the LNM-positive and LNM-negative groups.

CONCLUSION

Pharmacokinetic quantitative parameters with histogram and texture features obtained from DCE-MRI are associated with the molecular subtypes of human breast cancer, and may serve as potential imaging biomarkers to differentiate between the luminal A and luminal B molecular subtypes.

CLINICAL RELEVANCE/APPLICATION

(Dealing with quantitative DCE-MR and the luminal A and luminal B molecular subtypes classification in breast cancer)'Quantitative parameters with histogram and texture features can be linked to two ER-positive cancer.'

SSJ01-06 Using Machine Learning to Quantify the Distribution and Morphology of Microcalcifications to Improve Cancer Prediction

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E450A

Participants
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PURPOSE

To develop a machine learning approach to classify whether suspicious microcalcifications (MC) are malignant based on their distributional patterns.

METHOD AND MATERIALS

We used 1481 mammographic images with MC findings from a public screen-film mammography dataset (DDSM), which provided radiologist-assigned BI-RADS scores and biopsy-proven diagnoses. We developed an automated algorithm to detect MCs by rescaling the image to different resolutions and applying morphological operations. Given our interest in distributional patterns, we only considered images with three or more detected MCs, reducing the total images to 743. We used principal component analysis of the MC locations to get the directions and values of the largest possible variance and it's orthogonal. We utilized these features and the number of MCs as the basis for our quantitative description of MC distribution. Using five-fold cross validation, we trained an ensemble classifier (gradient boosting) to predict malignancy, inputting the aforementioned features along with the BI-RADS score. As a baseline, we compared the model to the predictive performance of using BI-RADS only.

RESULTS

Of the 743 studies, 403 were benign, and 340 malignant. When building a classifier solely using our MC distribution features, the model achieved an area under the curve (AUC) of 0.650 (sensitivity (SEN) 0.535, positive predictive value (PPV) 0.598). Using BI-RADS alone, the model AUC was 0.791 (SEN 0.385, PPV 0.835). When both were combined into a single model, the AUC improved to 0.802 (SEN 0.615, PPV 0.694). Increasing the minimum number of MCs to generate our features reduced the sample size but improved the AUC.

CONCLUSION

We demonstrate that using a quantitative measure of MC distribution in addition to the BI-RADS assessment adds information to predict whether suspicious MCs are malignant. Our model could be further expanded by examining additional texture features and employing deep learning techniques to discover informative features.

CLINICAL RELEVANCE/APPLICATION

MCs can be a sign of breast cancer, and the indication for biopsy is based on BI-RADS. However the morphology and appearance of MCs is affected by the overlying breast fibroglandular tissue, leading to subjective interpretations and interreader variability. We hope that by employing our approach, we can increase the accuracy of interpretation and decrease the number of unnecessary biopsies and patient anxiety.

SSJ02

Breast Imaging (Artificial Intelligence in Mammography)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E451B

AI BR

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

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Jessica W. Leung, MD, Houston, TX (*Moderator*) Scientific Advisory Board, Subtle Medical

Sub-Events

SSJ02-01 Training Deep Learning Models as Radiologists: Breast Cancer Classification Using Combined Whole 2D Mammography and Full Volume Digital Breast Tomosynthesis

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E451B

Participants
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Jinze Liu, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Digital beast tomosynthesis (DBT) or 3D mammography in combination with 2D mammography has emerged as a promising clinical approach to breast cancer detection but at a cost of increased interpretation time by radiologists. Numerous deep learning models have been developed with promising results in automatic classification of breast cancer. However, existing models typically focus on using either 2D or 3D mammograms. Inspired by clinical practice, we proposed novel convolutional neural networks (CNN) for breast cancer classification utilizing combined whole 2D mammogram and full volume DBT to increase the model performance.

METHOD AND MATERIALS

In this retrospective study, we collected both 2D mammograms and DBT of biopsy proven lesions (342 benign and 165 malignant) from 507 patients. The whole mammographic images were labeled as benign or malignant without lesion annotation. Instead of using DBT directly, we first converted each DBT to a dynamic image which captured the subtle changes between two successive slices. Then, the 2D mammograms and dynamic images were fed into five ImageNet pretrained deep learning networks (Alexnet, VGG, Resnet, Densenet, and Squeezenet) as feature extractors. Finally, the feature maps of both the 2D mammograms and dynamic images were fused and used in a 3D CNN classifier.

RESULTS

Based on the receiver operating characteristic (ROC) analysis of all the 507 lesions, the combined 2D and 3D mammography achieved high performance with area under the ROC curve (AUC) of 0.93 in the task of differentiation of cancer from benign lesions. This is better than the performance of the 2D or 3D mammography alone (AUC= 0.72 for 2D and 0.66 for DBT) on the same dataset in breast cancer classification. The consistently better performance (up to 40.91% increase) of the combined images was observed in all the proposed CNN models.

CONCLUSION

The increased performance of combined 2D and 3D mammogram strongly suggests that deep learning models, like radiologists, can benefit from training with the 2D and 3D mammography together. One limitation of this study is that the dataset size is small, which may limit the predicting power of the proposed model.

CLINICAL RELEVANCE/APPLICATION

With increasing adoption of DBT in clinical practice, more accurate automatic deep learning tool using combined 2D mammogram and tomosynthesis can improve breast cancer diagnostic efficiency and have meaningful impact in clinical practice.

SSJ02-02 Prospective Analysis of CNN Based Approach of Distinguishing Atypical Ductal Hyperplasia from Ductal Carcinoma in Situ in Breast

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E451B

Participants
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PURPOSE

We have previously developed and published a convolutional neural networks (CNN) based algorithm to distinguish atypical ductal hyperplasia (ADH) from Ductal Carcinoma in Situ (DCIS) using a mammographic dataset. Purpose of this is to further validate our CNN algorithm by prospectively analyzing unseen new dataset to evaluate the diagnostic performance our algorithm.

METHOD AND MATERIALS

An IRB-approved study was performed. New dataset composed of 280 unique mammographic images from 140 patients were used to test our CNN algorithm. All patients underwent stereotactic-guided biopsy of calcifications and underwent surgical excision with available final pathology. ADH group consisted of 122 images from 61 patients with the highest pathology diagnosis of ADH. DCIS group consisted of 158 images from 79 patients with the highest pathology diagnosis of DCIS. Two standard mammographic magnification views (CC and ML/LM) of the calcifications were used for analysis. Calcifications were segmented using an open source software platform 3D Slicer and resized to fit a 128x128 pixel bounding box. Our previously developed CNN algorithm was used. Briefly, a 15 hidden layer topology was used. The network architecture contained 5 residual layers and dropout of 0.25 after each convolution. Diagnostic performance metrics were analyzed including sensitivity, specificity, accuracy and area under the ROC curve (AUC). The 'positive class' was defined as pure ADH group in this study and thus specificity represents minimizing the amount of falsely labeled pure ADH cases.

RESULTS

Area under the ROC curve (AUC) was 0.90 (95% CI ± 0.04). Diagnostic accuracy, sensitivity and specificity was 80.7%, 63.9% and 93.7% respectively.

CONCLUSION

Our CNN model prospectively distinguished pure ADH from DCIS using mammographic images with high specificity.

CLINICAL RELEVANCE/APPLICATION

Using the patients' mammographic images, our CNN algorithm can be used to predict patients with pure ADH who may be safely observed rather than undergo surgery.

SSJ02-03 Developing an Artificial Intelligence Algorithm Pipeline for Predicting Malignancy Risk for Mammographic Microcalcifications Leveraging the ACR Data Science Institute (DSI) Use Case Library

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E451B

Participants
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PURPOSE

This study implements a pipeline to develop artificial intelligence (AI) algorithms to diagnose mammographic microcalcifications using the publicly-available use case authored by the Data Science Institute (DSI) breast imaging panel.

METHOD AND MATERIALS

Our pipeline, focuses on the clinical goals of the DSI use case entitled 'Classifying Suspicious Microcalcifications,' simultaneously codifying how to 1) extract relevant mammography cases using widely available National Mammography Database (NMD) fields, 2) construct AI algorithms integrating computational and clinical input, and 3) formalize clinically-relevant evaluation metrics; all designed to support proof of generalizability. We collected mammograms with microcalcifications using an NMD database of consecutive screening and subsequent diagnostic mammograpms (1/1/2006-12/31/2015) from an academic practice for women ≥40. Matched outcomes from a Cancer Center registry confirmed final pathology using 6 ordinal subcategories: 4 malignant categories (invasive>DCIS grade 3> DCIS grade 2> DCIS grade 1) and 2 benign categories (high risk>normal). According to the DSI use case, we developed AI algorithms to calculate malignancy risk (using 10-fold cross validation) for ROC curve comparison using the DeLong method-as an example. We also derived a binary classification (benign versus malignant) and a 6-class stratification in order to classify pathologic severity and use BI-RADS to derive generalizable metrics.

RESULTS

Our final dataset contained 10,834 images with microcalcifications and ground truth pathology: 778 cancers (385 invasive; 89 DCIS grade 1; 183 DCIS grade 2; 121 DCIS grade 3) and 10,056 benign (283 high risk; 9773 normal). An example result from our pipeline: our Graph Neural Network algorithm achieved an area under the ROC curve of 0.65 which was statistically significantly superior to a baseline model using logistic regression (AUC = 0.52; $p < 0.001$). Generalizability planning includes specification of a pre-assigned threshold to use for evaluation metrics according to BI-RADS.

CONCLUSION

We demonstrate feasibility of developing an AI pipeline for realizing an important DSI use case in breast imaging.

CLINICAL RELEVANCE/APPLICATION

Assessing if microcalcifications on mammography are malignant is a clinically important pursuit. The relevant DSI use case effectively guided a promising pipeline for AI algorithm development.

SSJ02-04 Deep-Learned Mammographic Phenotypes Indicate Racial Differences in Breast Parenchymal Patterns

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E451B

Participants
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PURPOSE

To investigate racial differences in breast parenchymal patterns extracted from full-field digital mammography (FFDM) screening studies using deep learning, while also accounting for differences in age, body-mass index (BMI) and breast density.

METHOD AND MATERIALS

We analyzed a random sample of FFDM studies from 2000 self-identified African-American (AA) and 2000 Caucasian women, who underwent routine mammographic screening (Selenia Dimensions, Hologic Inc.) at our institution between September 2010 and December 2014. A deep learning model (ResNet-34 architecture) was built to learn mammographic phenotypes differentiating AA from Caucasian women, using all four standard mammographic views of the raw (i.e., 'FOR PROCESSING') imaging data from each FFDM study. To evaluate the ability of the deep-learned mammographic phenotypes to identify differences in parenchymal patterns between AA and Caucasian women while also testing for potential confounding, three Random Forest classification models were evaluated using an 80%-20% train-test split-sample approach and inputs from: (1) the deep-learned mammographic phenotypes alone, (2) the deep-learned mammographic phenotypes combined with potential confounding variables such as age, BMI, and automated area-based and volumetric percent density measures estimated with the Volpara software (v1.5.3, Volpara Health Technologies), and (3) these potential confounding variables alone. The area under the curve (AUC) of the receiver operating characteristic on the independent test set was used as performance metric to measure the ability to classify the two races based on the features evaluated.

RESULTS

The performance of the deep-learned mammographic phenotypes alone was significant (AUC = 0.88, $p<0.05$), while combining them with age, BMI and Volpara density did not change the performance (AUC = 0.88). Substantially lower race classification capacity was demonstrated when age, BMI and Volpara density were evaluated alone (AUC = 0.69, $p<0.05$).

CONCLUSION

Deep learning elucidated racial differences in mammographic parenchymal phenotypes, which can only be partially explained by factors such as age, BMI and breast density.

CLINICAL RELEVANCE/APPLICATION

Differences in parenchymal phenotypes may provide new insight on racial disparities in breast cancer's onset age and outcomes, as well as the need for adjusting breast screening guidelines by race.

SSJ02-05 Diagnostic Performances of Artificial Intelligence (AI)-Based Diagnostic Support Software for Mammography: Results Using a Standardized Test Set Built for External Validation

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E451B

Participants
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PURPOSE

To evaluate the diagnostic performances of a artificial intelligence (AI)-based diagnostic support software for mammography when applied to a standardized test set built for external validation.

METHOD AND MATERIALS

A total of 1,986 mammograms were collected consecutively from four participating centers to construct a standardized test set for validation. Cancer diagnosis was based on pathologic diagnosis (n=1,189, 59.9%), while benign diagnosis was based on either biopsy or benign imaging features showing stability for more than 2 years follow-up (n=797, 40.1%). Mammography images were analyzed using Lunit INSIGHT for Mammography (Lunit Inc., South Korea), a deep learning-based software that provides per-breast malignancy scores with region-of-interests (ROIs) for suspicious malignant lesions on mammography. Diagnostic performances were calculated using the optimized cutoff for malignancy scores.

RESULTS

Diagnostic performances using Lunit INSIGHT for Mammography on the 1,198 cases were as follows (optimal cutoff 0.068): sensitivity 90.2%, specificity 90.9%, accuracy 90.2%, and AUC 0.960, respectively. Diagnostic performances were significantly higher in mammographically-fatty breasts than dense breasts: 95.2%, 93.4%, 94.3%, 0.978 vs 88.6%, 87.7%, 88.3%, and 0.947, respectively, and in cancer size >2cm than <2cm: 96.7%, 90.1%, 92.5%, 0.981 vs 85.6%, 90.1%, 87.8%, 0.939, respectively.

CONCLUSION

The AI-based diagnostic support software for mammography showed high diagnostic performances in general, including cases of mammographically-dense breasts and small cancers. Further validation studies using standardized test sets are anticipated to prove the clinical feasibility of various diagnostic support softwares in real-world practice.

CLINICAL RELEVANCE/APPLICATION

The artificial intelligence-based diagnostic support software for mammography showed high diagnostic performances when applied to a standardized test set constructed for validation, proving its potential to provide guidance in mammography interpretation in real-world practice.

SSJ02-06 Data-Driven Imaging Biomarker for Breast Cancer Screening in Mammography: Prediction of Tumor Invasiveness in Mammography

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E451B

Participants
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PURPOSE

To assess feasibility of data-driven imaging biomarker in mammography (DIB-MMG; an imaging biomarker derived from large-scale mammography data based on deep learning technology) whether prediction of tumor invasiveness is applicable on mammography - discrimination of ductal carcinoma in situ (DCIS), DCIS with microinvasion (DCIS-MI), and invasive ductal carcinoma (IDC).

METHOD AND MATERIALS

A total of 151,764 exams of 4-view mammograms were collected from multiple institutions for developing DIB-MMG, where 31,776 were cancer (confirmed by biopsy), 49,644 were benign (confirmed by biopsy or at least 1 year of follow-up imaging), and 70,344 were normal exams (confirmed by at least 1 year of follow-up imaging). Surgical assessment of tumor invasiveness (459 DCIS, 373 DCIS-MI, and 6,365 IDC) was collected for 7,197 out of 31,776 cancer exams. A separate set of 777 cancer exams (46 DCIS, 49 DCIS-MI, 682 IDC) were used for evaluation. Previously, we assessed the feasibility of DIB-MMG as a diagnostic-support tool for breast cancer screening in mammography. In this study, we further investigated whether DIB-MMG is applicable to predict tumor invasiveness in mammography. DIB-MMG-TI (i.e. Tumor Invasiveness) was developed via two stages of training - 1) training with diagnosis labels (normal, benign, cancer), followed by 2) fine-tuning with invasiveness labels (DCIS, DCIS-MI, IDC) on the subset of cancer exams. We exploited the location of cancer lesions (6,229 among 7,197 exams) for the purpose of attention (i.e. attention mechanism in AI) in order to predict the invasiveness in more effective way.

RESULTS

AUC was summarized on two tasks: 1) discrimination of IDC from DCIS and DCIS-MI, and 2) discrimination of DCIS from DCIS-MI and IDC. For each task, per-exam AUC of DIB-MMG-TI on 777 exams of validation dataset was 0.781 and 0.690 respectively, while per-breast AUC for each task was 0.775 and 0.690. Fig.1 shows examples.

CONCLUSION

This study showed that discrimination of DCIS-MI from DCIS is more difficult than that from IDC in mammography. Experimental results showed that DIB-MMG-TI is feasible to discriminate IDC from the rest. Further clinical validation with observer performance study is needed.

CLINICAL RELEVANCE/APPLICATION

With further clinical validation, DIB-MMG-TI can be used as a preoperative diagnostic-support tool for prediction of tumor invasiveness in mammography.

SSJ03

Cardiac (Myocarditis and Inflammation)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: N227B

CA

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

Participants
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Sub-Events

SSJ03-01 Layer-Specific Strain Analysis in Patients with Suspected Acute Myocarditis: Comparison of Diagnostic Performance

Tuesday, Dec. 3 3:00PM - 3:10PM Room: N227B

Participants
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PURPOSE

Myocardial strain parameters based on cardiac magnetic resonance (CMR) feature tracking (FT) have been described to provide additional diagnostic information for the assessment of regional or global myocardial dysfunction in patients with acute myocarditis. Recent software developments allow the assessment of layer-specific myocardial strain. We aimed to determine the diagnostic performance of different layer-specific strain parameters for the diagnosis of acute myocarditis.

METHOD AND MATERIALS

68 patients with suspected acute myocarditis and 51 control subjects underwent multiparametric CMR at 1.5 Tesla. Layer-specific FT strain measurements were derived from cine images using dedicated software (Medis Suite MR, QStrain RE). Left ventricular global peak systolic longitudinal (GLS), circumferential (GCS) and radial strain (GRS) with determination of endocardial, mid-myocardial and epicardial layers, were assessed. Receiver operating characteristic analysis was performed to calculate areas under the curve (AUC).

RESULTS

Left ventricular ejection fraction was slightly reduced in patients with myocarditis (54.59±10.74% vs. 60.51±4.04%). Patients with acute myocarditis showed markedly reduced endocardial, mid-myocardial and epicardial GCS and GLS values when compared to healthy controls ($p<0.001$ for all parameters). No difference were found for radial strain values ($p>0.05$, respectively). Best diagnostic performance was observed for mid-myocardial GCS values (AUC: 0.82, cutoff: >-24.3%, sensitivity: 72%, specificity: 84%). Except for epicardial GLS (AUC: 0.74, $p=0.057$ vs. mid-myocardial GCS), the diagnostic performance of mid-myocardial GCS outperformed all other investigated strain parameters ($p<=0.01$ for all other comparisons).

CONCLUSION

CMR FT layer-specific strain values are reduced in patients with acute myocarditis. Especially, mid-myocardial GCS showed a high performance for the diagnosis of acute myocarditis and might further broaden the diagnostic targets of CMR in these patients. These findings correspond with the physiological model of strain layers, where mid-myocardial fibers determine predominantly the circumferential strain and, if affected, may contribute to a higher level of myocardial dysfunction.

CLINICAL RELEVANCE/APPLICATION

Mid-myocardial global circumferential strain has a high diagnostic performance and may serve as a reliable new diagnostic parameter in cases of suspected acute myocarditis.

SSJ03-02 Degree of Agreement between New Lake Louise Criteria and Old Lake Louise Criteria in Suspected Acute Myocarditis Patients among Different Clinical Presentation

Tuesday, Dec. 3 3:10PM - 3:20PM Room: N227B

Participants

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PURPOSE

To assess the degree of agreement of new Lake Louise Criteria (nLLC) and old LLC (oLLC) in suspected acute myocarditis patients among various clinical presentations including infarct-like (IL), arrhythmic (A) and cardiomyopathic (CM).

METHOD AND MATERIALS

104 consecutive patients with clinical suspicion of acute myocarditis were scanned on a 1.5T MR [45.5±17.5 years, 35 females (33%)]. Cardiac MR (CMR) protocol included: Cine-sequences, T2wSTIR, late and early Gd enhancement, T2 mapping, native T1 mapping and post-Gd T1 mapping. 4 patients were excluded for unknown clinical history. Frequency of clinical presentations were: 50/99(50%) IL, 21/99(21%) A and 29/99(29%) CM. Ventricular functions were recorded and compared. Patients were evaluated both with nLLC and oLLC. The degree of agreement was assessed with Cohen's kappa test for the whole population and per each group.

RESULTS

Statistically significant differences were highlighted between CM and both A and IL groups, in terms of EDV/BSA(mL/m2) and EF(%) (101.50 [87.68 to 120.90] vs 76.10 [68.99 to 96.52] and 74.87 [70.40 to 80.72]; 37.70 [31.30 to 45.40] vs 55.50 [41.60 to 58.08] and 56.04 [54.90 to 58.08]; p0,05, respectively). CMR diagnosis of myocarditis was performed in 41/104 (39.4%) patients with oLLC and in 43/104 (41.3%) with nLLC (κ= 0.68 CI95% 0.54 to 0.82). A good agreement was found in IL presentation between oLLC and nLCC (28/50, [56.0%] vs 25/50 [50.0%] κ= 0.72 CI95% 0.53 to 0.91). On the contrary, a moderate degree of agreement was detected for A and CM patients (oLLC vs nLLC; 4/21 [19.0%] vs 5/21 [23.8%]; 7/29 [24.1%] vs 10/29 [34.5%]; κ= 0.58 CI95% 0.15 to 1; κ= 0.59 CI95% 0.28 to 0.90, respectively).

CONCLUSION

The degree of agreement between original and new Lake Louise Criteria is different among various clinical presentation.

CLINICAL RELEVANCE/APPLICATION

The different degree of agreement between original and new Lake Louise Criteria reflects the various performance of the criteria for the diagnosis of acute myocarditis in diverse clinical scenarios.

SSJ03-03 Comparison of Original and 2018 Lake Louise Criteria for Diagnosis of Acute Myocarditis: Results of a Validation Cohort

Tuesday, Dec. 3 3:20PM - 3:30PM Room: N227B

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PURPOSE

Cardiac magnetic resonance (CMR) is frequently performed in patients suspected of having acute myocarditis. Imaging diagnosis is based on the Lake Louise criteria (LLC). The 2018 LLC added parametric mapping techniques as part of a T1- and T2-based criterion. We aimed to compare the diagnostic performance of the original LLC and the 2018 LLC and simultaneously validate previously reported cutoff values for parametric mapping techniques.

METHOD AND MATERIALS

A total of 40 patients with suspected acute myocarditis and 26 control subjects underwent CMR. CMR protocol allowed for assessment of T2 signal intensity ratio, early gadolinium enhancement ratio, late gadolinium enhancement, T1 relaxation times, extracellular volume and T2 relaxation times. The original and the 2018 LLC were assessed and differences between sensitivities and specificities were calculated using McNemar's test.

RESULTS

The 2018 LLC yielded a sensitivity of 87.5% (95% confidence interval [CI]: 73.9%-94.5%) and a specificity of 96.2% (95% CI: 81.1%-99.3%). The original LLC had a sensitivity of 72.5% (95% CI: 57.2%-83.9%) and a specificity of 96.2% (95% CI: 81.1%-99.3%). Sensitivity of the 2018 LLC was significantly higher compared to the sensitivity of original LLC (P=0.031). No differences in specificity were observed between both scores (P=0.999).

CONCLUSION

Multiparametric CMR has a high diagnostic value for the diagnosis of patients with suspected acute myocarditis. The 2018 LLC further improve the diagnostic performance of CMR by increasing its sensitivity. An implementation of the new score into routine diagnostic protocols should be considered.

CLINICAL RELEVANCE/APPLICATION

Novel 2018 Lake Louise criteria provide a high diagnostic accuracy for the diagnosis of acute myocarditis and significantly increase the sensitivity compared to the original score. Existing local reference/ cutoff values can be used to implement the new criteria into clinical routine.

SSJ03-04 Incremental Value of Cardiac Deformation Analysis in Fulminant Myocarditis: A Cardiovascular Magnetic Resonance Imaging Study

Tuesday, Dec. 3 3:30PM - 3:40PM Room: N227B

Participants
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PURPOSE

To evaluate the diagnostic value of cardiac magnetic resonance (CMR) feature-tracking (FT) myocardial strain analysis in patients with fulminant myocarditis and its association with myocardial oedema.

METHOD AND MATERIALS

A total of 26 patients with Fulminant Myocarditis(FM)and 25 patients with non- Fulminant acute Myocarditis(NFAM)underwent a comprehensive CMR protocol at 3.0T MR. Cardiac MR imaging approaches included late gadolinium enhancement, native T1 mapping, T2 mapping and extracellular volume fraction. FT CMR analysis of systolic longitudinal (LS), circumferential (CS) and radial strain (RS) was performed. Receiver operating characteristic analysis was performed to compare diagnostic performance.

RESULTS

When compared with NFAM, FM patients demonstrated reduced CS and LS values (LS: -12.23 ± 3.74% vs. -16.11 ± .44%, CS: -17.24 ± 4.14% vs. -20.71 ±2.62%, $P < 0.05$, respectively). LS (ECV: $r = 0.639$, $P < 0.001$; T2: $r = 0.517$, $P < 0.05$) and CS (ECV: $r = 0.631$, $P < 0.001$; T2: $r = 0.464$, $P < 0.05$) showed the strongest correlations with ECV and T2 relaxations times . The extent of LGE in patients did not correlate to their respective strains. Regarding the differentiation between FM and NFAM patients, the addition of global strain parameters to native T1, ECV and T2 enhanced the diagnostic performance in such patients (AUC=0.913) (Fig. 1).

CONCLUSION

Our study demonstrate that the assessment of cardiac strains applying FT on standard cine images is feasible in patients with fulminant myocarditis. And Cardiac strains parameters, especially, global peak systolic circumferential and longitudinal strain are significantly impaired in patients with FM. Myocardial strain metrics can sufficiently discriminate between FM and NFAM patients and show basic associations with the extent of myocardial inflammation.

CLINICAL RELEVANCE/APPLICATION

Myocardial strain metrics can sufficiently discriminate between FM and NFAM patients and show basic associations with the extent of myocardial inflammation.

SSJ03-05 Mapping Cardiac Magnetic Resonance (CMR) for Early Prediction of Unfavorable Left Ventricle Remodeling in Acute Myocarditis: MIAMI Study

Tuesday, Dec. 3 3:40PM - 3:50PM Room: N227B

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PURPOSE

Acute myocarditis is a multifaceted disease with non-specific clinical presentations and unpredictable outcome, ranging from complete recovery to end-stage dilated cardiomyopathy. A key element in the unfavorable left ventricle remodeling is the chronicization of the inflammation. Pixel-wise mapping technique resulted more sensitive than conventional CMR images in the diagnosis of acute myocarditis. However, the role in the detection of subtle inflammation is still under investigation and imaging predictors of outcome are still largely unknown.

METHOD AND MATERIALS

Thirty-eight patients with clinical suspicions of acute myocarditis underwent cardiac MR (CMR) at 1.5 T scanner for the evaluation of morpho-functionality and hyperaemia with ce-SSFP images, oedema with STIR and T2 mapping, scarred myocardium with LGE, native-T1 and ECV. When clinically indicated endomyocardial biopsy (EMB) was performed. A second CMR was performed 2 month after baseline. Forty-five healthy volunteers underwent CMR as control group.

RESULTS

Thirty-three patients out of 38 completed CMR follow-up. EMB was performed in 26 patients and confirmed CMR diagnosis. Infartlike presentation was the most frequent [21 patients (55%) vs. 10 (27%) with heart failure and 7 (18%) with sudden cardiac death/arrhythmia]. At baseline CMR: LV-EDV was 135 ml with EF 53%, LL criteria were positive (T2-ratio: 2.8, Hyperemia: 13%, LGE: 6%) and T1, T2 mapping and ECV were significantly higher than normal values. No differenced were observed among clinical presentation (p>0.05). Mapping parameters showed excellent diagnostic accuracy for myocarditis in acute phase (AUC: 95%, 98%, 90% for T1 map, T2 map and ECV) and convalescent phase (90%, 85%, 89% for T1 map, T2 map and ECV) At short-term follow-up, a slight recovery of EF was experimented with a reduction of all LL and mapping parameters without differences among clinical presentations. The modification of native-T1 values correlated to the recovery of EDV (R=0.8242, p=0.0005) and ejection fraction (R= -0.4559, p=0.0378).

CONCLUSION

Lower recovery of T1 value in convalescent phase is associated to higher EDV and lower EF.

CLINICAL RELEVANCE/APPLICATION

Early evaluation of mapping modification may predict worst outcome and could be useful for risk stratification and for guiding personalized therapy.

SSJ03-06 A New Perspective to Myocarditis with Dual-Energy CT

Tuesday, Dec. 3 3:50PM - 4:00PM Room: N227B

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PURPOSE

Dual-energy computed tomography (DECT) is an evolving technology that provides information about material composition. In recent years, it has become possible to evaluate myocardial tissue by dual energy applications. The purpose of this study is to evaluate myocardium on an iodine map in DECT and to compare the DECT with MRI findings, which is the current gold standard in acute myocarditis.

METHOD AND MATERIALS

A prospective study was conducted involving patients with findings of myocarditis without any coronary artery pathology. Patients were assessed for acute myocarditis on DECT and cardiac MRI by two observers. The 17-segment-model analysis was used to assess myocardial abnormalities in terms of the number of segments, location and pattern involved, and an interobserver agreement was calculated.

RESULTS

A total of 22 patients were evaluated by CMR within 24 hours following DECT, which was within 12 hours of the onset of chest pain. Transmural diagnosis was good, subepicardial and centromyocardial diagnosis was excellent, and a perfect match was found in nodular and band-like pattern for both observers. The correlation was found to be statistically significant in terms of the total number of segments diagnosed between the DECT findings of Observer 1 and the MRI and Observer 2 and the MRI (p <0,001).

CONCLUSION

This study demonstrates that the combination of coronary angiography and iodine map images with DECT within a single examination can accurately diagnose malign coronary artery anomalies, coronary artery disease and acute myocarditis, which can cause symptoms of acute coronary syndrome with accuracy.

CLINICAL RELEVANCE/APPLICATION

• On dual-energy CT, iodine mapping shows iodine distribution in the myocardium. • Dual-energy CT may be used successfully in the diagnosis of acute myocarditis.

SSJ04

Cardiac (MRI: General Topics)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: N230B

CA MR

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

SSJ04-01 Prevalence and Pattern of Cardiac Injury Identified by Late Gadolinium-Enhancement of Cardiac Magnetic Resonance Image in Acute Moderate to Severe CO Poisoning with Elevated High-Sensitivity Troponin I: Prospective Observational Study

Tuesday, Dec. 3 3:00PM - 3:10PM Room: N230B

Participants
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PURPOSE

Myocardial injury is a frequent consequence of moderate to severe carbon monoxide (CO) poisoning. In addition, long-term mortality is significantly higher in patients who experienced myocardial injury than patients without myocardial injury. No studies have investigated myocardial injury due to carbon monoxide poisoning through cardiac magnetic resonance image (CMR). We want to know whether there are actually cardiac muscle changes identified by late gadolinium-enhancement (LGE) in CMR in acute phase after acute CO poisoning

METHOD AND MATERIALS

This prospective observational study collected data from consecutive patients who were diagnosed with acute CO poisoning and myocardial injury, defined as elevated high-sensitivity TnI (hs-TnI) level above the upper limit, at the ED between August 2017 and February 2019. CMR was performed to evaluate cardiac muscle changes identified by LGE. Patients with coronary artery disease were excluded. We classified the location of myocardial injury into 4 categories (subepicardium, mesocardium, subendocardium, and transmural) and examined the distribution of injured myocardium

RESULTS

Seventy-five patients were included. Fifteen patients (20.0%) had cardiac injury identified by LGE in CMR. The territory of left anterior descending artery (LAD) (7 patients, 46.7%) was the most common distribution in patients with positive LGE. Patients with LAD territory pattern all showed damage to the subendocardial area. In addition, mesocardium (6 patients, 40.0%) was second common site in patients with positive LGE and there was no transmural damage. Two patients with damage to the subepicardial area also showed in the RCA territory pattern. One patient had global damage distribution, defined as including distribution of all three coronary artery (LAD, left circumflex artery, and right coronary artery). Male sex was significantly more in the positive LGE group than in the negative LGE group ($p=0.011$). Decreased initial mental status was significantly more in the positive LGE group than in the negative LGE group ($p=0.006$).

CONCLUSION

Cardiac injury identified by LGE of cardiac MRI was found in 15 patients (20.0%) in acute moderate to severe CO poisoning with elevated hs-TnI.

CLINICAL RELEVANCE/APPLICATION

This is the first report about CMR results of CO poisoning. This prospective observational study collected data from consecutive patients who were diagnosed with acute CO poisoning and myocardial injury

SSJ04-02 Feature Tracking Cardiac Magnetic Resonance Imaging: A Supplementary Parameter to Improve the Risk Stratification in Patients with Ischemic Cardiomyopathy

Tuesday, Dec. 3 3:10PM - 3:20PM Room: N230B

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PURPOSE

The aim of this study was to evaluate retrospectively the prognostic value of feature tracking (FT) derived cardiac magnetic resonance imaging (CMR) strain parameters such as Global Circumferential Strain (GCS), Global Longitudinal Strain (GLS) and Global Radial Strain (GRS) for cardiovascular mortality and appropriate therapy in a cohort of patients with severe ischemic cardiomyopathy (ICM).

METHOD AND MATERIALS

ICM patients (n=246) who underwent CMR imaging prior to primary or secondary ICD implantation were retrospectively included. The following CMR parameters were assessed: GCS, GLS and GRS, calculated for both left and right ventricles, cardiac mass, ventricular and atrial volumes, atrial and ventricular functions, scar characteristics, such as ratios between left ventricular mass, infarct core mass and peri-infarction mass. FT parameters were generated from short-axis and two long axis (4-chamber; left 2-chamber) cine (SSFP- sequences) views with dedicated software (cvi42, Circle Cardiovascular Imaging Inc., Calgary, Canada). The primary endpoint was a composite of cardiovascular mortality and appropriate ICD therapies (defined as antitachycardia pacing (ATP) and adequate shock).

RESULTS

A total of 246 patients with ICM were followed up to a median of 3.7 years (1336 days; interquartile range (IQR) 460-2.062 days). 11 patients were excluded due to lack of image quality or lack of sequence acquisition resulting in 235 patients. Cardiovascular mortality occurred in 22 patients, while appropriate ICD therapies occurred in 49 patients. Those patients affected by the primary endpoint were associated with significantly reduced GRS (13.44±5.23 vs 15.20±7.63; p=0.04) and GLS (-5.99±1.75 vs -6.60±2.44 ; p=0.037) compared to patients without. In multivariable Cox regression analysis, peri-infarction scar (HR 1.11, 95%CI: 1.04-1.22, p=0.005) and GRS (HR 0,94, 95%CI: 0.90-0.98, p=0.003) were independently and significantly associated with the primary endpoint, whereas LVEF and core scar and GLS were not.

CONCLUSION

Reduced GRS seems to be an independent predictor of cardiovascular mortality and/or appropriate ICD therapy. Additionally GRS can identify a subgroup of ICM patients with an increased risk of life-threatening VA and hence could help in clinical decision making.

CLINICAL RELEVANCE/APPLICATION

Feature Tracking derived Global Radial Strain can identify a subgroup of ICM patients with an increased risk of life-threatening VA.

SSJ04-03 Cardiac Magnetic Resonance for Asymptomatic Type 2 Diabetics with Cardiovascular High Risk (CATCH) - Pilot Study

Tuesday, Dec. 3 3:20PM - 3:30PM Room: N230B

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PURPOSE

Stress cardiac magnetic resonance (CMR) for silent myocardial ischaemia in asymptomatic high risk type 2 diabetics has never been performed and the effectiveness of a screening programme is unknown. To assess feasibility of a screening programme we aimed to (i) determine the prevalence of silent myocardial ischaemia (ii) determine the number of false positive cases.

METHOD AND MATERIALS

We prospectively recruited patients with a Framingham risk score >=20% from 3 sites from August 2017 to January 2019. Adenosine stress CMR was performed in all patients. Positive stress CMR cases were referred for catheter coronary angiography with fractional flow reserve (FFR) measurements. Positive catheter coronary angiography was an FFR<=0.8 or coronary artery narrowing >=70% if FFR was not performed. Myocardial perfusion reserve index (MPRI) was measured in all cases.

RESULTS

63 patients were recruited (mean age 66yrs +/- 4.4; 77.8% male). There were 25 positive stress CMR scans. 3 patients refused

catheter coronary angiography (CCA). 9 positive stress CMR patients were shown to have FFR positive (14.3% of patient population). 13 patients had false positive stress CMRs. 3 negative stress CMR patients had CCA outside the study protocol and were confirmed as true negatives at catheter coronary angiography. 5 patients (7.9%) had infarcts detected of which 2 patients had no evidence of stress perfusion defects. Patients with false positive stress CMR had lower MPRI than true positive patients and patients without perfusion defects (1.32+/-0.29 vs 1.42+/-0.25 vs 1.45+/-0.29 respectively) although this was not statistically significant (p>=0.05). After a median follow-up of 382 days, there was no deaths, myocardial infarcts, heart failure or stroke.

CONCLUSION

14.3% of asymptomatic patients with type 2 diabetes and a Framingham risk >=20% had silent obstructive coronary artery disease which were confirmed by FFR. A false positive rate of 20.6% was demonstrated using stress CMR.

CLINICAL RELEVANCE/APPLICATION

Stress CMR screening of asymptomatic diabetic patients with Framingham risk score >20% found that ~14% of patients have obstructive coronary artery disease but there is a high false positive rate probably due to microvascular disease.

SSJ04-04 Decreased Left Atrial Longitudinal Strain is Significantly Associated with All-Cause Mortality in Restrictive Cardiomyopathy

Tuesday, Dec. 3 3:30PM - 3:40PM Room: N230B

Participants
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PURPOSE

Restrictive cardiomyopathy (RCM) represents a spectrum of disorders with a common physiology but divergent etiologies. The overall prognosis of RCM is poor with progression to heart failure and increased mortality. In this single institution retrospective cohort study, we aim to evaluate the association between cardiac magnetic resonance (CMR) variables and all-cause mortality. The secondary aim is to assess the difference of CMR imaging variables in RCM between women and men.

METHOD AND MATERIALS

98 patients with RCM (30 women and 68 men); age 61 ± 13 years referred to CMR from 2007 to 2015 were included in the study. All patients were followed to date to evaluate all-cause mortality. The CMR exam consisted of late gadolinium enhancement (LGE) images and cine images which were used for measuring indexed left ventricular (LV) mass, ventricular volume, ejection fraction (EF), and ventricular and left atrial (LA) strain. Logistic regression analysis adjusted for cardiovascular disease risk factors were performed to identify CMR variables associated with all-cause mortality.

RESULTS

50 patients (51%) had multiple myeloma and 39 (40%) had amyloidosis. 46 (47%) patients demonstrated signal enhancement on the LGE images and 35 (36%) experienced death. While mortality in patients with RCM was significantly associated with lower body mass index (p=0.03) and higher indexed LV mass (p=0.05), only LA longitudinal strain (p= 0.001) (Figure 1), older age (p=0.05), and presence of amyloid and diabetes (p=0.02 and 0.05) remained significantly associated after adjustment in the regression analysis (table 1). The presence of LGE was not associated with mortality (p=0.29). Women with RCM demonstrated higher LV circumferential strain peak (mean ± SD = 7.4 ± 1.7 versus 6.5 ± 1.6, p=0.03) smaller indexed ventricular end-diastolic volumes (p=0.005 and 0.01 for LV and RV respectively) and smaller LA volume (0.05). Mortality in women was not significantly different than in men (p=0.36).

CONCLUSION

Decreased LA longitudinal strain is independently associated with all-cause mortality in patients with RCM beyond the need for gadolinium administration. Women with RCM demonstrated higher LV circumferential strain peak.

CLINICAL RELEVANCE/APPLICATION

Left atrial longitudinal strain is associated with mortality in patients with restrictive cardiomyopathy and can play role in patients' prognosis.

SSJ04-05 Diastolic Dysfunction in Competitive Male Triathletes with Myocardial Fibrosis following a Strenuous Endurance Exercise

Tuesday, Dec. 3 3:40PM - 3:50PM Room: N230B

Participants
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PURPOSE

The purpose of this study was to analyse left ventricular (LV) diastolic function by cardiac magnetic resonance (CMR) following an endurance competition in triathletes with (LGE+) and without myocardial fibrosis (LGE-).

METHOD AND MATERIALS

30 asymptomatic male triathletes (45 ±10 years) underwent CMR (Philips, Achieva) before and 2.1 ±1.1 hours after an official endurance competition. To detect focal and diffuse myocardial fibrosis late gadolinium enhancement (LGE) imaging and native and post-contrast T1 Mapping were part of the baseline CMR protocol. The modified Look-Locker inversion recovery (MOLLI) sequence was used for T1 Mapping. Diastolic LV function was determined by time-volume analysis using cine SSFP sequences (25 phases of the cardiac cycle). Early peak-filling rates (EPFR) and atrial peak-filling rates (APFR) as well as peak-filling rate ratio (PFRR=EPFR/APFR) were determined at baseline and post-competition.

RESULTS

LGE+ triathletes demonstrated higher LV mass (89 ±7 vs. 78 ±10 g/mSquared, P<0.01) and ECV (26.2 ±1.4 vs. 24.5 ±1.3 %, P<0.01) than their LGE- counterparts. At baseline, APFR was higher in LGE+ compared to the LGE- triathletes (161 ±34 vs. 121 ±30 ml/s/mSquared, P<0.01). While APFR in LGE- triathletes showed a significant increase (121 ±30 vs. 163 ±57 ml/s/mSquared, P<0.001), it remained unchanged in LGE+ triathletes before and after the competition (161 ±34 vs. 169 ±50 ml/s/mSquared, P=0.75). EPFR and PFRR remained unchanged in both groups. There were no significant post-competition differences regarding LVEF. However, LGE+ triathletes had higher post-competition left atrial volumes than LGE- triathletes (43 ±9 vs. 34 ±7 ml/mSquared, P<0.01) and decreased LAEF (53 ±6 vs. 59 ±6 %, P<0.05).

CONCLUSION

Post-competition diastolic function in LGE- triathletes was characterized by a significant compensatory increase of APFR. In contrast, the LGE+ group did not show any relevant changes coming from already increased baseline values and had decreased post-competition LAEF compared to LGE- triathletes. This suggests exhaustion of left atrial compensatory mechanisms most likely related to impairment of diastolic function in LGE+ triathletes.

CLINICAL RELEVANCE/APPLICATION

Triathletes with focal non-ischemic LGE and increased ECV in the remote myocardium might be in danger of developing subclinical diastolic dysfunction.

SSJ04-06 Myocardial Microvascular Dysfunction in Type 2 Diabetes Mellitus Patients Accompanied with Obesity: Assessment Using 3.0T Cardiovascular Magnetic Resonance Imaging

Tuesday, Dec. 3 3:50PM - 4:00PM Room: N230B

Participants
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PURPOSE

To determine the effect of obesity and type 2 diabetes mellitus (T2DM) on myocardial microvascular function referred for cardiovascular magnetic resonance (CMR) first-pass perfusion imaging, and to clarify the important risk factors contributing to microvascular dysfunction in T2DM patients.

METHOD AND MATERIALS

A total of 79 healthy controls and 120 clinically diagnosed T2DM patients underwent CMR examination. All clinical data and image parameter were recorded and analyzed. Univariable analysis was performed to identify the predictors of myocardial microvascular dysfunction. Variables with a probability value of <0.1 in the univariable analysis were included in a backward multivariable analysis that was based on a linear regression model.

RESULTS

All perfusion parameters showed a trend that the microvascular function decreased in T2DM patients when compared with controls on the same weight scale. For the T2DM subgroup and controls subgroup, the perfusion function gradually reduced as BMI increased, which was confirmed by all perfusion parameters, except TTM (all P < 0.01). In univariable analysis, multiple variables were associated with microvascular perfusion dysfunction, such as gender, BMI, high-density lipoprotein (HDL) levels, smoking history, diabetes duration, HbA1c, heart rate. With further multivariable analysis, the perfusion parameter models demonstrated that different risk factors have varying influences on microvascular function. The microvascular wash-in function and blood flow were mainly related to BMI, and perfusion time was mainly related to heart rate.

CONCLUSION

multiple variables contribute to myocardial microvascular dysfunction and have varying influences on different pathways of microvessels in T2DM patients. Obesity is one of the important risk factors for myocardial microvascular dysfunction, and myocardial microvascular function gradually reduced as BMI increased.

CLINICAL RELEVANCE/APPLICATION

It is well established that obesity is consistently associated with a high incidence of T2DM in the general population, and the underlying cardiovascular diseases are a principal cause of morbidity and mortality in both of them. Microvascular dysfunction, which has emerged as an important role of myocardial impairment, enables the early assessment of patient status and the prediction of prognosis.

SSJ05

Chest (Artificial Intelligence/Machine Learning - Lung Malignancy)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S102CD

AI CH OI

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

SSJ05-01 Incidence Lung Cancer after a Negative CT Screening in National Lung Screening Trial: Deep Learning for Detection of Missed Lung Cancers

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S102CD

Participants
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PURPOSE

To retrospectively analyze the screening CT examinations of the National Lung Screening Trial (NLST) participants with incidence lung cancer after a negative screening round and evaluate the value of deep learning-based computer-aided detection (CAD) system in the detection of missed lung cancers.

METHOD AND MATERIALS

The images of NLST participants diagnosed with incidence lung cancer after verifiable negative CT screen were retrospectively analyzed (n = 122). Two experienced radiologists classified each of the previous-round CT screens as positive or negative and determined if missed lung cancer was present according to the NLST criteria and Lung-RADS classification in a consensus manner. A CAD system based on DenseNet 3D convolutional neural networks, trained with LIDC-IDRI dataset, was then introduced. Patient-wise and lesion-wise sensitivities along with the patient-wise false-positive rates of the CAD system were analyzed according to the NLST criteria and Lung-RADS classification separately.

RESULTS

According to the NLST criteria, 84% (103 of 122) of the previous-round CT screens were determined as positive and 60% (73 of 122) had missed lung cancers. The CAD system found 95% (98 of 103) of the CT screens as positive with 16% (3 of 19) of false-positive rate, and successfully detected 74% (54 of 73) of the missed lung cancers. Following the Lung-RADS classification, 79% (96 of 122) CT screens were determined as positive and 54% (66 of 122) had missed lung cancers. The CAD system found 89% (85 of 96) as positive with 19% (5 of 26) of false-positive rate, and detected 74% (49 of 66) of the missed lung cancers.

CONCLUSION

In this retrospective study of incidence lung cancers, the majority of the previous-round CT screens met the criteria for a positive screen and had missed lung cancers. The sensitivity of deep learning-based CAD system was 89-95% for positive screens and 74% for missed lung cancer detection, while the false-positive rate was limited.

CLINICAL RELEVANCE/APPLICATION

Lung cancers are frequently missed in low-dose CT screening and a deep learning-based CAD system has the potential to improve early diagnosis.

SSJ05-02 How Many Malignancies Present at Baseline That Get Diagnosed in the Next Screening Round? Could Their Workup Be Accelerated?

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S102CD

Participants

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PURPOSE

In the context of screening, a high proportion of diagnosed cancers have been reported to be higher than Stage I in both the NELSON (33%) and NLST (46%) trials, even after baseline scanning in NLST (34%). We hypothesise that many cancers may be visible in the baseline low-dose CT (LDCT) despite only being diagnosed from the LDCT obtained one year later. We further hypothesise that an AI-based lung cancer prediction (LCP) score would help identify some of these missed cancers on the earlier CT.

METHOD AND MATERIALS

The data consisted of 3914 subjects from the NLST with at least one solid or semi-solid nodule with a long-axis diameter >=6mm in the baseline LDCT. Subjects either only had benign findings or were diagnosed with cancer at baseline or one year later. A manual evaluation was performed of malignancies diagnosed at time-point 1, to check if a nodule >=6mm in size was visible at baseline. Thresholds to rule-in malignancies using the LCP score and the Brock model were selected by matching the specificity to that (87.2%) reported for baseline LDCTs in a retrospective evaluation of LungRADS (Pinsky et al., 2015) with a reported sensitivity of 84.9%.

RESULTS

98 of the 147 cancers diagnosed at timepoint 1 were visible at baseline. Seven of the "non-visible" cancers presented with sizes between 3 and <6mm and were not considered further. The LCP score ruled-in 68 (16 Stage II+) of these 98 visible cancers while Brock ruled-in 38 (9 Stage II+) cancers. The sensitivity and 95% confidence interval (CI) of the LCP risk score of patients diagnosed at baseline was 94.6% (90.9, 97.1). The sensitivity when including cancers diagnosed at time-point 1 was 86.9% (82.1, 92.0). For Brock, that sensitivity was 65.1% (59.2, 71.3).

CONCLUSION

Cancers only diagnosed at time-point 1 have a less malignant appearance at baseline, but in many cases accelerated workup is possible with either method if an operating point is chosen appropriately (e.g. to match the specificity of LungRADS). Despite the introduction of cancers only diagnosed at the next screening round, the LCP score achieves a sensitivity at least as good as LungRADS when applied to baseline-diagnosed cancers alone.

CLINICAL RELEVANCE/APPLICATION

AI-based lung cancer prediction could accelerate the diagnostic work-up of cancers visible in baseline screening low dose CTs. This may lead to some cancers being diagnosed at an earlier stage.

SSJ05-03 Lung Malignancy Overlooked at Chest Radiography: Performance of a Deep Learning-Based Automatic Detection Algorithm

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S102CD

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PURPOSE

To evaluate the performance of a recently developed deep learning-based automatic detection algorithm (DLAD) to detect lung malignancy overlooked at initial interpretation of chest radiograph by radiologists.

METHOD AND MATERIALS

Among the 5439 lung malignancies pathologically confirmed between April 2003 and May 2018 in a tertiary hospital, we identified patients who had overlooked lung malignancies on chest radiographs for this diagnostic cohort study. A total of 155 patients (mean patient age was 67 years [range, 29-90; 87 male patients {mean age, 67 years; range, 34-90} and 68 female patients {mean age, 64 years; range, 29-85}]) with overlooked malignant pulmonary lesions on chest radiographs were included in this study. Two radiologists independently determined whether the overlooked lesions were actionable or not. Discordant classifications were arbitrated by a third adjudicator radiologist. DLAD performance was measured in terms of sensitivities for the detection of overlooked lung malignancy and number of false-positive marks per radiograph.

RESULTS

Among 155 patients with overlooked malignancies, 127 patients were judged to have actionable lesions. When the threshold of activation value was set as 0.3, the sensitivity of DLAD for actionable lung malignancies (54% [68 of 127]) were higher than that for non-actionable lung malignancies (14% [4 of 28]). The number of false-positive marks per patient was 0.24 (31 of 127). When the threshold of activation value was set as 0.15, the sensitivity of DLAD for actionable lung malignancies increased to 60% (76 of 127), and the number of false-positive marks per patient was 0.35 (44 of 127).

CONCLUSION

The current DLAD algorithm can detect slightly more than half of the lung malignancy overlooked by radiologists at chest radiography, with only a small number of false-positive marks.

CLINICAL RELEVANCE/APPLICATION

Our study demonstrates the potential of a DLAD algorithm to reduce the number of lung malignancies that may be overlooked by radiologists.

SSJ05-04 The Utility of a Convolutional Neural Network (CNN) Model Score for Cancer Risk in Indeterminate Small Pulmonary Nodules Compared to Clinical Practice According to British Thoracic Society Guidelines

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S102CD

Participants
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PURPOSE

To assess the potential utility of a convolutional neural network (CNN) model score for cancer risk compared to clinical practice performed following the British Thoracic Society (BTS) guidelines (2015), to improve care in patients with incidentally detected indeterminate small, < 15mm, pulmonary nodules at a UK tertiary referral centre.

METHOD AND MATERIALS

Following the implementation of BTS guidelines in 2015, 148 consecutive patients with 162 benign nodules and 10 malignant nodules were included in the analysis. It was necessary to boost the number of independent cancer nodule scores in order to power calculations based on the score distribution, so the population was enriched with 23 additional incidentally detected cancers detected over a wider time period. A review of the imaging and intervention recommendations and time intervals to establish the diagnosis, according to histology or 2-year follow-up, was conducted, blinded to the CNN model score. A CNN model, which had been trained on a manually-curated US National Lung Screening Trial (NLST) dataset was used to generate a score, which was applied to both cohorts. 6 nodules (1 cancer) were unable to be scored by the CNN and were excluded from analysis. In each case, the highest-scoring nodule in a patient was used as the index nodule.

RESULTS

Use of a threshold CNN score of 5.0 would have prevented 38 CT and 3 PET-CT scans in patients with benign nodules without missing any cancers, accounting for 41.3% of the total number of CT and 37.5% of the total PET-CT of follow-ups on these patients. 15 benign nodules would not have required any follow-up whatsoever, preventing 23 CTs, using a threshold of 0.56. In 11 patients (35.5%) with cancer, their investigation and intervention would have been expedited by 3.4 months using a CNN threshold score of 80.

CONCLUSION

A CNN generated model score applied to incidentally detected indeterminate small pulmonary nodules reduces the need for follow-up imaging in benign cases, whilst expediting imaging and intervention in cancer cases compared to actual practice.

CLINICAL RELEVANCE/APPLICATION

Our work shows the potential of CNNs in reducing the need for follow-up scans and intervention in low-scoring benign nodules, whilst potentially accelerating the investigation and treatment of high-scoring cancer nodules.

SSJ05-05 A Deep Learning-Based CAD that Can Reduce False Negative Reports: A Preliminary Study in Health Screening Center

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S102CD

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PURPOSE

To evaluate the clinical value of a deep learning-based computer-aided detection (DLCAD) model that can reduce false negative reports on screening chest CTs that were considered normal.

METHOD AND MATERIALS

A DLCAD consisting of a 2.5D CNN for candidate detection and a 3D CNN for false positive reduction was trained with a public LIDC-IDRI dataset. Preliminary validation performance for the same dataset was 90.7% sensitivity under one false-positive per scan threshold. Ten thousand low dose chest CT cases that were reported normal were collected from a single-center screening cohort from the year 2011 to 2015. 'Normal' was defined as containing no malignant or benign lesions. The deep learning-based CAD analyzed these cases reported as normal and detected nodule candidates. Four radiologists reviewed the results of CAD independently. When the candidate nodule was accepted, the type (solid, part-solid and ground-glass nodule [GGN]) and size of nodules were annotated.

RESULTS

DLCAD analyzed 9952 cases (48 cases with inappropriate parameters, scan range or field of view were excluded) and detected 471 nodule candidates. Among them, 283 nodules from 269 patients were reported to be the true nodules by more than three radiologists. Excluding 67 nodules (with insufficient consensus), 216 nodules were categorized to be the same diameter range and nodule type by more than three radiologists. Among 216 nodules, 151 (69.9%) nodules were solid, three (1.4%) were part-solid, and 62 (28.7%) were GGN. Among 151 solid nodules, 10 (6.6%) nodules were larger than or equal to 6mm (eight [5.3%] 6 to 8mm, two [1.3%] 8 to 15mm) and 141 (93.4%) were smaller than 6mm. All three part-solid nodules were smaller than 6mm. All 62 GGN were smaller than 20mm. According to the Lung-RADS, two solid nodules were category 4A, eight solid nodules were category 3, and the remaining 206 nodules were category 2.

CONCLUSION

The deep learning-based CAD has detected 2.7% (269/9952) false negative cases with neglected nodules. 4.6% (10/216) nodules were higher than Lung-RADS category 3, which require follow up scans.

CLINICAL RELEVANCE/APPLICATION

The deep learning-based CAD will perform an ancillary role as a safeguard and a competent second reader by reducing false negative rates.

SSJ05-06 Added Value of Machine Learning in Follow-Up Lung Cancer Screening

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S102CD

Participants
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PURPOSE

Current challenge in lung cancer screening is the high false positive rate and overdiagnosis of indolent cancers. We examined if a machine learning predictor (ML) developed from combined longitudinal CT image features, patient demographics and clinical history could improve screening positive predictive value (PPV) and identify aggressive cancers.

METHOD AND MATERIALS

In a double-blinded study, we developed a ML predictor from 25,097 National Lung Screening Trial (NLST) individuals, and blindly validated it in 2,294 Pan-Canadian Early Detection of Lung Cancer Study (PanCan). All individuals who had received 2 or more CT screenings from both studies were included. We compared area under the time-dependent ROC curve (AUC) and PPV between ML and LungRADS, and examined the added value of ML to LungRADS in identifying aggressive cancers.

RESULTS

In PanCan validation sample, ML has higher 3-year time-dependent AUC(=0.899) as compared to LungRADS (AUC=0.858), p=0.028. When fixing the same sensitivity in the range of 80% - 90% for both ML and LungRADS, the ML has 28%-65% higher PPV than the LungRADS throughout all fixed sensitivity levels. Although ML high-risk group included only 9.6% of the total sample, it included 94.4% and 84.7% of all lung cancers diagnosed within 1 and 2 years. In the NLST, within LungRADS 4B individual, ML high-risk subgroup had higher lung cancer mortality (HR=31.8, P<0.001). In contrast, within ML high-risk subgroup, LungRADS 4B individuals had lower but non-significant lung cancer mortality (HR=0.93, p=0.59). Among N=404 NLST screening detected stage I&II lung cancers who received surgery, ML high-risk patients had higher lung cancer mortality (HR=44.3, p<0.001).

CONCLUSION

The ML predictor has higher sensitivity and PPV than LungRADS in lung cancer screening. It has added value in identifying more aggressive lung cancers among screening detected stage I&II cancers who received surgery.

CLINICAL RELEVANCE/APPLICATION

The ML predictor has potential added value to LungRADS in identifying aggressive lung cancers. It could help clinicians to determine the optimal nodule follow-up strategy and treatment of screen detected lung cancer.

SSJ06

Emergency Radiology (Trauma Imaging: New Concepts)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S406A

ER

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

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Sub-Events

SSJ06-01 Prognostic Utility of Magnetic Resonance Imaging (MRI) in Predicting Neurological Outcomes in Patients with Acute Thoracolumbar Spinal Cord Injury

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S406A

Participants
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PURPOSE

Utility of MRI for predicting neurological outcomes in acute cervical spinal cord injury (SCI) is well established but its value in thoracolumbar (TL) SCI needs to be evaluated.

METHOD AND MATERIALS

Seventy six patients operated for acute TL spinal injuries between january 2014 to march 2016 were reviewed to obtain demographic details, neurology at admission and at final follow up. Patients were divided based on the neurology at presentation into group 1 (ASIA A), group 2 (ASIA B, C, D), group 3 (normal neurology). Preoperative MRI and CT scans were evaluated to measure parameters like osseus canal compromise (OCC), spinal cord compression (SCC), spinal cord swelling (SCS), length of cord swelling (LOS), length of edema (LOE) and presence of hemorrhage. The MRI parameters were compared between the groups for their predictive value of neurology on admission and at final follow up.

RESULTS

Of the 38 patients in group 1, 6 patients recovered by 1 grade, 9 patients recovered by 2 grades and there was no recovery in 23(60.5%) patients. Among group 2 patients, 9 (40.9%) out of 22 recovered to ASIA E neurology. On univariate analysis SCC (P=0.009), LOS (P=0.021), length of edema (P=0.002) were associated with complete neurological deficit at presentation. However on multivariate regression analysis only LOE was significant (P=0.007) in predicting neurology at admission and at follow up.

CONCLUSION

Greater the rostrocaudal Length of edema (LOE), worse is the neurology at presentation and it is associated with poor neurological recovery at follow up.

CLINICAL RELEVANCE/APPLICATION

Among the MRI parameters, Length of edema had the highest individual correlation with poor neurological presentation Length of edema - poor prognostic sign for recovery.

SSJ06-02 Can Quantification of Pulmonary Contusion in the Setting of Blunt Trauma Predict Patient Outcome?

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S406A

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PURPOSE

To analyze patients with variable degrees of pulmonary contusion and assess correlation with complications of blunt thoracic trauma.

METHOD AND MATERIALS

This retrospective study was IRB approved and HIPAA compliant. Informed consent was waived. Patients >=16 years old who sustained blunt thoracic trauma with Injury Severity Score (ISS) >=15 and CT scan within 24 hours of admission from 1/30/13 to 6/30/17 were included. 153 patients met inclusion criteria. Of the 153 patients included, 121 were male (79.1%) and 32 were female (20.9%). The mean age was 46.2 [16-97] and the mean ISS was 22. AAST lung injury scale was assessed in a blinded fashion by fellowship-trained radiologist with >10 years of trauma experience. Pulmonary contusion was measured using the 3 largest dimensions on orthogonal planes. Other CT variables included pneumothorax, pleural effusion, hemothorax, pulmonary laceration, pneumatocele, rib/sternal/scapular fractures, flail chest, and number of lobes injured. Clinical parameters collected were ISS, pulmonary/cardiac/renal comorbidities, intubation on presentation, ventilation associated pneumonia (VAP), and ARDS. Statistical analysis was performed using t-test, Fisher's exact test, and logistic regression.

RESULTS

With respect to CT imaging findings, the number of pulmonary lobes injured was associated with ARDS (p=0.01) and the presence of rib fractures was associated with VAP (p=0.03). Flail chest was associated with mortality (p=0.03). For every 100 mL increase in volume of pulmonary contusion, the odds of death increased by 1.20 times (p=0.04). For every 100 mL increase in volume of pulmonary contusion, the odds of ARDS increased by 1.21 times (p=0.015). With respect to clinical parameters, ISS, thoracostomy tube placement, supplemental O2 requirement, and age were associated with ARDS. ISS and age were associated with VAP. ISS and intubation on presentation were associated with mortality (all p-values <0.05).

CONCLUSION

The volume of pulmonary contusion is associated with patient mortality with statistical significance. In the setting of blunt trauma, the number of pulmonary lobes injured, rib fracture and flail chest are associated with ARDS, VAP and mortality, respectively.

CLINICAL RELEVANCE/APPLICATION

With the importance of adequate resource allocation in trauma, CT imaging findings seen in the setting of blunt thoracic trauma that prognosticate morbidity and mortality may assist in optimizing triage.

SSJ06-03 Injury Incidence and Patterns Associated with Electric Scooter Accidents

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S406A

Participants
Aiza Ashraf, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
Mohsin Mukhtar, BS, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Mark S. Frank, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Electric motorized rental scooters (e-scooters, such as Bird and Lime), touted as a solution for 'last mile' problem, have the potential for significant utility in urban areas and college campuses. These vehicles can reach speeds up to 15 miles per hour. Since their legalization in our municipality on September 4, 2018, anecdotal observations have included a spike in imaging exams for 'scooter' accidents performed within our hospital system. The purpose of this study was to describe the injury incidence and imaging ordering patterns associated with the use of e-scooters in our municipality.

METHOD AND MATERIALS

Electronic medical records (EMRs) and radiology archives in our institutional database were searched for instances of imaging exams ordered to for injuries related to scooter accidents. Inclusion criteria include age 18 years or higher, seen at the ER of a performance site from 2013 to 2018, and 'scooter' included as a key word in the imaging request. Basic statistical analysis of the number and distribution of injuries diagnosed on imaging were performed.

RESULTS

A total of 69 exams performed on 36 unique emergency department patients with a definitive description of involvement of an e-scooter were identified. Two-thirds of these patients were ages 18-30 years. Of the imaging exams, a total of 44 (63.8%) were radiographs of the extremities, including 15 (34.1% of extremity exams) of the forearm/hand/wrist and 17 (38.6% of extremity exams) of the knee/leg/ankle/foot. A total of 18 CT exams (26.1%) were performed, including 13 (72.2% of CT exams) of the head, face or cervical spine. Of the 36 patients, 52.8% (N=19 patients) had documented injuries on 29 separate imaging exams with an overall exam positivity rate of 42.0%. The most common injuries included distal radial fracture (N=6), followed by soft tissue injury of the head, face, wrist, and ankle (N=5).

CONCLUSION

Over half of individuals who received imaging in the setting of e-scooter accidents were found to have a radiographically apparent injury. The injuries vary but the most common patterns include distal radial fracture and soft tissue injuries involving the head, face, wrist and ankle.

CLINICAL RELEVANCE/APPLICATION

Within our health system, imaging performed in the setting of e-scooter injuries was positive in over one half of instances. Radiographs of the extremities as well as CT of the head, face and cervical spine were the exams most lilkely to be ordered.

SSJ06-04 Assessment of an AI-Powered Algorithm for the Automatic Detection of Rib Fractures

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S406A

Participants
Luca Noordtzij, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose
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PURPOSE

To analyze the diagnostic performance of a deep learning-based algorithm for the automated detection of rib fractures in trauma CT scans.

METHOD AND MATERIALS

We retrospectively identified all whole-body trauma CT scans referred from our emergency department between 01/2018 and 12/2018 (n=461). The exams were categorized as positive (n = 158) and negative (n = 303) for rib fractures according to the clinically approved written reports. After full anonymization, CT datasets (1.5 mm bone kernel) were analyzed using an algorithm for the detection of rib fractures based on a convolutional neural network that had previously been trained on an independent sample (n = 11,000). The review of the results was performed on a web-based feedback system by comparing the detected results with the findings in the written reports.

RESULTS

Twelve cases had to be excluded due to technical problems. Overall, the algorithm achieved a sensitivity of 78.8% (115/146; 95% confidence interval [CI]: 71.2%-85.1%) and a specificity of 94.1% (285/303; 95% CI:90.8%-96.4%) on a per exam level (positive predictive value of 86.5%; 95% CI: 80.2%-90.1%, F1 score: 83%). On a per finding level there were 285 false negative findings out of 855 fractures mentioned in our reports, corresponding to a sensitivity of 66.7% (570/855; 95% CI: 63.4%-69.8%) and a specificity of 80.7% (285/353; 95% CI: 74.3%-83.4%). Furthermore, 85 positive findings (58 acute and 27 chronic fractures) detected by the algorithm were not mentioned in our reports.

CONCLUSION

We found good performance of an algorithm automatically detecting rib fractures in whole-body trauma CT scans on a per exam level. On a per finding level, some limitations become evident. Fractures that had not been documented in the written reports were detected by the algorithm. Thus, it constitutes a fundament for further developments in direction of a clinical decision support tool that improves accuracy of healthcare provision.

CLINICAL RELEVANCE/APPLICATION

Rib fractures are often underdiagnosed due to time-restrictions and focus on urgent findings in an emergency setting. AI-based detection has the potential to support without reader distraction.

SSJ06-05 Optic Nerve Sheath Diameter is a Prognostic Biomarker of Computed Tomography (CT) in Patients with Traumatic Brain Injury and Its Comparison with Standard Rotterdam and Marshall Computed Tomography Scores (CT Scores)

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S406A

Participants
Naveen Kumar, MD, Gulbarga, India (*Presenter*) Nothing to Disclose

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PURPOSE

The aim of this study is to prove that the optic nerve sheath diameter (ONSD) is an important and isolated predictor of outcome in patients with traumatic brain injury (TBI) and its comparison with standard Rotterdam and Marshall Computed tomography (CT scores).

METHOD AND MATERIALS

A prospective study of 100 patients performed in the department of radiology. About 100 patients underwent CT imaging for traumatic brain injury between January 2018 to June 2018. Bilateral ONSD was measured 3mm posterior to the eyeball in axial and sagittal planes and the mean value was calculated. RCTS and Marshall Score was assessed on the same CT images, the bias was eliminated by blinding RCTS and Marshall score to ONSD measurement.

RESULTS

100 patients were included, mean age of the group was 40-50years. ONSD in mild TBI includes RCTS-2 and RCTS-3 was 3.3mm (SD

0.39 mm) and 4.1 mm (0.047 mm) respectively. Mean ONSD in moderate and severe TBI (RCTS score 4 and above) was 4.83 mm and above (SD 0.4 mm). Mean ONSD correlated with occurrence of diffuse cerebral edema, presence of subdural and extradural hematoma however, in isolation there was no statistical significance.

CONCLUSION

Diameter of optic nerve sheath is considered as a valid, reliable, and non-invasive screening tool in determining the elevated intracranial pressure in cases with traumatic brain injury and its indirect predictor of outcome in patients with TBI.

CLINICAL RELEVANCE/APPLICATION

Calculation of Optic nerve sheath diameter and its comparison with standard Rotterdam and Marshall CT scoring in TBI patients to confirm ONSD as a Prognostic Biomarker of outcome in TBI patients.

SSJ06-06 Laryngeal and Hyoid Fracture Detection in Forensic Post-Mortem CT: Comparison of Standard Post-Mortem CT with High Resolution Post-Mortem Cervical CT and Autopsy Findings

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S406A

Participants
Andreas Bucher, MD, Frankfurt am Main , Germany (*Presenter*) Travel support, Guerbet SA;
Boris Bodelle, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Research support, General Electric Company; Research support, Siemens AG
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Sara Heinbuch, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the detection rate of laryngeal and hyoid fractures in suspected homicide victims with suspicion of strangulation in standard full body forensic CT imaging and high-resolution reconstructions from dedicated cervical CT against autopsy findings.

METHOD AND MATERIALS

This single-centre, observer-blinded study included a total 15 full post mortem full body CT examinations. All CT series were acquired on a third generation dual source CT. For each case an additional high-resolution scan was performed of the larynx and hyoid bone (CTHR). CTN was acquired as a neck spiral from full body CT at a tube voltage of 120 kV and reference tube current of 300 mAs; CTHR was acquired at a fixed tube current of 350 mAs at 120 kV. CTN was reconstructed with standard clinical reformations of the neck in axial, coronal and sagittal orientations at 3 mm slice thickness and 2 mm increment. CTHR was reconstructed in anatomically oriented sections of the larynx and hyoid bone in axial, coronal and sagittal orientation at 1 mm slice thickness and 1 mm increment. Macroscopic correlation by autopsy report was available for all cases. Fracture location was recorded in a binary fashion for all anatomic regions. Image reporting was performed by an independent reader for reconstructions from CTN and CTHR seperately in a blinded fashion.

RESULTS

A total of 105 anatomical regions were compared from autopsy reports, CTN and CTHR reports. 17 fractures were identified on autopsy. Most fractures were located at the base of the right superior horn of the thyroid cartilage (29%). Sensitivity of fracture detection from CTN was 20% (4/17 fractures). Sensitivity of fracture detection from CTHR was 92.9% (15/17 fractures; p=0.001). Youden-index was improved from 0.17 in CTN to 0.82 in CTHR. Fractures of the hyoid bone were significantly less common, detection rate was identical in CTN and CTHR (1 of 2 cases each).

CONCLUSION

Post mortem CT imaging in cases of suspected strangulation provides good detection rate of larynx fractures with dedicated high resolution acquisition and reconstruction protocol, but is not adequate for fracture detection when standard reconstruction of clinical cervical protocol is performed.

CLINICAL RELEVANCE/APPLICATION

Post mortem CT imaging of the neck should include an additional high-resolution CT spiral with dedicated reconstructions to guide autopsy when cervical trauma or strangulation is suspected.

SSJ07

Gastrointestinal (Pancreas Diffuse Disease)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S403B

GI

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

Participants
Temel Tirkes, MD, Indianapolis, IN (*Moderator*) Nothing to Disclose
Kyuran A. Choe, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSJ07-01 Validation of Apparent Diffusion Coefficient MR Parameters for Differentiation between Mass-Forming Autoimmune Pancreatitis and Pancreatic Ductal Adenocarcinoma

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S403B

Participants
Hainan Ren, BMedSc, Sendai, Japan (*Presenter*) Nothing to Disclose
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Several studies reported the effectiveness of apparent diffusion coefficient (ADC) to differentiate mass-forming autoimmune pancreatitis (AIP) and pancreatic ductal adenocarcinoma (PDAC); however, the results are inconsistent. The purpose of our study was to validate ADC parameters to differentiate the two conditions.

METHOD AND MATERIALS

Twenty-one patients with AIP and 101 patients with PDAC who met the criteria of Japan Pancreas Society 2011 or European Society for Medical Oncology were enrolled in this retrospective study. Regions of interest (ROIs) were placed where the ADCs visually appeared to be most decreased and increased within the lesions on ADC maps to obtain ADCmin and ADCmax. We obtained the secondary derivation as follows: ADCdiff = ADCmax-ADCmin. As for the conventional method, oval or round ROIs to cover entire lesions as much as possible were placed on ADC maps to obtain ADCmean. All the ADC parameters were compared between AIP and PDAC by using Mann-Whitney U test. $P < .05$ was considered significant. After Bonferroni correction of 4 multiple comparisons, the critical value became < 0.0125 (0.05/4).

RESULTS

No significant difference was found in patient background factors including lesion size. The ADCmin, ADCmax, ADCdiff and ADCmean in mass-forming AIP were significantly lower than those in PDAC ($p<0.0001$, $p<0.0001$, $p<0.0001$ and $p<0.0001$, respectively). Receiver operating characteristic curve analysis to differentiate mass-forming AIP from PDAC revealed that area under curves of ADCmin, ADCmax, ADCdiff and ADCmean were 0.76, 0.98, 0.88 and 0.94, respectively. Using the optimal cut-off value 1.38×10-3mm2/sec of ADCmax, sensitivity, specificity, positive predictive value and negative predictive value were 93, 96, 98 and 64 %, respectively. Using the optimal cut-off value 1.23×10-3mm2/sec of ADCmean, sensitivity, specificity, positive predictive value and negative predictive value were 85, 96, 98 and 58 %, respectively.

CONCLUSION

All the ADC parameters showed significant difference between mass-forming AIP from PDAC. Particularly, the diagnostic performance of ADCmax was highest and ADCmax might help in differentiating the two conditions.

CLINICAL RELEVANCE/APPLICATION

ADCmax which was obtained by placing ROI on visually most increased area within the lesion might help in differentiating mass-forming autoimmune pancreatitis and pancreatic ductal adenocarcinoma.

SSJ07-02 Pancreatic T1 Mapping and Extracellular Volume Fraction in Patients with Glucose Intolerance

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S403B

Participants
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Masayuki Matsuo, MD, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of pancreatic T1 mapping and extracellular volume fraction (ECV) for assessing patients with impaired glucose tolerance (IGT).

METHOD AND MATERIALS

This prospective study was approved by our institutional review board and written informed consent was obtained. Forty-four consecutive patients with known or suspected pancreatic disease underwent contrast-enhanced magnetic resonance (MR) imaging including T1 mapping using saturation recovery sequence. Patients were classified into two groups according to American Diabetes Association criteria: HbA1c < 6.5% (Low value group), and HbA1c >= 6.5% (High value group). Pre-contrast pancreatic T1 value and ECV of the pancreas were computed. Pre-contrast pancreatic T1 value, ECV and HbA1c values were then compared.

RESULTS

HbA1c values positively correlated with pre-contrast pancreatic T1 value and ECV (*r = 0.79, P < 0.001 and r = 0.60, P < 0.001, respectively). The pre-contrast pancreatic T1 value and ECV were significantly higher in High value group than in Low value group (P < 0.0001). Although there was no significant difference between two qualitative values (P = 0.14), the sensitivity, specificity, and area under the receiver-operating-characteristic curve for differentiating High and Low value groups were superior in ECV (100%, 93.5%, and 0.990) compared to pre-contrast pancreatic T1 value (84.6%, 96.8%, and 0.906).*

CONCLUSION

ECV of the pancreas could serve as a potential imaging biomarker for the assessment of pancreatic fibrosis leading to IGT.

CLINICAL RELEVANCE/APPLICATION

Our study demonstrated ECV possibly indicates severity of glucose intolerance. This index may be an important quantitative imaging biomarker for the screening of patients with IGT.

SSJ07-03 Pancreaticobiliary Lesions Developed in Treated Type 1 Autoimmune Pancreatitis: Nature, Image Pattern, and Risk Factors

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S403B

Participants
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Timm Denecke, MD, Berlin, Germany (Abstract Co-Author) Speaker, Bayer AG Travel support, Bayer AG
Patrick Asbach, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Bernd K. Hamm III, MD, Berlin, Germany (Abstract Co-Author) Research Consultant, Canon Medical Systems Corporation; Stockholder, Siemens AG; Stockholder, General Electric Company; Research Grant, Canon Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, General Electric Company; Research Grant, Elbit Imaging Ltd; Research Grant, Bayer AG; Research Grant, Guerbet SA; Research Grant, Bracco Group; Research Grant, B. Braun Melsungen AG; Research Grant, KRAUTH Medical KG; Research Grant, Boston Scientific Corporation; Equipment support, Elbit Imaging Ltd; Investigator, CMC Contrast AB
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PURPOSE

To determine the incidence and nature of pancreaticobiliary lesions developed in a prospective cohort of patients with treated type 1 autoimmune pancreatitis (AIP), to evaluate the imaging pattern, and to identify risk factors for disease relapse.

METHOD AND MATERIALS

From a prospectively managed radiological and clinical database (since 2012) of consecutive AIP patients who were treated and followed up (>=18 months) at our institution, patients with pancreaticobiliary lesion(s) development during follow-up were identified. Imaging pattern was compared to the initial attack. Univariate and multivariate analysis was conducted for factors predicting relapse.

RESULTS

Among 103 patients with treated type 1 AIP, 44 (42.7%) patients had pancreaticobiliary lesions during follow up (median time interval to initial diagnosis: 17 months, range 3 to 62 months). The majority of them were after steroid discontinuation (63.6%), the others during maintenance therapy (29.5%) or with steroid tapering (6.8%). All lesions were disease relapse, which responded to steroid treatment. Imaging pattern change was common. Pancreas involvement was less frequent (81.8% vs 100%, p=0.003), and pancreas size was smaller (p<0.01) at relapse. Extra-pancreatic bile duct (ExPanBD) involvement was more severe and extensive at relapse (both p<0.01). Multivariate analysis revealed ExPanBD involvement (hazard ratio 1.976, 95% CI 1.149-3.570, p=0.023) and a lower serum response index (hazard ratio 1.834, 95% CI 1.073-3.322, p=0.037) as significant independent predictors of relapse.

CONCLUSION

AIP relapse is common, often with image pattern change mimicking a new neoplasm. ExPanBD involvement at initial diagnosis and a poorer serum response at the induction phase suggests high risk of relapse.

CLINICAL RELEVANCE/APPLICATION

In treated type 1 AIP, it is not uncommon to observe new pancreaticobiliary lesion development, when the original lesions have *subsided. The lesions may be mass-like, and the image pattern may differ from the initial attack. However, disease relapse is much more likely than development of a new malignancy. Close radiological follow-up shows lesion resolution after re-administration of steroid treatment.*

SSJ07-04 Risk Assessment for Pancreatic Fistula after Pancreaticoduodenectomy with Preoperative Computed Tomography

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S403B

Participants
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PURPOSE

to evaluate the predictive value of preoperative CT features for the risk of postoperative pancreatic fistula.

METHOD AND MATERIALS

this IRB-approved retrospective study included 88 Patients who underwent pancreaticoduodenectomy in two centers. Patients were divided in 2 groups according to clinical data: 44 patients with clinically-relevant postoperative pancreatic fistula (POPF group), and 44 patients without POPF (non-POPF group). One reader experienced in pancreatic imaging (at least 10 years' experience) for each center reviewed the preoperative MDCTs of the patients of the center and measured at the planned resection plane the main pancreatic duct (MPD) diameter, the density of the parenchyma in the different enhancement phases and the parenchymal thickness. The difference in attenuation between the venous and arterial phase was calculated as a surrogate for parenchymal fibrosis: increasing attenuation from the arterial to the venous phase was interpreted as a sign of fibrosis. Body composition was analysed by calculating visceral adipose tissue area (VAT), subcutaneous adipose tissue area (SAT), and skeletal muscle area at the L2-level using ImageJ software. Retrorenal fat thickness and psoas density were also measured. Fisher's exact test was used for categorical variables and Mann-Whitney test for continuous variables.

RESULTS

MPD diameter was 2,7±2,6 mm in the fistula group and 6,3±3,1 mm in non-fistula group (P<0,0001). The mean attenuation difference between venous and arterial phase was 2,6 HU in POPF group and -13,2 HU in non-POPF group (P=0,0010). SAT was 18018,6 mm2 in POPF group and 12269,7 mm2 in non-POPF group (P=0,004). No significant difference observed for the other parameters.

CONCLUSION

fibrosis, expressed by increasing enhancement of the normal pancreatic parenchyma at the planned resection plane, MPD diameter and increased SAT may express increased risk for pancreatic fistula after pancreaticoduodenectomy.

CLINICAL RELEVANCE/APPLICATION

a preoperative assessment based on standard CT imaging of the risk of developing POPF could be useful for patient risk stratification and better and more personalized treatment planning.

SSJ07-06 The Selection of an Optimal Energy Level for Improving Necrosis Depiction in Acute Pancreatitis Using Mono-Energetic Algorithm during Dual-Energy CT of Pancreas

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S403B

Participants
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Xinyue Chen, London , United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine optimal energy level using mono-energetic algorithm for necrosis depiction in acute pancreatitis in terms of necrosis conspicuity and image quality during dual-energy CT of pancreas.

METHOD AND MATERIALS

Retrospectively enrolled 48 patients of acute pancreatitis with proven necrosis (24 male and 24 female) between March 2015 and January 2016. The median age was 46 years. Dual-energy (100kVp and Sn140kVp) was performed. And portal venous phase was chosen to be the acquisition phase. Three imaging series (100kVp, Sn140kVp and mixed imaging) were reconstructed automatically after acquisition. In addition 12 Image data sets, at energy levels ranging from 40keV to 150keV (in 10-keV increment) were reconstructed using mono-energetic algorithm. Two radiologists blindly evaluated these 15 image datasets and graded subjective image quality in 4-point scale on a per necrosis basis. Five parameters of image quality, including difference of CT value between pancreatic parenchyma and necrosis, CNR of pancreatic parenchyma-to-necrosis, signal to noise ratio (SNR) of pancreas, image noise and score of subjective diagnosis were compared between image sets. ANOVA and bonferroni correction were used to do the statistic analysis.

RESULTS

The inter-observer agreement was excellent (ICC: 0.8).Difference of CT value between pancreatic parenchyma and necrosis was significantly higher on 40keV images than others($p <0.001$), but the score of subjective diagnosis couldn't meet the diagnosis standard. The second was 50keV, and the score could just meet the diagnosis standard. Image noise of 80keV was significantly lower than others($p <0.001$),while CNR,SNR and score of subjective diagnosis of 80keV were significantly higher than others respectively($p <0.001$).

CONCLUSION

It is demonstrated in the study 50keV image reconstructed by mono-energetic algorithm might improve depiction of necrosis for acute pancreatitis on second generation dual-source scanner, while 80keV image might improve CNR, SNR and image quality.

CLINICAL RELEVANCE/APPLICATION

Since the necrosis is illustrated to be the most serious morphologic findings closely relating to mortality, it is crucial to have a correct assessment of it in acute pancreatitis. Dual-energy CT allows a better delineation of necrosis by applying mono-energetic post-processing. It is suggested to use 50keV as the optimal energy level to detect necrosis of acute pancreatitis.

Printed on: 10/29/20

SSJ08

Gastrointestinal (CT Dose and Abbreviated MR Screening Techniques)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S401CD

CT GI MR SQ

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

Participants
Jessica B. Robbins, MD, Madison, WI (*Moderator*) Nothing to Disclose
Jeong Hee Yoon, MD, Seoul, Korea, Republic Of (*Moderator*) Research Grant, Bayer AG Speaker, Koninklijke Philips NV Speaker, Bayer AG

Sub-Events

SSJ08-01 Diagnostic Performance and Image Quality of Low-Tube Voltage and Low-Contrast Agent Dose Protocol for Hepatic Dynamic Computed Tomography

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S401CD

Participants
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Tatsuya Shimizu, MD, Yamanashi, Japan (*Abstract Co-Author*) Nothing to Disclose
Marie-Luise Kromrey, MD, Greifswald, Germany (*Abstract Co-Author*) Nothing to Disclose
Yoshihito Aikawa, RT, Chuo, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroshi Onishi, MD, Yamanashi, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate diagnostic performance and image quality of low-tube voltage and low-contrast agent dose protocol for hepatic dynamic computed tomography (CT).

METHOD AND MATERIALS

This retrospective study, held between January and May 2018, included 424 patients (mean age, 70.5±10.1 years; 289 men, 135 women). They underwent hepatic dynamic CT using one of two protocols: tube voltage, 80 kVp; contrast dose, 360 mgI/kg, and iterative reconstruction (n=180) and tube voltage, 120 kVp; contrast dose, 600 mgI/kg, and filtered back projection (n=224). Two radiologists independently scored lesion conspicuity and image quality using 5- and 3-point scales, respectively. Another radiologist measured CT number of abdominal organs, muscles, and hepatocellular carcinoma (HCC) in each phase. Lesion detectability, diagnostic ability for HCC, image quality of the arterial phase, CT number including lesion-to-liver ratio, and radiation dose were compared between protocols.

RESULTS

Both protocols showed high lesion detectability (sensitivity, 86.1%-92.5%; specificity, 94.6%-97.3%; accuracy, 92.8%-95.0%) and diagnostic ability for HCC (sensitivity, 85.7%-93.3%; specificity, 93.6%-98.6%; accuracy, 93.3%-96.6%). The 120-kVp protocol showed better image quality for the arterial phase than the 80-kVp protocol (P<0.0001 for both); however, the ratio of fair image quality was not significantly different (P=0.3161 and 0.4084). CT number of abdominal organs and muscles was higher in the 80-kVp protocol than in the 120-kVp protocol in each phase (P<0.0001-0.0357) for all structures, except portal vein in the arterial phase and renal medulla in the portal venous phase (P=0.1760 and 0.1280). Lesion-to-liver ratio was not significantly different for all phases (P=0.2108-0.8653). Volume CT dose index and dose-length product in the arterial phase were significantly lower for the 80-kVp protocol than for 120-kVp protocol (15.2±3.6 vs 32.1±9.3 mGy and 397.3±122.2 vs 880.2±312.7 mGy·cm, respectively, P<0.0001 for both).

CONCLUSION

The 80-kVp protocol has diagnostic performance and image quality, equivalent to the 120-kVp protocol, with lower radiation and contrast agent doses.

CLINICAL RELEVANCE/APPLICATION

Low-tube voltage with iterative reconstruction for hepatic dynamic CT may decrease radiation and contrast agent doses, with equivalent diagnostic performance and image quality than the 120-kVp protocol.

SSJ08-02 Pilot Study to Assess Feasibility of Fast Whole Body MRI Imaging in Oncologic Screening

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S401CD

Participants
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PURPOSE

Assess the feasibility of whole-body MRI imaging in 30 minutes in oncologic applications.

METHOD AND MATERIALS

Our IRB approved this HIPPA-compliant prospective study. Twenty-six adult patients assessed for metastatic diseases were scanned with WB-DWI methods using a 3T MRI scanner. Axial fat-suppressed T2-weighted (T2WI), DWI, precontrast TS T1-weighted (T1WI) followed by post contrast FS T1WI in the arterial, portal venous and delayed phases were acquired (gradient time of 30 minutes). A single reader utilizing a five-point-scale recorded image quality of each WB-MRI study. Findings on whole-body MRI were recorded. The number of lesions was compared to those detected on CT or PET-CT studies, performed with 12 months of whole-body MRI if available. The WB-MRI, CT, and PET-CT were divided into standard anatomical location including chest, abdomen, and pelvis. The number of lesions within each anatomic location was compared in all three modalities.

RESULTS

Our study included 14 males and 12 females with the mean (±standard deviation) age of 55(±14) years. All whole-body MRI examinations were successfully obtained in the median time of 35 (IQR, 29-39) minutes. There were 17,21 and 8 lesions detected from chest, abdomen and pelvis, respectively in CT studies (N=19). Additionally, total of 0, 3, 2 lesions were detected in the chest, abdomen and pelvis respectively by assessing PET-CT studies (N=5). The WB-MRI detected 15 Lesions in chest, 38 Lesions in abdomen and 8 lesions in pelvis. All lesions detected on PET-CT were also detected on WB-MRI. Four lesions (16%) detected on WB-MRI in abdomen parts were missed on CT, while WB-MRI missed 2 lesions (11%) detected by CT in the chest parts; all were less than 10 mm. These two studies are comparable in detecting lesions in the pelvis. The overall image quality of whole-body MRI was 4/5.

CONCLUSION

We have demonstrated that fast multiparametric WB-MRI may be preformed in approximately 30 minutes, with relatively high image quality. Lung lesions <10mm may not be readily detected by WB-MRI.

CLINICAL RELEVANCE/APPLICATION

Whole-body MRI might be an acceptable alternative for CT or PET, in staging, assessment and monitoring of treatment response in oncologic applications.

SSJ08-03 Assessment of Noise Reduction Potential and Image Quality Improvement of a Deep Learning-Based Image Reconstruction Algorithm in Abdomen CT

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S401CD

Participants
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PURPOSE

To evaluate the image quality improvement and noise reduction in routine dose, non-enhanced abdomen CT imaging by using a deep learning-based image reconstruction algorithm in comparison with ASIR-V .

METHOD AND MATERIALS

9 patients who underwent routine dose, abdomen CT using GE Revolution CT (GE Healthcare, Waukesha, WI) were included . After scanning, all scans were reconstructed with the recommended level of 40% ASIR-V and for comparison purpose and deep learning-based image reconstruction algorithm (TrueFidelityTM, GE Healthcare).DLIR-L, DLIR-M, DLIR-H. The CT attenuation values and SD of the subcutaneous fat, back muscle and descending aorta were measured at the level of tracheal carina of all reconstructed images. The signal-to-noise ratio (SNR) was calculated with SD representing image noise. The subjective image quality was independently evaluated by two experienced radiologists.

RESULTS

For all DLIR images, the objective image noise (SD) of fat, muscle and aorta decreased and SNR increased along with DLIR-L, DLIR-M, DLIR-H. The SD of DLIR images were significantly lower than that of 40% ASIR-V. In terms of subjective image evaluation, all DLIR reconstructions and 40% ASIR-V had good diagnostic acceptability. However, DLIR-M, DLIR-H showed significantly superior visibility of small structures when compared with the 40% ASIR-V and DLIR-L, and DLIR-H was the best series of TrueFidelity images, with a highest subjective image quality, at the same time the image sharpness was not significantly decreased in DLIR-H images.

CONCLUSION

In routine dose, non-enhanced abdomen CT, DLIR show greater potential in reducing image noise and artefacts and maintaining image sharpness when compared to the recommended level of 40%ASIR-V algorithm. Combining both the objective and subjective evaluation of images, non-enhanced abdomen CT images reconstructed with DLIR-H have the highest image quality.

CLINICAL RELEVANCE/APPLICATION

Recently a deep learning-based image reconstruction algorithm has been introduced . This image reconstruction technique employs deep CNN-based models, including millions of trained parameters, to improve the image quality with natural image texture, lower image noise, and high-resolution

SSJ08-04 Deep-Learning-Based Abdominal CT Denoising: Impact of Changes in Reconstruction Parameters Relative to Training Data

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S401CD

Participants
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PURPOSE

Deep-learning-based CT denoising methods are typically trained on images using a single set of reconstruction parameters. However, reconstruction parameters vary considerably between abdominal CT exam types and practices. This work aimed to quantify the performance of a convolutional neural network (CNN) denoising algorithm when applied to abdominal CT images with reconstruction parameters different from the training data.

METHOD AND MATERIALS

A CNN with 36 convolutional layers was trained on 250,000 image patches clipped from ten contrast-enhanced abdominal CT scans reconstructed with a Siemens' D30 kernel, 3 mm image thickness, and 275 mm field of view (FOV). Supervised learning was used for training, with simulated quarter dose images used as inputs, full dose images as the ground truth, and a mean-squared-error loss function. Six patients were reserved for testing the network. Baseline performance was evaluated with test data that had the same reconstruction parameters as the training data. Without retraining, the network was then applied to data with a range of reconstruction settings: FOV from 100 mm to 450 mm, kernel strength from D10 to D50, and image thickness from 1 to 5 mm. Performance was evaluated by visual assessment, root mean square error, noise level, and spatial resolution. Percent noise reduction was calculated as the difference in noise level from quarter dose to CNN output divided by quarter dose noise level.

RESULTS

The CNN demonstrated 73±6 % noise reduction relative to quarter dose at baseline, with no degradation of spatial resolution (i.e., when test data reconstruction = training data reconstruction). CNN denoising efficacy was decreased, to only 47±5 % noise reduction, when FOV was decreased by 50 mm ($p = 0.0004$), or to only 60±7 % noise reduction, when a smoother (D20) kernel was used ($p = 0.001$). Resolution loss was noted (visual and line profile inspection) when the network was applied to larger FOVs or sharper kernels. CNN performance was largely maintained when applied to test data with different image thicknesses.

CONCLUSION

Performance of the evaluated CNN-based CT denoising method varied significantly with FOV and kernel strength, but not with image thickness.

CLINICAL RELEVANCE/APPLICATION

While impressive noise reduction can be obtained using CNNs, reconstruction parameters must be carefully considered. Improvements in generalizability are therefore necessary.

SSJ08-05 Hepatocellular Carcinoma Screening with Abbreviated MRI: Comparison of Noncontrast, Dynamic-Contrast Enhanced and Hepatobiliary Phase Protocols Post Gadoxetic Acid

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S401CD

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PURPOSE

To compare the performance of reconstructed abbreviated MRI (AMRI) protocols derived from a full gadoxetic acid-enhanced MRI for HCC screening in an at risk population.

METHOD AND MATERIALS

This retrospective study included 237 consecutive eligible patients (M/F 146/91, mean age 58y) with chronic liver disease (cirrhosis or HBV without cirrhosis) who underwent gadoxetic acid MRI in 2017 for HCC screening. Patients with history of HCC/other malignancies, liver transplantation and acute liver disease were excluded. Three reconstructed AMRI sets were assessed separately by 3 independent radiologists: non contrast (NC-AMRI: T2WI HASTE+diffusion weighted imaging (DWI)), Dynamic-AMRI (Dyn-AMRI: T2WI+Dynamic T1WI) and EOB-AMRI (T2WI+DWI +T1WI hepatobiliary phase). Lesions were characterized using a composite scoring system for NC-AMRI and EOB-AMRI [negative, subthreshold (<10mm), positive] and LI-RADS v2018 algorithm was used for Dyn-AMRI. Only LI-RADS5 lesions were considered HCC. A preliminary cost-effectiveness analysis was performed comparing each AMRI set to published ultrasound (US) sensitivity in USA (60%).

RESULTS

The reference standard demonstrated 13/237 patients with HCC (incidence 5.5%, mean size 33.7±30mm, range:10-120mm). Inter-reader agreement was substantial for NC-AMRI and EOB-AMRI (k=0.76 and 0.75) and excellent for Dyn-AMRI (k=0.86). Pooled per-patient sensitivities were 61.5% for NC-AMRI [CIs: 34.4-83%], 84.6% for Dyn-AMRI [60.8-95.1%] and 80.8% for EOB-AMRI [53.6-93.9%], without significant difference between sets (p-values range:0.06-0.16). Pooled per-patient specificities were 95.5% [92.4-97.4%], 99.8% [98.4-100%] and 94.9% [91.6-96.9%], respectively, with a significant difference between Dyn-AMRI and the other sets (p<0.01). All AMRI methods were cost-effective compared to US. Dyn-AMRI was the most cost-effective with incremental cost-effectiveness ratios (ICER) of $11,253 and life-year gain of 11months compared to US.

CONCLUSION

We observed limited sensitivity of NC-AMRI protocol for HCC detection. EOB-AMRI and Dyn-AMRI showed a similar sensitivity with a slightly better specificity and cost-effectiveness for Dyn-AMRI. Further confirmation in a larger study is needed.

CLINICAL RELEVANCE/APPLICATION

Non contrast abbreviated MRI (AMRI) showed low diagnostic performance for HCC screening. AMRI with dynamic T1 (Dyn-AMRI) showed higher specificity and better cost effectiveness compared to AMRI with hepatobiliary phase.

SSJ08-06 Accuracy of an Abbreviated Screening MRI Protocol without Contrast Media for Patients at Risk for Hepatocellular Carcinoma

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S401CD

Participants
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PURPOSE

To evaluate the accuracy of an abbreviated screening MRI protocol without contrast media for patients at risk for hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board. Four-hundred and twenty eight MRI exams were performed at our institution in patients with increased risk for hepatocellular carcinoma , from January 2015 to December 2015. Exclusion criteria were: history of treated HCC (166 cases) and subsequent studies of the same patient (123 cases). A total of 139 MRI cases were anonymized without post-contrast series (abbreviated protocol) and retrospectively analysed by three radiologists with different levels of experience (10, 8 and 1 year of experience with abdominal MRI). Later, one senior radiologist re-evaluated the full protocol as the reference standard, using LI-RADS v.2018. The abbreviated protocol included T2 weighted, fat-saturated T2 weighted, diffusion-weighted and GRE in/out-of-phase sequences. The following criteria were evaluated: presence of nodule suspicious for HCC, lesion size, lesion location and presence of nodule on each MRI sequences of the abbreviated protocol.

RESULTS

One-hundred and thirty nine patients were included, 38 women and 101 men, with an average age of 54.1 years. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of abbreviated protocol for detection of nodules categorized as LI-RADS 4 and 5 (reference standard) were: 88.3%, 77.2%, 74.6%, 89.7% and 82.0% (most experienced reader), 85.0%, 78.5%, 75.0%, 87.3% and 81.3% (intermediate experienced reader) and 85.0%, 73.4%, 70.8%, 86.6% and 78.4% (less experienced reader), respectively. Interobserver agreement was moderate for lesion detection (weighted K= 0.57, CI=0.41-0.78). The sensitivity of each MRI sequence was 71.7%, 73.3% and 76.7% on T2-weighted, 68.3%, 75.0% and 73.3% in fat-saturated T2-weighted, 76.7%, 75.0% and 73.3% in in/out-of-phase and 63.3%, 70.0% and 68.3% in DWI for most experienced, intermediate experienced and less experienced readers, respectively.

CONCLUSION

The abbreviated MRI protocol demonstrated high sensitivity for hepatocellular carcinoma screening in risk patients.

CLINICAL RELEVANCE/APPLICATION

HCC is the most common primary malignancy of the liver and a common cause of death from cancer worldwide. Abbreviated MRI protocol possibly allows more cost-effective, high sensitivity imaging for HCC screening.

SSJ09

Gastrointestinal (Quantitative Imaging Techniques)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S403A

BQ GI

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

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Sub-Events

SSJ09-01 Evaluation of Hepatic Perfusion in Pancreatitis Patients by 3rd-Generation Dual-Source Computed Tomography

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S403A

Participants
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PURPOSE

A number of studies have demonstrated that acute pancreatitis (AP)can result in liver damage, which is often without obvious clinical symptoms, but plays an important role in the progression of AP and other organ damage.Fewer studies published about the difference in hepatic perfusion parameters in patients with AP, Therefore, we quantitatively investigated hepatic perfusion in patients with mild AP(MAP) and severe AP (SAP)compared to control group using perfusion CT.

METHOD AND MATERIALS

The clinical and abdominal CT data on all patients were retrospectively analyzed, including 61 patients with AP and 15 cases as a control group,and the AP group further classified into mild AP(26 cases)and severe AP(35 cases) according to CT severity index (CTSI).Upper abdomen perfusion CT imaging was performed in all cases by 3rd-generation dual-source CT. Perfusion CT imaging was obtained for 54 s beginning with a bolus injection of 60 ml of contrast agent (600-630 mgI/kg) at a flow rate of 5 ml/s. Perfusion data were analyzed by the deconvolution method to obtain blood flow(BF, mL/100mL/min),blood volume(BV, mL/100mL),arterial liver perfusion (ALP, mL/100mL/min) , portal venous liver perfusion (PVP, mL/100mL/min),mean transit time(MTT,s) and hepatic perfusion index(HPI,%). Finally, hepatic perfusion parameters were compared for any significant ($P < 0.05$) differences among mild AP patients, severe AP patients and control group.

RESULTS

Various perfusion parameters was significantly higher in the control group than severe AP patients (BF:p=0.002 BV:p=0.000, PVP:p=014,MTT:p=0.000,HPI:p=0.039, $p < 0.05$; ALP: p=964>0.05). There was no significant difference in various perfusion parameters between mild AP patients and the control group ,except in MTT(8.53±0.92s vs 7.59±1.30s,p=0.018).

CONCLUSION

Using quantitative analysis on hepatic perfusion CT, we demonstrated the decrease of various hepatic perfusion parameters ,namely hepatic blood perfusion in SAP, responding to the changes in hepatic hemodynamics in SAP,hepatic perfusion CT is useful for evaluation and prediction of liver damage in patients with SAP.

CLINICAL RELEVANCE/APPLICATION

(dealing with adjunct to imaging) ' In patients with pancreatitis, CT liver perfusion imaging is a non-invasive method to help assess hemodynamics and microvascular changes in the liver.'

SSJ09-02 Comparative Effectiveness of Noninvasive Tests for Staging Chronic Liver Disease

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S403A

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PURPOSE

To prospectively compare the diagnostic performance of multiple noninvasive tests for staging hepatic fibrosis in patients with chronic liver disease using histology as the reference standard

METHOD AND MATERIALS

This is a single-center, IRB-approved, HIPAA-compliant, prospective pilot study. Adults with chronic liver disease presenting to Interventional Radiology for random liver biopsy are enrolled prior to biopsy. Ultrasound shear-wave elastography of the liver is performed using a Philips scanner with standard acquisition parameters to measure liver stiffness (USE). MR elastography of the liver is performed using a 1.5 T Siemens scanner with standard acquisition parameters to measure liver stiffness (MRE). All patients undergo CT-guided liver biopsy and obtained CT images of the liver are used to measure liver surface nodularity (LSN score) using a previously described semi-automated method. Serum labs within 30 days of liver biopsy are used to calculate the FIB-4 score, a serum biomarker of hepatic fibrosis. The concordance of FIB-4 score, LSN score, USE, and MRE with histologic Metavir staging of hepatic fibrosis are assessed using Harrell's C statistics. Odds Ratios (OR) from ordinal logistic models are reported.

RESULTS

The preliminary data includes fifteen adults (11 female; age range 34 - 72, mean 55). Mean interval between liver biopsy and ultrasound/MR is 0 days. The histologic range of hepatic fibrosis includes 7 livers with no fibrosis (F0), 3 with mild-moderate fibrosis (F1-2), and 5 with advanced fibrosis-cirrhosis (F3-4). Mean and range of FIB-4 score are 1.7 (0.5 - 4.4). Mean and range of LSN score are 2.7 (2.0 - 4.1). Mean and range of hepatic stiffness measured by USE and MRE are 8.8 kPa (3.9 - 17.9) and 5.4 kPa (2.4 - 15.7), respectively. The C-stat concordance for FIB-4 score, LSN score, USE, and MRE are 0.84, 0.87, 0.77, and 0.85 respectively. Odds of moving up one fibrosis stage are 3.84 ($p=0.013$), 69.8 ($p=0.005$), 1.01 ($p=0.267$), and 1.53 ($p=0.019$), respectively, per one unit increase.

CONCLUSION

In this pilot study, liver surface nodularity score has non-inferior diagnostic performance compared to FIB-4 score, USE, or MRE in staging hepatic fibrosis in patients with chronic liver disease.

CLINICAL RELEVANCE/APPLICATION

Liver surface nodularity score may serve as a quantitative biomarker for staging hepatic fibrosis in patients with chronic liver disease.

SSJ09-03 Quantifying Non-Alcoholic Fatty Liver: Liver-Spleen CT Ratio or Fat Concentration in Dual-Energy Spectral CT? Accuracy Comparison with Magnetic Resonance Q-Dixon Technique

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S403A

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PURPOSE

To compare the accuracy of using conventional liver-spleen (LS) CT ratio or fat concentration (FC) in spectral CT to quantify non-alcoholic fatty liver using the fat fraction (FF) determined using magnetic resonance Q-dixon (MRQd) technique as a reference standard.

METHOD AND MATERIALS

Retrospectively analyzed 80 liver patients with both MRQd and spectral CT within one week. Using MRQd results, patients were divided into normal and fatty liver groups (normal: n=20, FF<5%; mild: n=26, FF=5%-10%; moderate: n=20, FF=11%-25%; and severe: n=14, FF>25%). The liver FC was measured on the lipid-based material decomposition images in spectral CT by 2 senior abdominal radiologists by placing regions of interest in two different hepatic lobes over 7 image slices centered at the hepatic portal level. Final FC values were obtained by averaging the measurements. The two doctors also measured the LS CT ratio on the 70keV images. Measurements were repeated three times weekly to evaluate the repeatability using intra-group or inter-group correlation coefficient (ICC). The correlation between MRQd and spectral CT results was analyzed. The diagnostic efficacy of using FC in spectral CT for differentiating normal and mild fatty livers was tested by ROC curve.

RESULTS

The ICC values were high indicating consistent measurements. There were differences in FC between any groups ($P<0.05$), while the LS ratio was not significantly different between the normal and mild fatty liver group ($p>0.05$). There was a positive correlation between FC in spectral CT and FF in MRQd (r=0.959, P<0.001), and a negative correlation between LS ratio and FF (r=-0.848, P<0.001). ROC curve analysis showed that with a FC cut-off value of 351.19mg/ml, the sensitivity, specificity and area under curve were 95%, 100% and 0.990, respectively in differentiating the normal and fatty liver group.

CONCLUSION

The fat concentration in spectral CT has excellent correlation with the fat fraction by MR Q-dixon and is better than that determined by liver-spleen CT ratio. FC in spectral CT has high accuracy to differentiate normal and fatty livers for non-alcoholic fatty liver patients.

CLINICAL RELEVANCE/APPLICATION

The fat concentration measurement in spectral CT can replace the Liver-Spleen CT Ratio as an imaging method for the diagnosis of fatty liver, and its accuracy is high.

SSJ09-04 MRE Practice Improvement: Comparison of Clinical MRE Liver Stiffness Measurements Made by MR Technologists versus Expert MRE Analysts

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S403A

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PURPOSE

MR elastography (MRE) is increasingly used clinically to noninvasively assess hepatic stiffness, an imaging biomarker used to detect and monitor liver fibrosis. Although MRE is well studied in research settings, less is known about its performance in clinical settings where measurements are typically made by MR technologists who may be unfamiliar with the analysis. As part of a quality practice improvement project, we compared liver stiffness measurements made by MR technologists on clinical MRE exams with those made by expert MRE analysts.

METHOD AND MATERIALS

We retrospectively identified 46 MRE slices from 10 patients (60% female, age 27 to 69) who underwent 3T clinical MRE exams (2D SE-EPI at 60 Hz) at our institution. The MR technologist who performed each exam analyzed each MRE slice using commercial clinical analysis software on the GE scanner console by drawing regions of interest (ROIs) on the liver. Two expert MRE analysts (each with >= 300 research MRE exams analyzed) also analyzed the MRE slices, drawing ROIs according to QIBA MRE analysis guidelines using MRE-Quant analysis software (Mayo Clinic). Mean stiffness values (kPa) measured by MR technologists and expert analysts were compared pairwise by intraclass correlation coefficient (ICC) and Bland-Altman analyses, using bootstrap-based tests to adjust for within-patient dependence.

RESULTS

ICC between analysts (0.981) was higher than between technologists vs Analyst 1 (0.857, p<0.001) and vs Analyst 2 (0.869, p<0.001). MRE measurements by MR technologists were 0.39 (p<0.001) and 0.30 (p<0.001) kPa lower than those by Analyst 1 and 2, respectively, with limits of agreement (LOA) of (-1.52, 0.73) and (-1.46, 0.85) kPa. Bias between analysts (0.09 kPa, LOA [-0.45, 0.63 kPa]) was small but significant (p=0.002).

CONCLUSION

In clinical patients, there is less agreement in MRE stiffness measurements between MR technologists and expert MRE analysts than between two expert analysts. Compared to expert analysts, MR technologists underestimate liver stiffness. Research is needed to determine whether additional MR technologist experience and/or training will improve agreement between their measurements and those made by expert analysts.

CLINICAL RELEVANCE/APPLICATION

Stiffness measurements by MR technologists may differ meaningfully from those by expert analysts. Additional training may be required before MR technologists' measurements are reported clinically.

SSJ09-05 Prediction of Liver Regeneration in Recipients after Adult-To-Adult Living Donor Liver Transplantation Using Preoperative CT Texture Analysis

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S403A

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PURPOSE

To predict the rate of liver regeneration in recipients after living donor liver transplantation (LDLT) using preoperative CT texture and shape analysis of the future graft.

METHOD AND MATERIALS

103 donor-recipient pairs who underwent LDLT using right lobe graft were retrospectively included for this study. All donors underwent preoperative liver CT using same CT scanner. We semi-automatically segmented the right lobe of the liver which was to be a future graft using commercially available software. The volume of the future graft (Vpre) was measured and texture and shape analysis of Vpre was performed. All recipients underwent follow-up CT (mean, 12.0 ± 1.1 months) after surgery. The graft liver was segmented in the same manner, and the volume of the graft (Vpost) was measured. The regeneration index (RI) was defined by the following equation: [(Vpost-Vpre)/Vpre]×100 (%). We performed a stepwise, multivariate linear regression analysis to investigate the correlation between clinical features, texture and shape parameters and RI, and made the best-fit model for predicting RI.

RESULTS

The mean RI was 49.8 ± 44.7%. In the univariate analysis, Vpre, effective diameter, surface area, sphericity, roundness, compactness, energy and grey level co-occurrence matrix inverse difference moment (GLCM IDM) were significantly correlated with RI ($p<0.05$). In the multivariate analysis, Vpre (ß, -0.121, 95% CI: -0.176 - -0.066) and roundness_m (ß, -1.34, 95% CI: -2.67 - -0.01) as well as the sex (ß, 27.75, 95% CI: 10.60 - 44.91) of the donor and preoperative serum protein (ß, 9.85, 95% CI: 0.74 - 18.97) were shown to be independent predictors of RI ($p<0.05$). The best-fit predictive model for RI was as follows: RI (%) = 71.50 + 9.85×preoperative serum protein (g/dL) - 0.121×Vpre (mL) - 1.34×roundness_m (+ 27.75, if donor is female), where roundness_m = (roundness-0.780)×1,000.

CONCLUSION

Texture and shape parameters of the liver including Vpre and roundness were associated with liver regeneration. Preoperative CT texture and shape analysis of the future graft can be useful for predicting the rate of liver regeneration in recipients after LDLT.

CLINICAL RELEVANCE/APPLICATION

Preoperative CT texture and shape analysis of the future graft can help predict liver regeneration in recipients and assist in the surgical planning of LDLT.

SSJ09-06 Diffusion Kurtosis Imaging-Derived Histogram Metrics for Prediction of KRAS/NRAS Mutations in Rectal Adenocarcinoma: Preliminary Findings

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S403A

Participants
Yanfen Cui, Taiyuan, China (*Presenter*) Nothing to Disclose
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PURPOSE

Objective: To evaluate the potential role of diffusion kurtosis imaging (DKI)-derived parameters by using histogram analysis derived from whole-tumor volumes for prediction of the status of KRAS/NRAS mutations in patients with rectal adenocarcinoma.

METHOD AND MATERIALS

152 consecutive patients with rectal adenocarcinoma who underwent MRI examination including DKI (b values: 0, 700, 1400, and 2100 sec/mm2) were retrospectively evaluated. The quantitative parameters of D, K, and conventional apparent diffusion coefficient (ADC) were measured using whole-tumor volume histogram analysis. Student's t-test or Mann-Whitney U-test, receiver operating characteristic (ROC) curves, and Spearman's correlation were used for statistical analysis.

RESULTS

All the percentiles metrics of ADC and D values were significantly lower in the mutated group than those in the wild-type group (all $P< 0.05$), except for the minimum value of ADC and D (both $P > 0.05$), while K-related percentiles metrics were higher in the mutated group compared with those in the wild-type group (all $P< 0.05$). Regarding the comparison of the diagnostic performance of all the histogram metrics, K75th showed the highest AUC value of 0.866, and the corresponding values for sensitivity, specificity, PPV, and NPV were 67.57% and 92.31%, 89.29%, and 75.0%, respectively.

CONCLUSION

It was revealed that DKI metrics with whole-tumor volume histogram analysis, especially the K75th parameter, yielded more preferable AUC and specificity values for predicting KRAS/NRAS mutations than ADC and D values, and thus may potentially serve as an optimal imaging biomarker for the prediction of KRAS/NRAS/BRAF mutations for guiding targeted therapy.

CLINICAL RELEVANCE/APPLICATION

DKI metrics with whole-tumor volume histogram analysis, especially the K75th parameter, may potentially serve as an optimal imaging biomarker for the prediction of KRAS/NRAS mutations

SSJ10

Science Session with Keynote: Genitourinary (Quantitative Prostate MRI)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S502AB

BQ GU MR

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

FDA Discussions may include off-label uses.

Participants
Hebert Alberto Vargas, MD, Cambridge, United Kingdom (*Moderator*) Nothing to Disclose
Antonio C. Westphalen, MD, Medina, WA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ10-01 Genitourinary Keynote Speaker: Update on Quantitative Prostate MRI - Challenges and Opportunities for Translation Into Clinical Practice

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S502AB

Participants
Nicola Schieda, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

SSJ10-02 Application of a Novel High-Resolution, Accelerated Quantitative T2 Mapping Sequence at 3T for the Detection of Prostate Cancer

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S502AB

Participants
Andreas Bucher, MD, Frankfurt am Main , Germany (*Presenter*) Travel support, Guerbet SA;
Benjamin Kaltenbach, MD, Kelkheim, Germany (*Abstract Co-Author*) Nothing to Disclose
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Tom Hilbert, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG
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PURPOSE

Quantitative measurements of the prostate have been shown to produce reliable differentiation of malignant prostate lesions in the peripheral zone in several small scale studies with previous generation T2 mapping sequences. We tested the reliability of a novel, fast, high-resolution T2 mapping prototype sequence with parallel imaging and model-based reconstruction (T2M) in the detection of malignant prostate lesions.

METHOD AND MATERIALS

A total of 46 multiparametric MRI datasets for suspected prostate cancer (pCA) at 3T were included. All examinations included T2M in addition to a standard multiparametric prostate protocol. Confirmed pCA were present in 22 cases. Quantitative T2 mapping was acquired axially (0.7x0.7x3.0 mm3, 16 echoes with delta TE 10.8 ms, TR 5000 ms). Region-of-interest measurements (ROI) were performed on the T2 maps in 3 slices for healthy prostate tissue of the peripheral and transitional zone (apex, midbase, base) with a minimum area of 10 mm2. Confirmed malignant lesions were traced in a separate ROI on the most representative slice. Average and minimum values of T2M relaxation time (T2) were recorded per ROI.

RESULTS

Diagnostic image quality was obtained in all patients. Average acquisition time for T2M was 4:37 mins. Mean T2 was 153.7±45.1 ms for healthy tissue in the peripheral zone, 96.2±22.7 ms in the transitional zone. Mean T2 was significantly reduced for pCA in the peripheral zone (71.6±13.3 ms, p=0.001). Differences of mean T2 of pCA and average tissue of the transitional zone were suffcient to differentiate between tumor infiltration and average healthy tissue of the transitional zone (p=0.001). Minimal values of T2 showed good differentiation between healthy tissue and pCA (healthy: 99.4±19.9 ms, malignant: 52.0±10.6 ms; p=0.001).

CONCLUSION

Quantitative measurements from T2 mapping sequences provide good differentiation between healthy and malignant prostate tissue and are feasible in an expanded standard porstate protocol at high-resolution in acceptable acquisition time.

CLINICAL RELEVANCE/APPLICATION

Accelerated T2 mapping sequences could be a feasible addition to standard multiparametric prostate MRI for detection of prostate cancer.

SSJ10-03 Efficacy of Quantitative Texture Parameters of 3T Multiparametric MRI for the Differentiation of Transition Zone Prostate Cancer Lesions from Benign Prostatic Hyperplasia Nodules with

Wholemount Histopathology as Reference

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S502AB

Participants
Sohrab Afshari Mirak, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
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Kyunghyun Sung, PhD, Los Angeles, CA (*Abstract Co-Author*) Research support, Siemens AG
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Afshin Azadikhah, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To investigate the performance of different quantitative texture parameters of 3T multiparametric magnetic resonance imaging (3TmpMRI) for the differentiation of transition zone (TZ) prostate cancer (PCa) lesions from benign prostatic hyperplasia (BPH) nodules with wholemount histopathology as reference standard.

METHOD AND MATERIALS

This IRB approved, HIPAA compliant case-control study, included 77 patients. Regions of interest (ROI) for true positive TZ PCa lesions as well as the BPH nodules were contoured on 3TmpMRI axial T2-weighted images (T2WI), apparent diffusion coefficient (ADC) map of the diffusion weighted images (DWI) and dynamic contrast enhancement (DCE) MRI and the quantitative image analysis was performed. We generated 10 parameters including normalized T2WI signal intensity (SI) (calculated as mean T2WI signal intensity/ROI of obturator muscle), the shape of the histogram of T2WI SI (skewness and kurtosis), ADC minimum, ADC maximum, ADC skewness, ADC kurtosis, Ktrans (influx volume transfer coefficient), kep (efflux reflux rate constant) and Ve (the fractional volume of extracellular extravascular space). The quantitative parameters were compared between the TZ PCa and BPH nodules using paired sample t-test in SPSSv24. P-value<0.05 was considered as significant. The performance of the significant parameters were assessed using AUC for the ROC curves.

RESULTS

Mean patient age was 62.9±7.6 years with mean prostate specific antigen (PSA) 7.6±8.3 ng/ml. Compared to the BPH nodules, TZ PCa lesions had significantly higher T2WI SI (p=0.004), ADC skewness (p<0.001), Kep (p-value=0.026) and significantly lower ADC minimum (p<0.001) and ADC maximum (p=0.001). T2WI skewness, T2WI kurtosis, ADC kurtosis, Ktrans and Ve were not significantly different between cancerous and benign lesions (p>0.05). The highest AUC for the differentiation of TZ PCa from BPH was resulted from ADC skewness (0.998) followed by ADC minimum (0.891), ADC maximum (0.790), T2WI SI (0.625) and Kep (0.403) (figure 1).

CONCLUSION

3T mpMRI quantitative texture parameters, with higher performance of the parameters generated based on ADC maps, can be of significant value for the differentiation of TZ PCa from BPH nodules.

CLINICAL RELEVANCE/APPLICATION

Differentiation of transition zone prostate cancer from benign prostatic hyperplasia on 3T mpMRI can be difficult due to overlapping features, however mpMRI quantitative parameters may increase the performance.

SSJ10-04 PI-RADS-Based 3D Prostate Cancer Detection Using Residual Convolutional Neural Networks

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S502AB

Participants
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PURPOSE

Multi-parametric magnetic resonance imaging (mp-MRI) is playing an increasing role in prostate cancer assessment. Automated cancer localization as part of clinical decision support system can reduce inter-observer variability and time spent on image interpretation. This study evaluates the performance of a residual convolutional neural network (ResCNN) in the identification of potential areas of prostate cancer.

METHOD AND MATERIALS

A total of 337 cancer patients from the PROSTATEx dataset were analyzed in this study. Three radiologists segmented lesions that were PI-RADS v2 category three or higher using T2-weighted, ADC, and high b-value images. A 2D patch-based ResCNN was trained based on segmentations from the most senior radiologist. Volumetric predictions were generated using an adaptive threshold that controls the number of false positives. Sensitivity was measured by comparing network predictions to biopsy locations with clinically significant cancer using a distance criterion of 10 mm or less.

RESULTS

The network's sensitivity for detecting clinically significant cancer was 97% for all PI-RADS categories, whereas radiologists' sensitivities were 79±0.06%, 94±0.04%, and 99±0.02% for category 3, 4, and 5 lesions, respectively. The trade-offs for an increased network sensitivity were lesion volume overestimation (radiologists: 1.5cc, network: 3.2cc) and an increased number of false positives (PI-RADS 3: 29%, PI-RADS 4,5: 2%).

CONCLUSION

The proposed ResCNN was able to obtain similar sensitivity for detecting clinically significant cancer as the radiologists. This demonstrates the network's potential to assist radiologists in prostate cancer detection, especially for PI-RADS 3 lesions where the presence of clinically significant cancer is equivocal (sensitivity: network 97% vs radiologists 79%).

CLINICAL RELEVANCE/APPLICATION

We have demonstrated that a residual convolutional neural network trained on PI-RADS v2 protocol has the potential to assist radiologists in detecting clinically significant prostate cancers.

SSJ10-05 Radiomic Features from Prostate Bi-Parametric MRI Differentiate MRI-Invisible Lesions from Non-Tumor Region in the Peripheral Zone: A Preliminary Multi-Site Study

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S502AB

Participants
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PURPOSE

Approximately 12% of biopsy-confirmed prostate cancer (PCa) lesions cannot be detected on MRI, which are referred to as 'MRI-invisible' lesions (PI-RADS < 3 and Gleason Grade Group (GGG) >= 1). Radiomics derived from prostate multi-parametric MRI (mpMRI) have been shown to complement imaging in characterizing PCa. In this work, we explore radiomics from bi-parametric MRI (bpMRI) including T2-weighted MRI (T2WI) and apparent diffusion coefficient (ADC) maps to differentiate MRI-invisible lesions from non-tumor prostate tissue in the peripheral zone (PZ).

METHOD AND MATERIALS

In this study, a set of N = 100 PCa patients was included from 4 different institutions. Of these, 64 patients (N1) underwent 3T mpMRI prior to radical prostatectomy (RP) and 36 patients (N2) underwent 3T mpMRI with no abnormal signs followed by systematic biopsy that was negative. For N1, delineation of lesion regions of interest (ROIs) on bpMRI were obtained by mapping ROIs from corresponding RP surgical specimens and verified by an experienced radiologist. N = 39 visible lesions (VL) and N=25 invisible lesions (IL) were identified by the radiologist. Patients from N2 were used to obtain non-tumor (NR) ROIs within the PZ on T2WI and ADC maps. Training set (D1) consists of 15 NR, 15 IL and 18 VL, and the testing set (D2) consists of 21 NR, 10 IL and 21 VL. In D1, we identified stable radiomic features (test-retest and cross-site stability) that distinguished NR and IL, as well as NR and VL (to ensure their association with PCa). A logistic regression model (CL) was trained to separate NR and PCa lesions (IL + VL) in D1 and was then validated on D2 in terms of receiver operating characteristic (ROC).

RESULTS

Radiomic features including Co-occurrence of Local Anisotropic Gradient Orientations (CoLlAGe), Haralick features from T2WI; CoLlAGe and Laws features from ADC maps were found to distinguish NR and IL, VL. The area under the ROC curve (AUC) of CL on D2 is 0.93 (NR vs lesions), 0.97 (NR vs IL) and 0.91 (NR vs VL).

CONCLUSION

Radiomic features derived from prostate bpMRI were able to differentiate MRI-invisible lesions from non-tumor regions within the PZ.

CLINICAL RELEVANCE/APPLICATION

Radiomic based approaches might allow for non-invasive identification of PI-RADS invisible tumors and improve the lesion detection sensitivity of prostate MRI.

SSJ10-06 A Machine Learning-Assisted Decision Support Model with MRI Can Better Spare the Extended Pelvic Lymph Node Dissection at Cost of Less Missing in Prostate Cancer

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S502AB

Participants
Ying Hou, Nanjing, China (*Presenter*) Nothing to Disclose
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PURPOSE

To develop a machine learning (ML)-assisted model for identifying the candidates for extended pelvic lymph node dissection (ePLND) in prostate cancer by integrating clinical, biopsy and precisely defined MRI findings.

METHOD AND MATERIALS

248 patients treated with radical prostatectomy and ePLND or PLND were included. ML-based models were developed from 18 integrated features using a logistic regression (LR), support vector machine (SVM) and random forests (RFs) algorithm, respectively. The models were compared to a MSKCC nomogram using the receiver operating characteristic-derived area under the curve (AUC), calibration plot and decision-curve analysis (DCA).

RESULTS

Total 59/248 (23.8%) lymph node invasion (LNIs) were identified at surgery. After cross validation, the predictive accuracy of these ML-based predictors yielded similar AUCs (RFs: 0.906; 95% confidence interval [CI], 0.856-0.928; SVM: 0.891; 95% CI, 0.840-0.917; LR+: 0.886; 95% CI, 0.834-0.913), while higher than MSKCC nomogram (0.816, 95% CI, 0.762-0.862). The calibration of MSKCC tended to underestimate LNI risk across the entire range of predicted probabilities compared to RFs and SVM. The DCA demonstrated three ML-based models significantly improved risk prediction at risk threshold <= 80% compared to MSKCC. If ePLNDs missed was controlled < 3%, RFs resulted in higher positive predictive value (55/107 [51.4%] vs 56/139 [40.3%]), similar negative predictive value (137/141 [97.2%] vs 106/109 [97.2%]), and higher No. of ePLNDs spared (141/248 [56.9%] vs 109/248 [43.9]) compared to MSKCC.

CONCLUSION

Our ML-based model below 15% cutoff, superior to MSKCC nomogram, allows to 57% ePLNDs spared at the cost of missing < 3% LNIs.

CLINICAL RELEVANCE/APPLICATION

Preoperative identification of LNI is critical for appropriate treatment selection and planning.As precisely defining nodal stage is to allow surgeons to define which patients may benefit from ePLND or PLND during radical prostatectomy and which patients may safely avoid it.

Printed on: 10/29/20

SSJ11

Genitourinary (Evidence-Based Genitourinary Imaging)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S503AB

GU

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

Participants
Douglas S. Katz, MD, Mineola, NY (*Moderator*) Nothing to Disclose
Mariano Volpacchio, MD, Buenos Aires, Argentina (*Moderator*) Nothing to Disclose

Sub-Events

SSJ11-01 What is the Value of Surveying the Kidneys during Pelvic Ultrasound Examinations? A Clinical Audit of 1000 Patients

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S503AB

Participants
Sheila Oh, MBBCh, Hamilton, New Zealand (*Presenter*) Nothing to Disclose
Orlaith Brennan, Hamilton, New Zealand (*Abstract Co-Author*) Nothing to Disclose
Martin Necas, Hamilton, New Zealand (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Pelvic ultrasounds are commonly performed for various clinical indications in female patients presenting to the hospital. A survey of the kidneys is routinely included as part of the examination, but there is limited justification for their inclusion in the assessment of every female presenting for a pelvic ultrasound1-4. There may be reasonable clinical rationale to extend the examination to survey the kidneys in select patients, i.e. large pelvic masses or lower abdominal pain necessitating review of the kidneys. However, most pelvic ultrasounds are performed for different reasons including heavy/irregular bleeding and characterisation of ovaries for polycystic morphology which provide no clinical justification for routine survey of kidneys. The prevalence of incidental renal findings in female patients presenting specifically for pelvic sonography is currently unknown. We aim to determine the incidence, spectrum and severity of renal findings in patients presenting for pelvic ultrasounds and clinical outcomes upon their discovery.

METHOD AND MATERIALS

A retrospective sequential audit of pelvic ultrasound examinations in 1000 non-pregnant female patients presenting to Waikato DHB Ultrasound service (Waikato Hospital & Thames Hospital) between 1 January 2017 and 14 July 2017. Examinations were identified using a sequential search of our PACS system. Ultrasound reports and outcomes were analysed. Renal findings were separated into clinically significant criteria (e.g.Bosniak 2F-4 cyst, new angiomyolipoma(AML), renal cell carcinoma(RCC) or new urolithiasis); and insignificant criteria (e.g.simple cyst, stable AML or known urolithiasis). Clinical outcomes of patients with significant renal findings were determined by reviewing patients' clinical records for one-year following the ultrasound.

RESULTS

A total of 1999 kidneys were examined from 1000 female patients (Mean age=43) who underwent pelvic ultrasound examination;1 patient had previous nephrectomy. No significant renal findings were found in 96% of pelvic ultrasound examinations. Of the 46 significant renal findings, 91% were clinically inconsequential. Only 4 patients had incidental findings of high clinical priority requiring specialist treatment; 2 patients were symptomatic from obstructive urolithiasis and 2 patients harboured asymptomatic RCC. Overall incidence of incidental renal findings of high clinical priority in asymptomatic patients was 2 in 1000 patients.

CONCLUSION

Prevalence of significant incidental renal findings was 4.6% but the vast majority (91%) were clinically inconsequential. Prevalence of incidental renal findings of high clinical priority was only 4 in 1000(0.4%); two were symptomatic. Indiscriminate uncritical screening of kidneys in women presenting for pelvic ultrasound is not evidence-based and represents a low-yield examination with extremely low rate of incidental findings of clinical significance.

SSJ11-02 Intrapatient Analysis of Effect of Oral and Intravenous Contrast Material on CT Diagnosis of Acute Pelvic Pathologies

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S503AB

Participants
Tugce Agirlar Trabzonlu, MD, Chicago, IL (*Presenter*) Grant, Siemens AG
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Kamal Subedi, MBBS, Kathmandu, Nepal (*Abstract Co-Author*) Nothing to Disclose
Sonia Lee, MD, Irvine, CA (*Abstract Co-Author*) Nothing to Disclose
Mohammad Helmy, MD, Anaheim, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Ultrasound is the initial modality to evaluate acute pelvic pathologies. However, when symptoms are poorly localized, patients can be evaluated by CT. Our objective was to compare the performance of computed tomography (CT) without and with oral and intravenous (iv) contrast for the diagnosis of acute pelvic pathologies in the same patients by using dual energy CT (DECT) contrast-enhanced and virtual non-contrast (VNC) images.

METHOD AND MATERIALS

In this retrospective analysis, we reviewed DECT studies with oral and IV contrast obtained for abdominal pain. We included patients with a radiological diagnosis of acute pelvic pathologies and control cases without evidence of acute pelvic pathology scanned between October 2018 and March 2019. In the first session, the virtual non-contrast scans were randomized and analyzed. In the second session, true contrast enhanced images were randomized and analyzed. Findings of acute pelvic pathologies and diagnostic certainty in percentage were noted. Diagnostic performance of VNC images were compared with contrast enhanced CT studies. Sensitivity, specificity and accuracy were calculated. Fischer's exact test and Wilcoxon signed-rank test were used for statistical analysis.

RESULTS

Cohort included 46 patients with 92 sets of CT images (patients with acute pelvic pathologies n=27, control cases n=19). Pelvic pathologies included: tubo-ovarian abscess/ hydrosalphinx (n=13), ovarian cyst rupture (n=8), hemorrhage within an ovarian cyst (n=2), large ovarian cyst (n=3), dermoid cyst rupture (n=1). Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of VNC images were 70.4% (95% Cl= 49.8-86.3%), 94.7% (95% Cl= 74.0-99.9%), 95% (95% Cl= 73.5-99.2%), 69.2% (Cl= 55.5-80.3%) and 80.4% (95% Cl= 66.1-90.6%), respectively. Mean diagnostic certainty rate was significantly higher in true enhanced group when compared to VNC group (81.6% vs 100%, p=0.001).

CONCLUSION

When compared to contrast enhanced CT imaging, unenhanced images missed 30% of cases with acute pelvic pathologies. Also with contrast enhanced CT diagnostic certainty rate was significantly higher.

CLINICAL RELEVANCE/APPLICATION

The use of oral and intravenous contrast remains necessary in patients with suspected acute pelvic pathologies.

SSJ11-03 Suggestion on New Computed Tomography Criteria to Differentiate Pheochromocytoma from Adrenal Adenoma

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S503AB

Participants
Sohi Kang I, MD,MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sung Yoon Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To retrospectively investigate performance of new radiologic criteria to differentiate pheochromocytoma from adrenal adenoma using adrenal protocol computed tomography (CT).

METHOD AND MATERIALS

Consecutive 199 patients who underwent adrenal CT and surgically proven pheochromocytoma (n= 66) or adenoma (n= 133) were included. Patients were alternatively allocated to model development (n= 100) and validation (n= 99) groups, according to the order of surgical date. Two independent radiologists analyzed two CT criteria for pheochromocytoma. Conventional criteria were as follows: (a) lesion attenuation on unenhanced CT >10 Hounsfield unit (HU); (b) absolute percentage washout (APW) <60%; AND (c) relative percentage washout (APW) <40%. New criteria were as follows: (a) conventional criteria; OR (b) one of followings; (i) lesion attenuation on UCT >=40 HU; (ii) 1-min enhanced CT >=160 HU; or (iii) intralesional cystic degeneration seen on both 1-min and 15-min enhanced CT. Area under the curve (AUC) and inter-reader agreement were assessed.

RESULTS

Proportion of pheochromocytoma was similar between development and validation groups (26.0% versus 37.4%; p= 0.210). AUC of new criteria was consistently greater than that of conventional criteria for differentiating pheochromocytoma from adenoma (reader 1, 0.895 versus 0.755 for development group and 0.840 versus 0.724 for validation group; reader 2, 0.902 versus 0.799 for development group and 0.845 versus 0.724 for validation group) (p< 0.05 for all comparisons). Inter-reader agreement was excellent in interpreting any criteria (weighted kappa >0.800).

CONCLUSION

New radiologic criteria using adrenal protocol CT seem to improve diagnostic performance reliably in differentiating pheochromocytoma from adrenal adenoma.

CLINICAL RELEVANCE/APPLICATION

Conventional CT criteria have some overlaps in quantitative image finidngs between adrenal adenoma and pheochromocytoma. Thus, some of pheochromocytoma can be considered as adenoma radiologically. The present new criteria seem to allow more accurate prediction of pheochromocytoma by using adrenal protocol CT.

SSJ11-04 Establishing Normative Kidney Sizes for a Large Developing Country's Adult Population Using Big Data: A Study of 30,000 Ultrasound Scans Yields a Potential Gender and Age-Related Difference

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S503AB

Participants
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Salil Gupta, BEng, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

There are no large-scale population level studies describing kidney size in normal adult population from this geography. Currently, radiologists rely on data from other countries or on limited data from small-scale studies specific to this geography. We studied kidney sizes of 30,000 patients with normal kidneys and compare our findings to currently established normal values.

METHOD AND MATERIALS

65,000 text reports of abdomen ultrasound scans done for patients presenting to 4 radiology clinics between June 2016 and December 2018 were extracted and anonymised. 35,064 reports were removed from the database since they either had some abnormality in the kidney (as determined by a filter-based text search mechanism) or were of paediatric population. Kidney sizes (length and breadth) were present in all 29,936 reports (48.6% females) and cortical thickness measurement was present in 1,624 reports (46.1% females). The sizes and cortical thickness for both kidneys were extracted using keyword-based mechanisms and summary statistics calculated.

RESULTS

The average age of females was 49.8 years and males was 52 years. The average length of the kidney was 10 cm (right) and 10.1 cm (left) in females and 10.3 cm (right) and 10.4 cm (left) in males. Average cortical thickness in females was 1.1 cm (left), 1.2 cm (right) and in males was 1.3 cm (left), 1.4 cm (right). However, the regression plots of kidney length vs. age, showed inflection points in females (38.2 y (right), 39.3 y (left)) to occur earlier when compared to that of males (43.2 y (right), 42.2 y (left)). This observed difference in inflection points might support the idea that kidney atrophy begins earlier in females than males. Additionally as compared to standard textbook kidney sizes and previous literature from this geography, our study values were slightly higher - study from 2014 reported sizes in males to be 9.7 cm (right) and 9.8 cm (left), and females to be 9.5 cm (right) and 9.7 cm (left).

CONCLUSION

The use of data-mining techniques can enable study of large datasets which currently reside unstudied in institutions across the world, giving insight into defining normative values across age-groups, populations and regions.

CLINICAL RELEVANCE/APPLICATION

Practising radiologists and clinicians can use age- and gender-specific normal sizes to improve their reporting and guide more appropriate clinical management.

SSJ11-05 Adherence to Appropriate Imaging Management per Published Guidelines for Incidental Adnexal Masses at a Level 1 Trauma Center

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S503AB

Participants
Sagar V. Desai, BS, Mountain Top, PA (*Presenter*) Nothing to Disclose
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PURPOSE

Evidence-based guidelines have been published to standardize management of incidental findings; however, there has been limited investigation of the adherence rates to these guidelines. We evaluate the appropriateness of radiologists' recommendations for follow-up imaging of incidentally discovered adnexal masses using published guidelines as the reference standard.

METHOD AND MATERIALS

Computerized tomography (CT) reports within the trauma registry were searched for 'ovary', 'ovarian' and 'adnexal'. 157 reports were used for this pilot study. 3 investigators independently assessed CT reports and generated recommendations for follow-up imaging as per American College of Radiology (ACR) guidelines. Discrepancies were reviewed among investigators for a consensus decision. Dictated reports were compared to published recommendations to assess for appropriate management, inadequate management, or over-management.

RESULTS

61 (39%) reports were excluded as they contained pertinent negative verbiage, expected physiologic findings, inadequate characterization or repeat examinations, leaving 96 for further analysis. 62 (65% [95% CI 56, 75]) had appropriate management, while 25 (26%) had inadequate management and 9 (9%) over-management. Of the inadequately managed reports, 11 had no recommendation provided when follow-up was indicated and 14 did not include a time interval when prompt follow-up imaging was

indicated. There was a significant association between appropriate management and age (<=50 years, 42/47 [89.4%] vs >50 years, 20/49 [51.9%], p<0.0001) and mass size (<=3 cm, 34/44 [77.2%] vs > 3cm, 28/52 [53.8%], p=0.01).

CONCLUSION

Adherence of radiologists to the ACR recommendations for adnexal masses was suboptimal; of note, we find that patient age > 50 years and mass size > 3 cm were associated with poorer adherence. A larger study is needed to validate these findings; however, these findings suggest a need to implement educational initiatives to promote the appropriate management of incidental adnexal findings.

CLINICAL RELEVANCE/APPLICATION

Proper management of incidental adnexal masses balances the goal for early detection of ovarian malignancy against unnecessary imaging of low-risk lesions.

SSJ11-06 Towards Reducing Overutilization of Prostate mpMRI: Using PSA Density to Predict Negative and Indeterminate MRI Scans

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S503AB

Participants
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PURPOSE

To assess the applicability of a prediction model based on clinical parameters to reduce the number of negative and indeterminate multiparametric MRI (mpMRI) scans in patients at risk for prostate cancer (PCa).

METHOD AND MATERIALS

In this retrospective research ethics board approved study, we evaluated 865 patients with no prior PCa diagnosis who underwent prostate mpMRI, classified according to PI-RADS v2.0. The following clinical risk factors were collected: age, prostate volume, PSA, PSA density (PSAd). Lesions reported as PI-RADS >= 4 were considered as suspicious for clinically significant (cs) PCa. The patient cohort was randomly split into training (n=605) and validation cohorts (n=260) for all analyses. We used univariate and multivariate logistic regression, and area under receiver operator characteristic (ROC) curve (AUC) to predict PI-RADS >= 4 findings. The optimal decision threshold to confidently rule out a PI-RADS >= 4 disease was determined in the training cohort and applied to the validation cohort. In total, 116 patients underwent biopsy following MRI, revealing 11 csPCas (>= Gleason Grade Group 2).

RESULTS

In univariate analysis, all variables were significant predictors of PI-RADS scores >= 4 (p<0.05). In multivariate analysis, only age, prostate volume, and PSAd were independent predictors of PI-RADS scores >= 4 (p<0.0001). PSAd (AUC=0.74) outperformed other single parameters in diagnostic accuracy (age: AUC=0.55, p<0.01; prostate volume: AUC=0.65, p<0.05; PSA: AUC=0.60, p<0.01) and yielded no significant difference compared to the multivariate model (AUC=0.73). At a PSAd cut-off value of 0.078 ng/ml2 sensitivity, specificity, positive and negative likelihood ratio were 93.62%, 28.64%, 1.31 and 0.22, respectively. This decision threshold would result in the omission of 25% (64/260) of mpMRI scans in the validation cohort, missing 6% of PI-RADS >= 4 findings (3/47). The number of subsequent biopsies could thus be reduced by a maximum of 33% (12/36), whilst missing only one csPCa.

CONCLUSION

In patients at risk for PCa, applying a PSAd cut-off level of 0.078 ng/ml2 would result in 25% fewer mpMRIs being performed while missing a minimal number of csPCas. Further prospective validation is required.

CLINICAL RELEVANCE/APPLICATION

We present a triage strategy for patients at risk for prostate cancer based on PSAd, which safely avoids a large proportion of prostate mpMRI scans with negative or indeterminate findings.

SSJ12

Health Service, Policy and Research (Education and Academics)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E260

ED HP

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

Participants
Carol P. Geer, MD, Winston Salem, NC (*Moderator*) Nothing to Disclose
Marc H. Willis, DO, MMM, Palo Alto, CA (*Moderator*) Investor, Resonea, Inc

Sub-Events

SSJ12-01 National Survey to Assess Gender Differences Among Radiology Residency Applicants Regarding Factors Impacting Program Selection

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E260

Participants
Laura B. Madsen, MD,MSc, Mineola, NY (*Presenter*) Nothing to Disclose
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Jason C. Hoffmann, MD, Garden City, NY (*Abstract Co-Author*) Speakers Bureau, Merit Medical Systems, Inc; ;

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PURPOSE

To investigate which program factors were considered most important by radiology residency applicants when ranking programs and to assess whether there was any significant difference by gender.

METHOD AND MATERIALS

Following IRB exemption, a web-based survey was distributed electronically to diagnostic radiology (DR) and interventional radiology (IR) residency programs in the US and Canada via the Association of Program Coordinators in Radiology (APCR) mailing list. The residents were asked to evaluate the importance of 30 factors during their evaluation of programs when applying for residency using a 5-point Likert scale (1=very negative/not important, 5=very positive/extremely important). Demographic information was also collected. The Mann-Whitney test was used to compare males and females for each factor on the survey and considered statistically significant at the $p<0.05$ level.

RESULTS

370 residents (95.4% DR and 4.6% IR) and 1 DR fellow (0.3%) completed the survey. Overall, the most important factors to respondents during residency program selection were program culture (4.42), geographic location (4.17), fellowship placement of graduates (4.14), and imaging and/or procedure volume (3.98). Of the respondents, 269 were male (72.5%) and 101 were female (27.2%). There was a significant difference between male and female respondents in the importance given to program culture ($p=0.002$), composition of current residents (marital status, age, race, gender, and children status) ($p=0.007$), percentage of current female residents ($p<0.0001$), program size ($p=0.047$), call schedule ($p=0.025$) and female faculty ($p<0.0001$), which female respondents ranked more highly and considered to be extremely important, very important or somewhat important.

CONCLUSION

Applicants consider many factors during residency program selection. Overall program culture, geographic location, fellowship placement and imaging and/or procedural volume were most important to applicants. There were significant gender differences in how applicants weighted the importance of several factors during residency program selection.

CLINICAL RELEVANCE/APPLICATION

Understanding factors considered by applicants during the residency program application process can help residency programs recruit applicants.

SSJ12-02 Are Women Disadvantaged in Academic Radiology?

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E260

Participants
Rozita Jalilianhasanpour, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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David M. Yousem, MD, Owings Mills, MD (*Abstract Co-Author*) Royalties, Reed Elsevier; Employee, Medicolegal Consultation; Royalties, Analytical Informatics, Inc; Speaker, MRIOnline; ; ;

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PURPOSE

There has been a persistent gender bias in Radiology preventing women from assuming leadership positions. This could lead to or result from women not ascending faculty rank. We sought to determine if 1) women are appropriately represented in the senior author positions in radiology journals compared with their first authored contributions 2) women's contribution to the radiology literature is proportional to their percentage growth in academia 3) whether there are gender differences in senior academic rank after accounting for factors known to influence academic advancement.

METHOD AND MATERIALS

We assessed the gender of 3,702 first and last authors of manuscripts published in 9 high-impact American radiology journals between 2002-2017. For the same years, we looked at the gender composition of academic faculty and ranks based on AAMC data. We calculated the proportion of faculty members with respect to gender and academic ranks over time. We also plotted the productivity rates for each gender over 16 years .Additionally the gender ratio of junior and senior faculty positions was plotted over time to see if the gender ratio of junior faculty who entered AAMC rosters 16 years earlier would be balanced to the gender ratio of senior faculy 16 years later.

RESULTS

Women's proportion as the first author grew from 26.9% to 37.4%, and from 15.7% to 23.9% as the senior author. Senior author contribution of women remained significantly lower than first authorship with no sign of narrowing the gap. Women were underrepresented in each faculty rank over 16 years. For a given year, the percentage of women associate professor and full-professor were 6.80% and 13.97% less than the mean percentage of female assistant professor. Mean manuscript productivity rate of women as junior faculty for 16 years was nearly equivalent compared to their male counterparts. The ratio of women in senior academic rank did not change with an increase in women authorship.

CONCLUSION

Although women have made inroads in their contribution to radiology literature over the years, this has not translated to improvement in the ratio of senior authorship and faculty positions versus men. Despite increased involvement of women in research over time, the remain disproportionately at junior faculty positions.

CLINICAL RELEVANCE/APPLICATION

Gender disparity has persisted over the years and led to the under-representation of women in senior authorship and higher academic ranks.

SSJ12-03 Analysis of Kinematic Differences in Hand Motion between Novice and Experienced Operators in Interventional Radiology

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E260

Participants
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Muneeb Ahmed, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc

PURPOSE

Kinematic hand motion analysis has been used to quantify refinements in learned tasks in surgery. Here, we compare the hand motion of attending physicians to trainees completing a basic simulated interventional radiology procedural task using electromagnetic sensor technology to determine if kinematic hand motion analysis can detect differences between experienced operators and trainees.

METHOD AND MATERIALS

5 attendings and 3 trainees (2 fellows, one resident) performed a simulated task of threading a wire through a sheath and removing the inner dilator over a wire while the motion of their dominant hand was recorded using electromagnetic motion sensor technology. All participants were right-handed. The task was repeated for 10 trials. The total distance the participant's hands traveled during the task (path length) and total time to complete the task were compared between attendings and trainees individually and as a group. The first trial path length and the last trial path length were compared to detect improvement with task repetition. Statistical analysis using paired t-tests and two sample t-tests were performed.

RESULTS

Total path length to complete the task for the attendings was shorter than that for the trainees (69±12 cm vs. 107±22 cm, $p<0.05$). The attendings also took a shorter time to complete the task (71±18s vs. 82±16s, $p<0.01$). The path length for all participants (attendings and trainees) decreased between the first attempt at the task and the last attempt (94±20 cm vs. 78±22 cm, $p<0.05$).

CONCLUSION

Electromagnetic motion tracking technology was able to discern kinematic differences in hand motion between attending physicians and trainees in a simulated interventional radiology task. Kinematic analysis also detected improvements with task repetition. Further exploration of this technology as a method to objectively measure performance of procedures in radiology is warranted.

CLINICAL RELEVANCE/APPLICATION

Kinematic differences between attendings and trainees represent an objective measure of performance. This element may be used to determine when a trainee can be deemed competent for a given procedure.

SSJ12-04 Research Involvement and Barriers in Radiology Residency Programs: Perceptions, Attitudes, Practice, and Impact Worldwide

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E260

Participants
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PURPOSE

To assess the opportunities and interest in academia amongst radiology trainees worldwide, and to identify barriers to research activities.

METHOD AND MATERIALS

A 35-question online survey was distributed to radiology trainees internationally using social media and support via email newsletters from 13 radiological societies. Feedback regarding length and setup of radiology residency programs, participation in research and barriers to academic activities were investigated. Fisher and Chi-squared tests were used to differentiate findings. A $p<0.05$ indicated a statistically significant difference.

RESULTS

In total, 749 participants (348 women, 392 men, 9 undisclosed) completed the survey. Research involvement amongst radiology trainees varied significantly, ranging from 36% (21/59) in South America to 79% (46/58) in North America. Research productivity (i.e. poster or scientific presentations and publications) varied significantly, with trainees involved in research from North America mostly publishing original articles (27/58, 27%), European trainees mostly publishing review articles (94/437, 22%) and South American trainees mostly publishing case reports (28/59, 47%). There was a lack of formal allocated time for research in 60% (451/749) of participants. When compared to participants with formally allocated time, there was a lower number of published original articles (31%, 138/451 vs. 42%, 126/298, $p<0.001$), review articles (13%, 58/451 vs. 20%, 60/298, $p=0.007$), and first author publications (31%, 140/451 vs. 40%, 120/298, $p=0.009$). Barriers to research included lack of allocated time (58%, 434/749) and mentorship (49%, 366/749). Some participants (18% (136/749)) declared a lack of personal interest as a barrier. Lack of funding was declared a major barrier by 50% (19/38) of participants from African countries.

CONCLUSION

Radiology research involvement amongst trainees varies worldwide, with many not formally involved in academia. Residency programs seeking to enhance research output should focus on providing protected time, training and mentorship.

CLINICAL RELEVANCE/APPLICATION

High quality research drives technological advances. Lack of involvement in academia and mentorship during residency may hamper the ability of radiologists to contribute to discoveries and improvements for patient care.

SSJ12-06 Breaking the Stereotype: Interventions Aimed at Changing Medical Student Misperceptions of Radiology and Increasing the Female Match Rate

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E260

Awards
Trainee Research Prize - Medical Student

Participants
Victoria Podsiadlo, Worcester, MA (*Presenter*) Nothing to Disclose
Carolynn M. DeBenedectis, MD, Natick , MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of this project is to determine the effectiveness of the interventions implemented at a single medical school in disputing the common misperceptions of radiology and increase the number of female medical students pursuing radiology.

METHOD AND MATERIALS

1st (MSI) and 4th year medical students (MSIV) voluntarily participated in an online survey to assess whether the interventions implemented at one medical school corrected stereotypes about radiology, and to see if they increased the number of women going into radiology. The interventions included adding radiology into the preclinical curriculum, 3rd year electives in radiology, and a 'Women in Radiology Panel'. MSIs gave free text answers about their attitudes toward radiology, which were categorized into the '6 most common misperceptions': no patient contact, anti-social, dying field, spend all day in a dark room, good lifestyle, and other. MSIVs were asked why they did or did not choose radiology, and the answers were placed into the same 6 categories. We also looked at the impact the Women in Radiology Panel (WIRP) had on perceptions and whether attendees were more likely to consider radiology. We then looked to see if there has been an increase in the number of female students choosing radiology since implementation.

RESULTS

MSIV (N=64) response rates containing the '6 most common misperceptions' were decreased compared to MSIs (N=183), especially dark room ($p=0.01$), dying field ($p=0.54$), and antisocial ($p=<0.0001$). After the WIRP, attendees (N=18) rated their perception of patient contact ($p=0.001$) and work-life balance ($p=0.33$) higher. Attendees were also more likely to consider radiology ($p=0.003$). If exposed to 4 years of interventions there was a significant increase in the number of female students matching in radiology ($p = 0.01$).

CONCLUSION

Female students exposed to 4 years of interventions showed a significant increase in radiology match rate. The interventions also decreased the misperceptions about radiology. The WIRP was the most effective at changing misperceptions and resulted in a higher likelihood of considering radiology.

CLINICAL RELEVANCE/APPLICATION

Exposure to radiology early in medical school and the prescence of female radiologist role models can change misperceptions and increase the number of women choosing radiology.

SSJ13

Informatics (3D Printing, Augmented Reality, and Virtual Reality)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S501ABC

IN

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

FDA Discussions may include off-label uses.

Participants
Ciprian N. Ionita, PhD, Buffalo, NY (*Moderator*) Grant, Canon Medical Systems Corporation;
Christopher Morley, MD, New York, NY (*Moderator*) Co-founder, MediVis, Inc

Sub-Events

SSJ13-01 Implementing an In-House 3D Printing Service Across a Healthcare Enterprise

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S501ABC

Participants
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Michelle Ho, Philadelphia, PA (*Presenter*) Nothing to Disclose
Robert Neff, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Erik Backlund, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Bon Ku, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Philip S. Lim, MD, Abington, PA (*Abstract Co-Author*) Consultant, BioClinica, Inc Consultant, ICON plc Consultant, Siemens AG Consultant, GI Reviewers Consultant, VirtualScopics
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CONCLUSION

The creation of 3DP workflow tools and a management queue - via standard EMR integration - promotes access to 3DP and sets a new standard of care for providers across a healthcare enterprise. This development demonstrates a maturation of in-hospital 3DP service with the potential of scaling to other healthcare enterprises.

Background

Large clinical enterprises with multiple acute care hospitals and outpatient offices need to innovate scalable solutions to improve patient care. Integrated 3D printing (3DP) technology is emerging as a new standard of care, however the methods and workflows to implement this technology require demonstration. To meet growing demands, we established an in-house 3DP service involving a multi-disciplinary team of radiologists, clinicians, developers, designers, administrators, and students.

Evaluation

Leveraging multiple departments across our healthcare enterprise, we developed an entirely in-house 3DP service. Our software engineers developed an interface within the hospital's EMR along with a management system that allows clinicians to directly order 3D models and track their progress. Image segmentation, volume preparation, and printing are performed within a design lab staffed by clinicians, designers, and students with enterprise PACS access and expertise in 3D modeling and printing. Using the EMR 3D print interface, the team can collaborate with clinicians to validate models. At writing, we have 9 procedure specific 3D protocols in development with 6 surgical specialties across multiple hospitals. By integrating the 3DP process into EMR workflow, we have reduced friction to engage with this technology. Additionally, a data analytics team is able to extract measures and outcomes to be used for quality improvement.

Discussion

We have described the development of a streamlined in-house 3DP service that eliminates the need for outsourcing any step in the creation of patient care 3D models. By keeping the 3DP process in-house, we are able to reduce costs, create high quality custom models, remain HIPAA compliant, maintain quality control, and allow radiologists and other stakeholders to co-design and monitor the progress of the model.

SSJ13-02 Patient-Specific Metal Implants Using 3D Printing Technique for the Reconstruction of Skeletal Defect after Bone Tumor Resection

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S501ABC

Participants
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CONCLUSION

Our study suggests that 3D printing technology can be useful to reconstruct patient-specific bone defect where functional reconstruction was not feasible with conventional methods. Future study to identify the optimum method of hybrid combination will be necessary.

Background

Reconstruction of the skeletal defect after resection of bone tumors is challenging because it can occur in various locations with a diverse bone defect. Prosthetic reconstruction is one of the most commonly used method, however pre-existing modular prosthesis system cannot fully accommodate the patient's specific defect and functional requirement. To overcome this shortcoming, we made a patient-specific metal implant that could be combined with pre-existing modular prosthesis using a 3D printer. Here, we describe our experiences on the patient-specific implant for the treatment of bone tumors.

Evaluation

This study involved 3 consecutive bone tumor patients who were treated between October 2018 and March 2019. Primary tumors consisted of osteosarcoma of the scapula, chondrosarcoma of the humerus, and giant cell tumor of the proximal radius. Conventional reconstructions were expected to be non-functioning for all those 3 patients, due to extensive bone destruction involving major joints. After we obtained 3D CT and MRI images, a rapid prototype was made to simulate bone defect. Then we designed a patient-specific metal implant that could be combined with pre-existing prosthesis in a STL file that could be printed. We evaluated the feasibility of hybrid reconstruction for the treatment of bone tumors using a 3D printing technology and functional outcome.

Discussion

All three tumors were resected as preoperatively planned, and there were four combination points between implants. Three of them were screw type combination and one was pressure-fit. Patient-specific implants were combined with pre-existing modular prostheses without difficulties. The mean range of motion (ROM) was 73% when compared to the preoperative ROM and all patients could perform independent daily activities.

SSJ13-03 Quality Assurance in 3D Printing: Gage R&R Study of Bone Model Creation

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S501ABC

Participants
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Darshit Thakrar, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
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CONCLUSION

Gage R&R analysis of Housdorff distances in a quick and accurate means of assessing model creation protocols and segmenters.

Background

As 3D printing for the creation of anatomic models grows, there is a pressing need to ensure quality of the model creation process. While most 3D printers have well-defined tolerances, the repeatability and reliability of the virtual model creation process is less studied. The ability to evaluate overall and individual segmenters' quality is vital to the creation of high-quality models. Here, we present the results of a Gage repeatability and reliability analysis of the model creation process.

Evaluation

Three segmenters created STL's for 5 patient femurs. Each patient was segmented 3 times by each segmenter. Images were randomized and deidentified. The segmenters included a biomedical engineer, CT technologist, and pediatric radiologist, each with at least 1 year of experience in 3D printing. Each patient was segmented by a radiologist/biomedical engineer with greater than 3 years of experience to serve as the reference for analysis. STL's were compared to the reference mesh and root mean square error (RMSE) was calculated with Hausdorff distances. Gage R&R analysis was performed for the RMSE. A total of 39 segmentations were performed. The overall RMSE [quartiles] was 0.47 mm [0.34, 1.03]. The RMSE Gage R&R variance was 16.5%. One operator consistently had higher RMSE for all models, while another operator had higher RMSE for 2 patients.

Discussion

The Gage R&R for RMSE, measured at 16.5% indicates that the variability among and within segmenters accounts for 16.5% of the variation in measurements. Ideally the value should be less than 10%. We plan to implement further training and a strict protocol for the segmentation of bony anatomy and repeating the analysis to assess for change in the two outlier segmenters. Our results show that Gage R&R analysis of image segmentation using Hausdorff distances is a quick, robust method to evaluate individual segmenters and overall model preparation protocols. Before segmenters can create models for clinical patients, we suggest performing a similar analysis to ensure high quality in the creation of anatomic models.

SSJ13-04 3D Printed and Augmented Reality Models: Initial Evaluation on Quantitative Outcomes for Patients Undergoing Robotic Assisted Radical Prostatectomy

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S501ABC

Participants

Nicole Wake, PhD, Bronx, NY (*Presenter*) In-kind support, Stratasys, Ltd; Consultant, General Electric Company
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Hersh Chandarana, MD, New York, NY (*Abstract Co-Author*) Equipment support, Siemens AG; Software support, Siemens AG; ;

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PURPOSE

The purpose of this study was to prospectively assess whether 3D printed and augmented reality (AR) prostate cancer models improve quantitative surgical metrics in patients undergoing robotic assisted radical prostatectomy (RARP).

METHOD AND MATERIALS

Patients with MRI-visible prostate cancer (PI-RADS v2 >=3) scheduled to undergo RARP were prospectively enrolled in our IRB approved study. Patients were randomized to one of three methods of pre-operative image data visualization: 1) imaging alone, 2) imaging and a 3D printed model, or 3) imaging and an AR model. Quantitative metrics including operating room time, blood loss, and positive surgical margins were measured. Continuous surgical metrics for all of the 3D groups were compared to the group with just imaging using an unpaired t-test and non-parametric outcomes were compared with the Cochran's Q test.

RESULTS

99 patients were enrolled: 45 had imaging only, 37 had pre-operative 3D printed models, and 17 had pre-operative AR models. Total operating time (minutes) was 222 ± 47 for imaging, 213 ± 42 for 3D printed models, and 225 ± 38 for AR models. Blood loss (mL) was 232 ± 114 for imaging, 227 ± 148 for 3D printed models, and 203 ± 38 for AR models. Ten patients (22.2%) with imaging only, 3 patients (8.1%) with 3D printed models, and 7 patients (41.2%) with AR models, had positive surgical margins ($p = 0.005$). There was a 9-minute reduction in operating time for the 3D printed model group as compared to the imaging group (213 ± 42 vs 222 ± 47 minutes). However, the unpaired t-tests showed no statistical significance between any of the continuous 3D surgical metrics as compared to imaging as the gold-standard.

CONCLUSION

In this cohort, use of 3D printed models decreased operative times and rates of positive surgical margins compared to imaging alone.

CLINICAL RELEVANCE/APPLICATION

3D printed and AR prostate cancer models can assist surgeons to plan procedures thereby potentially improving patient outcomes and decreasing cost.

SSJ13-05 Common Femoral Arterial 3D Printed Haptic Simulator with Co-Registered Augmented Reality Hologram

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S501ABC

Participants
Adriene Eastaway, MD, Sandy, UT (*Presenter*) Nothing to Disclose
Abigail R. Cogman, DO, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Michael D. Weintraub, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
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Gabriel C. Fine, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Edward P. Quigley III, MD,PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

We provide a proof of principle for utilizing these tools to create a VR/AR teaching module for CFA access using 3D printing, the Microsoft HoloLens, and the co-registered haptic/virtual simulator using the Novarad Opensight Software.

Background

Common femoral artery (CFA) vascular access and subsequent closure for interventional procedures are commonly performed. Complications of CFA puncture include bleeding, dissection, thrombosis, pseudoaneurysm, neuropraxia, and injury to adjacent structures. To reduce the number of complications and ensure patient safety in an evolving training environment, simulators will likely be used with increasing frequency for interventional training. A growing body of evidence demonstrates simulators enhance user confidence, and decrease complications, procedural time, and radiation exposure. We developed a novel patient specific 3D printed haptic CFA simulator with coupled augmented reality (AR) anatomic hologram to provide tactile procedural practice and visuo-spatial reference.

Evaluation

We created osseous, vascular, and soft tissue models from anonymized CTA DICOM images. These were simultaneously 3D printed and displayed as an AR virtual model. We demonstrated overlay of the AR and haptic models of 3D patient CTA to be robust and accurate. For the haptic simulator, we printed osseous structures using polylactic acid, hollow vessel with Formlabs biomimetic elastic resin. These were embedded in a ballistic gel mold of soft tissues. Vessels were connected to pressurized fluid system and pump. US imaging of the haptic model faithfully reproduces patient's vascular anatomy. Successful puncture, catheterization, instrumentation, and closure of the CFA was achieved by trainees on initial attempts using US and using HoloLens AR platform.

Discussion

Simulators continually improve resident education in other medicine subspecialties, especially procedurally based simulations. We have made a unique and adaptable CFA simulator that can be used to improve interventional procedural competency at all training levels. Critically, 3D printed haptic CFA simulator realistically approximates the appearance of vessels, bones, and soft tissue under both fluoroscopy and ultrasound.

SSJ13-06 DS U-Net: Deeply Supervised U-Net for Fetal Brain Extraction

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S501ABC

Participants
Jingjiao Lou, Jinan, China (*Presenter*) Nothing to Disclose
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Dinggang Shen, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

We propose an automatic brain extraction method for fetal MRI using 2D U-net with deep supervision. Moreover, we propose a multi-stage approach to first localize the brain, and then segment the brain, and finally further refine the segmented brain, thus achieving high accuracy. Experimental results demonstrate that the precision and robustness of our method outperforms the existing methods.

Background

Fetal brain extraction/segmentation is one of the most essential steps for prenatal magnetic resonance imaging (MRI) reconstruction and analysis. Due to maternal breathing and unpredictable fetal movement, it is a challenging task to extract fetal brains from sparsely-acquired imaging stacks typically with motion artifacts. To address this, we propose an automatic brain extraction method for fetal MRI using multi-stage 2D U-Net with deep supervision (DS U-net).

Evaluation

Since the fetal brain only occupies a small proportion of positive pixels in fetal MRI, we firstly employ a coarse segmentation derived from DS U-net to define a 3D bounding box for localizing the position of the brain. The DS U-net is trained with deep supervision loss to acquire more powerful discrimination capability. Then, another DS U-net focuses on the extracted region to produce finer segmentation. The final prediction results are obtained by performing refined segmentation. We validate the proposed method on 80 stacks of training images and 43 testing images. The experimental results demonstrate the precision of our method with average Dice coefficient of 91.69%.

Discussion

After several layers of down-sampling, the dimensions of the feature maps reduce gradually and become smaller than that of the ground-truth masks. This subsequently makes the error back-propagation ineffective, slows down the convergence rate, and reduces the discrimination capability of the network. The U-net trained with deep supervision loss has more powerful discrimination capability. Additionally, feature maps from adjacent slices can be selected as additional channels to improve the segmentation performance.

SSJ14

Molecular Imaging (Theranostics)

Tuesday, Dec. 3 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
Christopher C. Riedl, MD, New York, NY (*Moderator*) Nothing to Disclose
Gabriel C. Fine, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose

Sub-Events

SSJ14-01 To Evaluate the Efficacy of 68Ga-DOTA-TOC and 18F-FDG PET/CT in the Follow-Up of Patients with Neuroendocrine Tumor Treated with the First Full Peptide Receptor Radionuclide Therapy Cycle

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S504CD

Participants
Sikandar M. Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

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PURPOSE

To evaluate the value of 68Ga-DOTA-TOC and 18F-FDG PET/CT for initial and follow-up evaluation of patients with neuroendocrine tumour (NET) treated with peptide receptor radionuclide therapy (PRRT).

METHOD AND MATERIALS

We evaluated 33 patients who were histologically proven NET.All these patients underwent both PRRT and three combined 68Ga-DOTA-TOC and 18F-FDG PET/CT studies. 68Ga-DOTA-TOC PET/CT was performed before PRRT, 3 months after completion of PRRT and after a further 6 - 9 months. 18F-FDG PET/CT was done within 2 months of 68Ga-DOTA-TOC PET/CT. Follow-up ranged from 11.8 to 80.0 months (mean 34.5 months).

RESULTS

All patients were 68Ga-DOTA-TOC PET-positive initially and at follow-up after the first full PRRT cycle. Overallx31 of the 99 18F-FDG PET studies (31 %) were true-positive in 19 of the 33 patients (58 %). Of the 33 patients, 14 (3 grade 1, 11 grade 2) were 18F-FDG-negative initially and during follow-up (group 1), 12 (3 grade 1, 6grade 2, 3 grade 3) were 18F-FDG-positive initially and during follow-up (group 2), 5 patients (1 grade 1, 3 grade 2, 1 grade 3) were 18F-FDG-negative initially but 18F-FDG-positive during follow-up (group 3), and 3 patients (all grade 2) were 18F-FDG-positive initially but 18F-FDG-negative during follow-up (group 4).18F-FDG PET showed more and/or larger metastases than 68Ga-DOTA-TOC PET in three patients of group 2 and two patients of group 3, all with progressive disease. In two patients with progressive disease who died during follow-up tumour SUVmax increased by 41 - 82 % from the first to the last follow-up investigation.

CONCLUSION

In known NET patients, the presence of 18F-FDG-positive tumours correlates strongly with a higher risk of progression. Initially, patients with 18F-FDG-negative NET may show 18F-FDG-positive tumours during follow-up. Also patients with grade 1 and grade 2 NET may have 18F-FDG-positive tumours. Therefore, 18F-FDG PET/CT is a complementary tool to 68Ga-DOTA-TOC PET/CT with clinical relevance for molecular investigation.

CLINICAL RELEVANCE/APPLICATION

Thus FDG PET-CT and Thus FDG PET-CT and 68Ga-DOTA-TOC PET-CT are complimentary to each other in evalaution and follow up after theraphy.

SSJ14-02 Inlaying Radiosensitizer onto the Polypeptide Shell of Drug-Loaded Ferritin for Imaging and Combinational Chemo-Radiotherapy

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S504CD

Participants
Jingwen Chen, Shanghai, China (*Presenter*) Nothing to Disclose
Qiuhong Zhang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Han Wang, MD, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Ferritin with unique hollow cavity is an emerging protein-based nanoplatform for anticancer-drug delivery, but the in vivo chemotherapeutic effectiveness is still unsatisfactory with such a monotherapy modality, which is urgently in need of improvement.

METHOD AND MATERIALS

Here a novel ferritin nanotheranostic with anticancer-drug doxorubicin encapsulated into its hollow interior and nanoradiosensitizer bismuth sulfide nanocrystals inlayed onto its polypeptide shell was synthesized for combinational therapeutic benefits. The formation mechanism of bismuth sulfide nanocrystals based on ferritin has been analyzed. The in vitro and in vivo treatment effects were carried out on HeLa cancer cells and tumor-bearing mice, respectively. The biocompatibility and excretion of the ferritin nanotheranostic have also been evaluated to guarantee their biosafety.

RESULTS

The polypeptide shell of ferritin provides nucleation sites for the bismuth sulfide nanocrystals through coordination interaction, and simultaneously inhibits the further growth of bismuth sulfide nanocrystals, rendering the bismuth sulfide nanocrystals like rivets inlaying onto the polypeptide firmly, which can not only strengthen the architectural stability of ferritin to prevent drug burst leakage during systemic circulation, but also act as excellent computed tomography contrast agents and nanoradiosensitizers for in vivo imaging-guided cancer combinational treatments.

CONCLUSION

The design concept of inlaying bismuth sulfide nanocrystals onto the polypeptide shell of doxorubicin-encapsulated ferritin significantly inhibits the tumor growth and simultaneously further broadens the application of ferritin in nanomedicine.

CLINICAL RELEVANCE/APPLICATION

The Bi2S3 nanocrystals onto the polypeptide shell can act as contrast agents for CT imaging, which can indicate the efficient tumor accumulation of Dox@AFBS through EPR effect after systemic administration, offering imaging guidance for in vivo cancer treatment.

SSJ14-04 A Fibronectin-Targeting Dual-Modal NIR-II Fluorescent and Photoacoustic Nanodots for Breast Cancer Imaging and Phototherapy

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S504CD

Participants
Defan Yao, Shanghai, China (*Presenter*) Nothing to Disclose
Yanshu Wang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Dengbin Wang, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Metastasis is the primary cause of death in breast cancer patients. Early diagnosis of high-risk breast cancer, including metastasis, requires accurate imaging of tumor biomarker for tailoring appropriate interventional therapies. Increased fibronectin expression, a hallmark of epithelial-tomesenchymal transition, is associated with high-risk breast cancer and metastasis. A fibronectin-targeting dual-modal NIR-II fluorescent and photoacoustic nanoprobe is synthesised for breast cancer imaging and photothermal/photodynamic therapy (PTT/PDT).

METHOD AND MATERIALS

Organic NIR-II fluorescent squaraine dyes were achieved through an organic synthetic reaction. Encapsulation of the dyes in a polymer matrix yields nanodots showing a large absorptivity at 915 nm and an emission maximum near 1000 nm. Further decoration of the nanodots with a penta-peptide CREKA (Cys-Arg-Glu-Lys-Ala) yields targeted nanodots, SQ@DSPE, which binds to fibronectin that are abundant in the tumour microenvironment of fast-growing breast cancer.

RESULTS

The nanodots SQ@DSPE showed a large absorptivity at 915 nm and an emission maximum near 1000 nm. The large NIR absorptivity of the nanodots facilitates NIR-I photoacoustic imaging and NIR-II fluorescence imaging. We find that the targeted nanodots could be used as deep intravascular contrast and provides robust signal enhancement in high-risk breast cancer, including metastasis. The photothermal conversion behavior and photodynamic activity of the nanodots enables PTT/PDT of breast cancer.

CONCLUSION

We report the NIR-II fluorescent molecule for dual fluorescence and photoacoustic imaging. The formulated nanodots have been successfully used for dual NIR-II fluorescence and NIR-I photoacoustic imaging for precise noninvasive angiography. The synergetic bimodal imaging with targeting CREKA-decorated nanodots showed precise breast cancer-tumor diagnosis with good specificity and high sensitivity. Collectively, the bright nanodots hold great promise for monitoring and visualizing vascular and breast tissue abnormalities.

CLINICAL RELEVANCE/APPLICATION

This research demonstrates the promise of NIR-II molecules and nanodots in dual-modal NIR-II fluorescence and NIR-I photoacoustic imaging for early detection of high-risk breast cancer and metastasis.

SSJ14-05 Radiosynthesis and Initial Evaluation of [11C]AG-488: Novel Dual-Targeted Anti-GBM Agent

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S504CD

Participants
Patrick Carberry, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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Akiva Mintz, MD, PhD, Paramus, NJ (*Presenter*) Consultant, Regeneron Pharmaceuticals, Inc

PURPOSE

PET imaging plays a critical role in the diagnosis of disease. Our goal is to extend its use into the drug development arena by radiolabeling experimental therapeutics and studying their biodistribution in hard to reach malignancies like brain cancer. Glioblastoma (GBM) is malignant Grade IV brain cancer that is invariably fatal with a median survival of about 14 months. Chemotherapy and novel molecular strategies often fail due to the inability of drugs to pass through the BBB. Thus, PET offers a real-time tool to evaluate drug kinetics and tumor access. AG-488 (FLAG-003) is a novel ligand with established anti-angiogenetic and anti-microtubule properties in tumor cells and murine models of cancer. In preclinical models of GBM, AG-488 has been shown to reduce tumor volume and prolong survival and is in early stage clinical trials. The goal of this work is to radiolabel AG-488 with the positron emitter 11C and demonstrate BBB permeability of this novel drug.

METHOD AND MATERIALS

The radiochemical synthesis of [11C]AG-488 was optimized reacting [11C]CH3I in a GE FxMeI module. MicroPET/CT were obtained dynamically for 60 minutes following IV injection of 50-100µl of [11C]AG-488. Image analysis was performed on PMOD software.

RESULTS

[11C]AG-488 was obtained in high radiochemical purity (>98%) and specific activity (2.5+/-0.5 Ci/mmol) in 30+/-5% radiochemical yield, decay corrected to EOS. MicroPET imaging revealed distribution in the heart, lungs and liver as well as good BBB penetration, manifested by increased initial tracer uptake and significant retention in the brain over time, similar to what is seen in our previous work with microtubule-specific tracers.

CONCLUSION

[11C]AG-488 can be synthesized with a high purity and yield and significantly crosses the BBB. We anticipate using [11C]AG-488 to help expedite the development of this novel dual-target drug as well as a potential companion diagnostic. We are therefore planning on further studying [11C]AG-488 in various orthotopic GBM models.

CLINICAL RELEVANCE/APPLICATION

AG-488 is a novel dual action drug that is being tested on high grade glioma, a devestating disease. We succesfully synthesized [11C]AG-488 to demonstrate blood brain barrier penetration on PET imaging and are studying its use to diagnose and stratify GBM patients.

SSJ14-06 First-In-Human Imaging of 89Zr-Daratumumab for CD38 Targeted Imaging of Myeloma

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S504CD

Participants
Gary A. Ulaner, MD,PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd; Research support, Novartis AG; Research support and Consultant, sanofi-aventis Group; Research support, sanofi-aventis Group
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PURPOSE

CD38 is an established therapeutic target in multiple myeloma that is expressed at high density by almost all myeloma cells. Daratumumab is an FDA-approved therapeutic antibody that binds directly to CD38. Our objective was first-in-huma imaging with 89Zr-radiolabeled daratumumab for CD38-targeted imaging of myeloma.

METHOD AND MATERIALS

Ten myeloma patients received 2 mCi of intravenous 89Zr-DFO-daratumumab in 20 or 50 mg of total antibody mass. Each patient underwent 4 PET/CT scans over the next 8 days, as well as blood draws and whole-body counts, to determine tracer biodistribution, pharmacokinetics, and radiation dosimetry.

RESULTS

Phase I first-in-human 89Zr-DFO-daratumumab PET/CT imaging demonstrated distribution in the blood pool, liver and spleen. A total antibody mass of 20 or 50 mg provided successful immunoPET imaging, while 3 mg total antibody mass demonstrated excessive background accumulation of tracer in the bone marrow, liver, and spleen. Imaging on days 5-8 provided superior tumor-to-background ratios than on days 1-4. Focal 89Zr-DFO-daratumumab uptake was visualized in previously known as well as unknown sites of osseous myeloma, consistent with successful CD38-targeted immunoPET imaging of myeloma in human patients.

CONCLUSION

89Zr-DFO-daratumumab provides successful whole-body PET visualization of myeloma in a first-in-human phase I trial of myeloma patients.

CLINICAL RELEVANCE/APPLICATION

This novel PET antibody will be tested for its potential to provide sensitive detection of myeloma, determine minimal residual disease

This novel PET antibody will be tested for its potential to provide sensitive detection of myeloma, determine minimal residual disease (MRD) status after completion of therapy, predict the effectiveness of daratumumab therapy, and serve as the basis of theranostic constructs for patients with myeloma.

Printed on: 10/29/20

SSJ15

Musculoskeletal (Muscle, Tendon, and Nerve)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E353C

MK

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

Participants
Theodore T. Miller, MD, New York, NY (*Moderator*) Nothing to Disclose
Antonio Barile, MD, L'Aquila, Italy (*Moderator*) Nothing to Disclose

Sub-Events

SSJ15-01 Quantitative Muscle Microstructural Changes Detected with Diffusion Tensor Imaging following Acute Hamstring Strain Injuries

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E353C

Participants
Christa Wille, Madison, WI (*Presenter*) Nothing to Disclose
Samuel A. Hurley, PhD , Madison, WI (*Abstract Co-Author*) Nothing to Disclose
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Bryan C. Heiderscheit, PhD, Madison, WI (*Abstract Co-Author*) Research Consultant, Altec, Inc;
Richard Kijowski, MD, Verona, WI (*Abstract Co-Author*) Research support, General Electric Company; Consultant, Boston Imaging Core Lab, LLC

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PURPOSE

The purpose of this investigation was to quantify changes in muscle microstructure following acute hamstring strain injury (HSI).

METHOD AND MATERIALS

Collegiate athletes with an HSI (n=16) underwent a magnetic resonance image (MRI) exam of the bilateral thighs using a GE MR750 3.0T scanner and 32-channel torso coil at a mean of 4 (± 2.5) days following injury. MRI exam included coronal and axial fat-suppressed T2-weighted fat/water IDEAL scan (44 cm FOV, 256x256, 44 slices, 4 mm thk, 5 mm gap; TR/TE 7418/86.8 ms) to identify regions of edema and axial DTI sequences. Diffusion weighted images were acquired with b=500 s/mm2, 30 directions, 6 b=0 volumes (48 cm FOV, 160x160, 72 slices, 3 mm thk; TR/TE 5770/51.1 ms), and repeated with reversed phase-encode direction. Distortion, eddy current, and motion correction were performed using FSL TOPUP and EDDY (FMRIB Software Library). Axial parameter maps of fractional anisotropy (FA), mean diffusivity (MD), radial diffusivity (RD), and principal effective diffusivity eigenvalues ($\lambda 1$, $\lambda 2$, $\lambda 3$) were created. Deterministic streamline tractography was performed using Euler integration with a step size of 0.1 mm (stopping criteria: 45° curvature and 0.20 FA thresholds). Mean DTI-parameters were identified for regions of injury within contractile muscle tissue using manual segmentation and compared to identical regions on the uninvolved limb with a Mann-Whitney-U test.

RESULTS

DTI-parameters demonstrate a significant decrease in FA ($p=0.046$) and significant increase in MD ($p=0.025$), RD ($p<0.01$), $\lambda 2$ ($p=0.021$), and $\lambda 3$ ($p<0.01$) in the region of injury compared to the mirrored region of normal muscle. Tractography from a selected subject demonstrates the effects of reduced FA on the involved limb (right) with fewer continuous fiber tracts present within the region of injury (purple) compared to the mirrored region of normal muscle on the uninvolved limb.

CONCLUSION

Significant muscle microstructural changes are detectable using DTI in athletes following an HSI. Decreased FA and increased diffusivity in regions of injured muscle indicate less restricted water diffusion, likely due to disruption of muscle fibers following injury.

CLINICAL RELEVANCE/APPLICATION

DTI-parameters can quantify microstructural changes in injured muscle and may have potential in guiding effective treatment following HSI.

SSJ15-02 Comparison of Quantitative MRI Parameters and Shear Wave Ultrasound Parameters of the Patellar Tendon in Subjects with Patellar Tendinopathy

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E353C

Participants
Richard Kijowski, MD, Verona, WI (*Presenter*) Research support, General Electric Company; Consultant, Boston Imaging Core Lab, LLC

Robert Moskwa, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Kenneth S. Lee, MD, Madison, WI (*Abstract Co-Author*) Grant, General Electric Company; Grant, National Basketball Association; Grant, Johnson & Johnson; Research support, SuperSonic Imagine; Royalties, Reed Elsevier
Ryan C. Sieve, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
John J. Wilson, MD, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Fang Liu, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare quantitative MRI parameters and shear wave ultrasound parameters of the patellar tendon in subjects with patellar tendinopathy.

METHOD AND MATERIALS

The study group consisted of 15 subjects with clinically diagnosed patellar tendinopathy of a single knee with no current or past symptoms of patellar tendinopathy of the contralateral knee. Shear wave ultrasound of the proximal patellar tendon of both knees was performed. The difference in shear wave speed between the asymptomatic and symptomatic knee (DIFSWS) was used as a proxy for loss of mechanical stiffness of the symptomatic patellar tendon due to tendon degeneration. An ultra-short echo-time (UTE) T2* mapping sequence using 16 echoes between 0.03ms and 35ms was performed on the symptomatic knee on a 3T scanner (GE Healthcare, Waukasha, WI). Single-component T2* relaxation time (T2*Single) and multi-component T2* parameters including the fraction of the fast relaxing macromolecular bound water component (FF) and the T2* relaxation time of the fast relaxing macromolecular bound water component (T2*F) and the slow relaxing bulk water component (T2*S) were measured in the proximal patellar tendon. Pain and disabiility in the symptomatic knee was assessed using the Tegner-Lysholm questionnaire. Pearson correlation coefficients were used to detemine the association between quantitative MRI parameters and DIFSWS and Tegner-Lysholm score.

RESULTS

There was a significant positive moderate association between T2*Single and DIFSWS (rho=0.668 and p<0.01). There was a significant positive moderate association between T2*F and DIFSWS (rho=0.608 and p=0.01) and between T2*F and Tegner-Lysholm score (rho=0.525 and p=0.04) (Figure 1). There was no significant association between FF and T2*S and DIFSWS (rho=0.039-0.043 and p=0.89-0.91) and between T2*Single, FF, and T2*s and Tegner-Lysholm score (rho=0.061-0.447 and p=0.09-0.83).

CONCLUSION

Increases in T2*Single and T2*F of the proximal patellar tendon in subjects with patellar tendinopathy were associated with loss of tendon stiffness with increases in T2*F also associated with increased pain and disability.

CLINICAL RELEVANCE/APPLICATION

Increased T2* relaxation time of fast relaxing macromolecular bound water of the patellar tendon measured using quantitative MRI in subjects with patellar tendinopathy is associated with loss of tendon stiffness measured using shear wave ultrasound and increased pain and disability.

SSJ15-03 Spontaneous Anterior Interosseous Nerve Syndrome (AINS) is a Fascicular Disease of the Median Nerve

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E353C

Participants
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Joseph Feinberg, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ogonna K. Nwawka, MD, New York, NY (*Abstract Co-Author*) Research Grant, General Electric Company
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PURPOSE

To test the hypotheses that (1) hourglass constrictions (HGCs) are present within the anterior interosseous nerve (AIN) fascicular group of the median nerve near the humeral medial epicondyle (ME) and (2) there is no extrinsic compression of the AIN or median nerve within the arm or forearm.

METHOD AND MATERIALS

At 2 different sites, a radiologist and neurologist (each with 5-6 years of dedicated peripheral nerve imaging experience) analyzed MRI (n=22) and ultrasound (US, n=23) neurography exams, respectively, to evaluate the median nerve and AIN within the arm and forearm in patients with electrodiagnostically and/or clinically confirmed AINS. MRIs were acquired either at 3 T (n=18) or 1.5 T (n=4) with a 16-channel flexible receive-only coil using multiplanar T2-weighted fat suppression and proton density pulse sequences, including at least 1 axial plane orthogonal to the median nerve. US was performed by the interpreting neurologist with an 18-5 MHz transducer; the median nerve was scanned in cross-section from the wrist to axilla and in areas of abnormality, longitudinal scans were additionally obtained.

RESULTS

Fascicular HGCs of the median nerve proper were identified in all MRI cases, and constrictions and/or swelling were identified in 87% of US cases. On MRI, HGCs were located a mean of 2.4 cm proximal to the ME, at posterior/posteromedial (68%, mean 1.7 cm, expected location of the AIN fascicle), anterior/anteromedial (19%, mean 5.3 cm, expected location of pronator teres/flexor carpi radialis fascicle), posterolateral (5%, mean 1.0 cm), and anterolateral (8%, mean 3.4 cm) locations. On US, HGCs were located a mean of 4.5 cm proximal to the ME, at posterior/posteromedial (55%, mean 4.3 cm), medial (36%, mean 5.0 cm), and posterolateral

(9%, mean 4.0 cm) locations. No extrinsic compressive site or mass of the median nerve or AIN within the arm/forearm was identified.

CONCLUSION

HGCs of the AIN fascicular group of the median nerve are the hallmark imaging finding in AINS, demonstrating the same phenotype seen in other affected nerves in PTS. There is no imaging evidence of extrinsic compression of the median nerve or AIN in AINS.

CLINICAL RELEVANCE/APPLICATION

This study defines an anatomic range where fascicular HGCs of the median nerve are found in patients with anterior interosseous nerve syndrome, which will aid in its diagnosis and potential treatment.

SSJ15-04 High Resolution Ultrasound Evaluation of Peripheral Nerves in Patients with Diabetic Polyneuropathy

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E353C

Participants
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PURPOSE

To determine the role of high resolution ultrasound(HRUS) for screening of Diabetic polyneuropathy(DPN) by evaluation of nerve cross sectional area(CSA)

METHOD AND MATERIALS

In this IRB approved case-control study, thirty DPN cases and thirty matched healthy controls were taken. The diagnosis of DPN was based on at least one symptom/sign of neuropathy in type II diabetes patient and one abnormal nerve conduction study (NCS) parameter measured in two separate nerves. DPN severity was determined by the Toronto Clinical Neuropathy Score (TCNS). Using an 8-18 MHz ultrasound (US) transducer peripheral nerve CSAs were measured bilaterally in both the cases and controls. Four nerves were included in the study and their CSAs were recorded at specific sites; median nerve(MN) at three sites- carpal tunnel inlet(CrTI), 5cm proximal to wrist and at antecubital fossa(ACF), ulnar nerve (UN) at three sites-wrist, cubital tunnel inlet and cubital tunnel outlet (CbTO), tibial nerve (TN) at medial malleolus and sural nerve(SN) at midcalf. Statistical tests were applied to compare the nerve CSAs between cases and control groups. CSA was also compared in relation to TCNS and NCS parameters (conduction velocity, latency and amplitude).

RESULTS

The mean CSAs of MN at CrTI, UN at wrist and CbTO, TN and SN were significantly larger in DPN cases. CSAs ROC cut-offs for MN at CTI, TN and SN showed good accuracy (AUC> 0.80, sensitivity 83-96%, specificity 70-83%), and for UN at wrist and CTO was even higher (AUC>0.96, sensitivity 86-96%, specificity 90-96%). Significant correlation was obtained between nerve conduction velocities and CSAs of MN at forearm, MN at ACF and UN at wrist, with r values of -0.38, -0.37 and -0.36 respectively ($p<0.05$). Significant correlations were found between nerve amplitude and CSA of MN at CrTI ($r=-0.42$) and between TCNS and CSA of SN ($r=.52$), $p<0.05$ for both.

CONCLUSION

The nerve size in patients with DPN is significantly larger as compared to normal controls with ulnar nerve CSA showing the highest diagnostic accuracy. Significant correlation between nerve thickness and NCS parameters facilitates HRUS as an efficient screening tool for DPN.

CLINICAL RELEVANCE/APPLICATION

DPN is very common and HRUS may serve as a non-invasive and low- cost screening tool especially in patients with severe DPN where NCS is not helpful as the nerves may be unexcitable.

SSJ15-05 Tissue Characterization Using Quantitative Acoustic Radiation Force Impulse Elastography (ARFI) in Athletes with Different Experience in Self-Myofascial Release

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E353C

Participants
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PURPOSE

Self-myofascial release using foam rolling (FR) has been developed into a popular preventive and recovery intervention and has been established in various sports disciplines. However, its effects on target tissue with regard to changes in stiffness properties are still poorly understood. The aim of this study was to investigate the role of foam rolling on muscle and ligament stiffness.

METHOD AND MATERIALS

Acoustic radiation force impulse elastography (ARFI) was performed in 40 volunteers (20 with more than 6 months of experience in foam rolling and 20 without any experience) before and several times (0 min, 30 min, 60 min, 120 min, 12 h and 24 h) after a standardized foam rolling exercise of the lateral thigh. The exercise protocol included 5 sets, each with 45 seconds foam rolling on the lateral thigh (20 seconds of rest between each set). Tissue stiffness was assessed at different compartments of the lateral thigh including superficial and deep muscle tissue (vastus lateralis muscle, VL; vastus intermedius, VI) and connective tissue (distal insertion of the iliotibial band, ITB).

RESULTS

Tissue stiffness of the ITB revealed a significant decrease in experienced athletes directly after the intervention (p=0.02) and 30 min post-intervention (p=0.02). No significant changes at the ITB were observed in non-experienced athletes. For VL and VI no significant changes were detected at any time point in both groups.

CONCLUSION

A significant short-term decrease of connective tissue stiffness in experienced athletes is detectable with ARFI, which may have an impact on biomechanical output of the fascia. Recommendations for self-myofascial release with foam rolling therapy have to be taken in consideration of athletes' experience and whether decreased tissue stiffness is required.

CLINICAL RELEVANCE/APPLICATION

ARFI seems to be an applicable tool for systematic assessment of tissue stiffness of different physical therapy approaches, e.g. tissue stiffness of the ITB in patients with ITB-syndrome.

SSJ15-06 Permanent and Non-Permanent Changes of Skeletal Muscle Diffusion Properties in Triathletes and Non-Athletes Detected by Diffusion Tensor Imaging and T2 Mapping

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E353C

Participants
Sarah Keller, MD, Berlin, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

Diffusion tensor imaging (DTI) of the skeletal muscle gives quantitative information in various conditions such as aging, exercise injury, and training. The aim of this study was to quantify changes in the skeletal muscle microstructure caused by i) Daily endurance training of triathletes (timepoint 1) in comparison to gender-matched healthy controls. ii) Active exercise due to participation at a triathlon (timepoint 2) in a cross-over intrasubject comparison to quantitates of timepoint 1 (i).

METHOD AND MATERIALS

In total N=22 triathletes (male:female 16:6; age (SD) 43.2 (11.5) years) and N=23 controls (male:female 16:7; age (SD) 38.2 (14.4) years) were sampled. Out of these 22 triathletes, N=12 (m:f 8:4) participated in a post-triathlon MRI examination, which was performed within three hours after the race. The MRI scan was performed at 3 Tesla using a fat-suppressed single-shot SE-EPI sequence. The DTI-parameters mean diffusivity (MD), fractional anisotropy (FA), and eigenvalues (λ1-3), as well as T2 times, were calculated using Osirix (v9.5 DTImap plugin; v1.6 and T2 fit map). The muscle fat fraction (MFF) was calculated using axial 3D GRE modified two-point Dixon-based MRI (2pt-MRIDIXON). Regions-of-interests (ROIs) were chosen at midthigh level for rectus femoris (RF), biceps femoris (BF), adductor magnus (AM), semitendinosus (ST), and semimembranosus muscle (SM), avoiding areas of a suspected muscle strain on T2 images.

RESULTS

At timepoint 1 the T2 relaxation times of male triathletes were significantly increased in RF, BF, ST, and SM muscles and the MD and the eigenvalue λ2 and λ3 were significantly decreased in RF muscles compared to controls. At timepoint 2 the MD and one or two of the eigenvalues λ1 and λ3 were significantly increased in AM, BF, ST, and SM muscles of male triathletes compared to the baseline measurements at timepoint 1, the T2 times remained unchanged. Similar trends at both timepoints were observed in female triathletes, however without statistical significance.

CONCLUSION

The combined assessment of quantitative T2 and DTI parameters provides insight into changes of the muscle microstructure caused by endurance training and active exercise.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates that endurance-training and active exercise triggered, gender-specific effects in the skeletal muscle microstructure can be quantified by quantiative multiparametric MRI.

SSJ16

Musculoskeletal (Knee)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E353A

MR MK

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

FDA Discussions may include off-label uses.

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Sub-Events

SSJ16-01 Comparing Clinical and Semi-Quantitative Cartilage Grading in Predicting Outcomes After Arthroscopic Partial Meniscectomy

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E353A

Participants
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PURPOSE

Cartilage loss on preoperative knee MRI is a predictor of poor outcomes after arthroscopic partial meniscectomy (APM). Previous studies have used time-intensive MRI grading systems which are not amenable for routine clinical use. The ability to predict outcomes with a clinically used grading system has not been studied. This study's purpose was to compare the ability to predict outcomes after APM with cartilage loss graded using a clinically used modified Outerbridge system and a semi-quantitative MOAKS (MRI Osteoarthritis Knee Score) system.

METHOD AND MATERIALS

Cases were randomly selected meeting the following criteria: 1. Preoperative knee MRI performed within 6 months of APM surgery 2. Outcomes measured at the time of surgery and 1 year after surgery. Surgical failure was defined as a less than 10 point improvement in the Knee Osteoarthritis Pain Score (KOOSpain). Cases were independently evaluated by 2 musculoskeletal (MSK) radiologists and 1 radiology fellow using both grading systems. Accuracy of each system in discriminating success and failure was estimated using area under the ROC (AUC) with 95% confidence intervals. A Wald test was used to test non-inferiority of the clinical grading system to MOAKs. Inter-reader agreement of two grading systems in predicting outcomes was also compared.

RESULTS

80 cases from 78 patients (38 females and 40 males) with mean age of 56.6 years (range of 45-77) were studied. 21 patients (27%) were surgical failures. At least Grade 2 (< 50% cartilage thickness loss) ranged from 23.3% (lateral tibial plateau) to 52.5% (medial femoral condyle) of the observations. Prediction model using clinical grading (AUC = 0.695 [0.566, 0.824]) was non-inferior (p = 0.047) to MOAKS grading (AUC = 0.683 [0.539, 0.812]). Both MRI prediction models performed better than a model with only demographics (AUC = 0.667 [0.522, 0.812]. Inter-reader agreement with clinical grading (80.8%) was significantly higher (P = 0.012) than with MOAKS (65%).

CONCLUSION

Cartilage loss graded on MRI with a clinically used system has similar ability in predicting outcomes after APM compared to a semi-quantitative system with significantly better inter-reader agreement.

CLINICAL RELEVANCE/APPLICATION

The ability to use a clinical MRI cartilage grading system to predict outcomes after APM allows for the development of point of care prediction tools from routine MRI readings.

SSJ16-02 Deep Convolutional Neural Network-Based Detection of Meniscus Tears: Comparison with Radiologists and Surgery as Standard of Reference

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E353A

Participants
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PURPOSE

To evaluate a novel fully automated deep convolutional neural network (DCNN) for detection of meniscus tears.

METHOD AND MATERIALS

This retrospective study was approved by the local ethics committee. We included 100 patients, who had undergone MRI and arthroscopy of the knee in our institution. All MRI studies were evaluated for medial and lateral meniscus tears by two musculoskeletal radiologists independently and by the DCNN. The surgical reports served as the standard of reference. Statistics included sensitivity, specificity, accuracy and ROC curve analysis as well as kappa-statistics.

RESULTS

Fifty-seven percent (57/100) of patients had a tear of the medial and 24% (24/100) of the lateral meniscus, including 12% (12/100) of patients with a tear of both menisci. For medial meniscus tear detection, the sensitivity, specificity and accuracy were for reader 1: 93%, 91%, and 92%, for reader 2: 96%, 86% and 92%, and for the DCNN: 84%, 88% and 86%. For lateral meniscus tear detection, the sensitivity, specificity, and accuracy were for reader 1: 71%, 95% and 89%, for reader: 2 67%, 99% and 91%, and for the DCNN: 58%, 92% and 84%. Sensitivity for medial meniscus tear detection was significantly different between reader 2 and the DCNN ($p=0.039$), no significant differences existed for all other comparisons (all $p >= 0.092$). The AUC-ROC of the DCNN was 0.882, 0.781 and 0.961 for detection of medial, lateral and overall meniscus tear. Inter-reader reliability was very good for the medial (kappa 0.876) and good for the lateral meniscus (kappa 0.741).

CONCLUSION

Our DCNN has the capability to detect tears of the medial and lateral meniscus in a fully automated fashion and with similar performances than radiologists.

CLINICAL RELEVANCE/APPLICATION

Fully automated detection of meniscus tears may decrease workload for radiologists and reduce health care costs.

SSJ16-03 ACL Graft Remodeling Revealed by Serial UTE-T2* MRI

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E353A

Participants
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PURPOSE

Evaluate changes over time in UTE T2* MRI relaxation times of implanted ACL grafts during graft healing/remodeling over the first year after ACL reconstruction.

METHOD AND MATERIALS

10 patients (ages 14-45 years) who underwent primary ACL reconstruction (ACLR) with or without meniscal injury. UTE-MRI evaluation at 1, 3, 6, 9, and 12 months after surgery. High-resolution 3D T2 scan (slice thickness: 0.6mm, TR: 18.7ms; TE: 11.5ms); Quad-echo UTE-T2 sequence (slice thickness: 1mm, TR: 20ms; TE: 0.3, 3, 6, and 9ms). The ACL-reconstructed knee was scanned at all 5 time points (1, 3, 6, 9, and 12 months), and the contralateral knee was imaged at 1 month. The region of interest (ROIs) for the ACL-reconstructed knee include the central 2/3 of the intra-articular portion of the ACL graft The region of interest for the contralateral uninjured knee included the ACL, patellar tendon (PT), and semitendinosus tendon (SemiT). At the 1-month time point for both injured and uninjured knees, each ROI was manually segmented from the surrounding tissues on the 3D T2 images using Mimics software (Materialise, Inc.; Belgium) (Figure 1). The 1-month segmentation masks were co-registered with the 4-echo UTE images obtained at each subsequent time point to ensure voxel-to-voxel anatomic matching of each segmentation mask. T2* relaxation times were calculated by fitting an exponential curve to the signal intensity data from the 4-echo UTE sequences. Mean T2* values for each ROI were calculated from all voxels within each ROI. Custom software was created using Python to extract average UTE-T2* values underlying each segmented ROI.

RESULTS

Mean T2* relaxation times for the ACL graft (Figure 2) increased over time, from 3.5 ms at 1 month to 5.4 ms at 6 months, with a statistically significant increase between 1 and 3 months ($p < 0.05$). Qualitatively, T2* relaxation times increased from near the values of the native SemiT tendon (2.2 ms) to approach that of the intact (contralateral) ACL (4.9 ms). Serial changes in T2* were not uniform throughout the graft substance (Figure 3). Remodeling appears to have begun near the tibial insertion site and progressed proximally towards the femoral insertion.

CONCLUSION

T2* values progressively increased over time, followed by regression towards the values of the intact native ACL.

CLINICAL RELEVANCE/APPLICATION

Early results show promise of UTE-T2 MRI for assessing ACL graft state.

SSJ16-04 Collagen Proton Fraction Estimated with Ultrashort Echo Time Magnetization Transfer (UTE-MT) MRI Modeling Correlates Well with Mechanical Properties of Cortical Bone

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E353A

Participants
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PURPOSE

To investigate the relationship between human cortical bone mechanics and the macromolecular proton fraction (MMF) obtained from ultrashort echo time magnetization transfer (UTE-MT) MRI modeling.

METHOD AND MATERIALS

156 cortical bone strips (~4×2×40 mm3) were harvested from the tibial and femoral midshafts of 43 donors (62±22 yo). Specimens were scanned using a 1-inch diameter T/R birdcage coil on a 3T clinical scanner (MR750, GE). The UTE-MRI scans involved: a) an actual flip angle imaging variable TR (AFI-VTR) sequence (AFI: TE=0.032; TRs=20, 100 ms; VTR: TE=0.032; TRs=20, 40, 100, and 150 ms; FA=45°) for T1 measurement (1), which is the prerequisite for the two-pool MT modeling, and b) a set of 3D-UTE-Cones-MT sequences (pulse power=400°, 600°, and 800°; frequency offset=2, 5, 10, 20, and 50kHz; FA=10°) for MT modeling (2-4). Other imaging parameters included: field of view=40×40mm2, matrix=160×160, slice-thickness=2mm. Afterwards, specimens were scanned using a Skyscan 1076 (Kontich, Belgium) µCT at 9 µm3 voxel size to measure bone porosity and bone mineral density (BMD). Finally, mechanical properties of the specimens were measured using 4-point bending tests. Pearson's correlation coefficients were calculated between MRI and µCT and mechanical properties.

RESULTS

Fig.1a shows the UTE-MRI image in axial plane at the middle of 20 bone strips with 4mm×2mm approximate cross-sections. Two representative specimens harvested from a 47-year-old male (I) and a 57-year-old female (II), respectively, are indicated with yellow rectangles. Fig.1b shows the corresponding µCT images. Figs.1c,d show corresponding MT modeling analyses. Figs. 1e-h show the scatterplots of Young's modulus, yield stress, ultimate stress, and failure energy on MMF, respectively. Young's modulus, yield stress, and ultimate stress demonstrated significant moderate correlations with MMF ($R=0.60$-0.61, $p<0.01$). MMF showed significant strong correlations with porosity ($R=0.72$) and BMD ($R=0.71$).

CONCLUSION

Significant correlations between bone MMF, mechanical properties, and microstructure suggest that the UTE-MT model can potentially serve as a novel tool to detect the variations of bone mechanics and microstructure.

CLINICAL RELEVANCE/APPLICATION

A UTE-MRI-based technique that correlates with bone mechanics and miscrostructure may be useful in future clinical studies for fracture risk estimation.

SSJ16-05 Reliability of a Novel Scoring System for Intraarticular Calcification of the Knee: BUCKS (Boston University Calcium Knee Score)

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E353A

Participants
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PURPOSE

Describe and assess the reliability of a novel computed tomography (CT)-based scoring system, the BUCKS (Boston University Calcium Knee Score) method, for assessing the burden and determining the localization of intra-articular mineralization.

METHOD AND MATERIALS

We included both knees from subjects of the most recent visit of the Multicenter Osteoarthritis Study (MOST), an NIH-funded longitudinal cohort of community-dwelling older adults with or at risk of knee osteoarthritis (OA). All subjects underwent CT scans of bilateral knees. For each knee, a musculoskeletal radiologist assessed the presence and severity of mineralization in cartilage, menisci, capsule and ligaments. Readings of a sample of 31 participants by the same reader and a second reader were repeated 12 later. The BUCKS method assesses 14 cartilaginous subregions and 6 meniscal segments (each meniscus was subdivided into 3 segments: anterior horn, body and posterior horn), similar to WORMS system. Cartilaginous subregions and meniscal segments were assigned a score ranging from 0-3 (figure). The joint capsule, bilateral posterior meniscal roots, 2 cruciate (ACL/PCL) and 2 collateral ligaments (MCL/LCL) were each scored 0 or 1 for absence or presence of mineralization. Vascular calcifications were scored 0-3.

RESULTS

Thirty one subjects (61 knees) were included. Mean age was 72.3 years (SD= 6.7, range=63-86). Mean BMI was 31.0 kg/m2 (SD 5.2). Sixty one percent (n=19) were female. Intra-articular calcium crystals were present on CT images of 50 knees, with 38 having articular cartilage calcifications and 35 having meniscal calcifications. Of the 61 knees, tibio-femoral Kellgren and Lawrence Grades were K&L=0 in 18 knees, K&L=1 in 13 knees, K&L=2 in 14 knees, K&L=3 in 12 knees and K&L=4 in 3 knees. The intra-reader reliability (weighted-kappa) ranged from 0.93 for ligaments to 0.94 for cartilage, 0.97 for vessels, 0.98 for meniscus, and 1.0 for joint capsule. The inter-reader reliability (weighted-kappa) ranged from 0.92 for cartilage to 0.95 for meniscus and vessels, and 1.0 for joint capsule and ligaments.

CONCLUSION

We have designed and described a novel scoring system for intraarticular mineralization of the knee, BUCKS, which shows excellent intra- and inter-reader reliability.

CLINICAL RELEVANCE/APPLICATION

BUCKS is a potentially useful tool for the understanding of the role of calcium crystals in knee OA.

SSJ16-06 Efficacy of Knee Unloader Bracing Evaluated with Quantitative MRI

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E353A

Participants
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PURPOSE

Unloader knee braces aim to shift the weight off the damaged compartment of the knee, and may offer pain reduction and delay time to surgery. Despite perceived benefits, the efficacy of bracing to reduce pain and preserve integrity of joint tissues, is under debate. The purpose of this study was to investigate if quantitative magnetic resonance imaging (qMRI) measures of bone marrow edema (BME; a pain correlate), cartilage, and meniscus are preserved after 9 months of unloader brace use in patients with osteoarthritis (OA).

METHOD AND MATERIALS

Patients with medial knee OA (n=4; 4 male; 50+/-13.4 yrs, mean+/-standard deviation) were imaged at 3T, before and 9 months after brace use. To evaluate BME, proton density fat suppressed images were processed to quantify the volume of high signal intensity within subchondral bone (Figure AB). To evaluate cartilage and meniscus, spin echo T2 map was acquired in sagittal plane, in the weight-bearing regions of lateral and medial tibiofemoral compartments. T2 values in tibial/femoral cartilage, and anterior/posterior meniscus, were determined (Figure C). Using repeated measures ANOVA, effects of brace use and knee compartment on BME and T2 values were assessed.

RESULTS

Initially, BME was found in 2 medial femoral condyles and all 4 medial tibial plateaus, with a mean volume of 1027+/-1103 mm3. After bracing, BME volume decreased by 82+9 % (p = 0.081). Changes in cartilage and meniscus T2 values are shown in Figure D. Femoral and tibial pooled cartilage T2 values (32.8+8 ms before, 32.6+5 ms after bracing) did not vary significantly with compartment (p=0.14) or bracing (p=0.9). Meniscus T2 values were initially higher (p=0.01) in the medial (17.4+5.4 ms) than lateral (12.8+3.5 ms) compartment but did not change after bracing (p=0.24).

CONCLUSION

In all patients, there was a decrease in BME volume without any new lesion development after 9 months of brace use. Despite small number of subjects, this data is promising, considering that without intervention, BME size may either decrease or increase.

CLINICAL RELEVANCE/APPLICATION

Combined with stable cartilage and meniscus T2 values, these results demonstrate the feasibility of using unloader brace to manage knee OA.

Printed on: 10/29/20

SSJ17

Nuclear Medicine (CNS Nuclear Medicine and PET)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S505AB

NM NR

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

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Sub-Events

SSJ17-01 Image-Based Deep-Learning Prediction of Amyloid Deposition Patterns Using Early Phase Imaging of Amyloid PET

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S505AB

Participants
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PURPOSE

This study is to develop an image-based deep-learning technique that generates predicted delay uptake patterns of amyloid PET using only early-phase images obtained after radiotracer injection.

METHOD AND MATERIALS

Deep-learning architecture was developed in a seven layer U-net convolutional neural network, units normalized by batch normalization, and activated by a rectified liner unit. [11C]PiB PET image sets were obtained from 259 subjects (age 67.3±8.0 yrs, 151 female) who underwent imaging at early (0-20 min) and delayed (50-70 min) time points. Additionally, an independent data set (20 subjects, age 67.4±8.7 yrs, 10 female) was used for testing the accuracy of future image prediction. The subjects included normal subjects, as well as Alzheimer's, Lewy body, and fronto-temporal dementias and mild cognitive impairment patients. Both volumetric PET images and NEUROSTAT/3D-SSP images were used for the analysis. By learning the relationship between the image at the early time point and the image at the delayed time point, the system performed the interpolation considering the relation and generated delayed images. In order to compensate for the small amount of data, a generative adversarial network (GAN) was used for learning.

RESULTS

The proposed technique achieved a root mean square percentage error (RMSPE) of 6.3%, peak signal-to-noise ratio (PSNR) of 21.8 dB, structural similarity index (SSIM) of 0.45 using NEUROSTAT/3D-SSP images to predict the delayed image based on the early image. These results shows that the predicted images are very similar to the real images.

CONCLUSION

This study has demonstrated the feasibility of an image-based deep-learning technique to predict delayed patterns of [11C]PiB PET uptake based on the early uptake. Such image-based prediction has not been well established in the past.

CLINICAL RELEVANCE/APPLICATION

This technique can predict delayed images from early images measured in a short time; hence it would contribute to saving measurement time and will benefit the patients, technicians and facilities.

SSJ17-02 Concordance between 18F-PI-2620 tau PET/MRI Imaging and Clinical Outcomes in Alzheimer Disease and Other Tauopathies

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S505AB

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

Primary pathology of Alzheimer disease (AD) includes both ß-amyloid and neurofibrillary tangles (NFT) of misfolded tau. Diagnosing tau pathology in vivo, and correlating pathology burden with clinical status, is crucial in diagnosing disease and in development of anti-tau therapy. The goal of this study was to 1) create a clinical protocol for evaluating a novel Tau PET ligand 18F-PI-2620 and 2) evaluate the concordance rate between radiologists and in comparison to clinical status.

METHOD AND MATERIALS

Per Braak staging, NFTs start in the entorhinal cortex in early stages (Braak 1-2), progress to the hippocampus (Braak 3-4) and lastly impact neocortex (Braak 5-6). Criteria for tau positivity was based on modified Braak staging, where Braak stages 1 & 2, 3 & 4, and 5 & 6 were collapsed into stage A, B, and C, respectively. Patients with no uptake were staged as 0. Tau positivity was determined based on visual uptake greater than off target regions. Two physicians were blinded to patient status, and independently evaluated the fused PET/MRI for 16 healthy older controls and 12 patients with mild cognitive impairment or dementia.

RESULTS

19, 2, 1, and 6 participants were classified as 0, A, B, and C, respectively. Using this staging, there was 89.2% agreement rate between readers (Cohen's kappa coefficient of 0.78, standard error=0.12). The greatest disagreement was for intermediate levels corresponding to Braak 3-4. Off target uptake included the substantia nigra, venous sinuses, the nasal sinuses, and choroid plexuses.

CONCLUSION

Overall, tau imaging with PI2620 is promising clinically, using modified Braak staging. Longitudinal imaging and confirmation with histopathology is needed to fully validate this tracer and understand whether Tau PET will be useful to track disease progression.

CLINICAL RELEVANCE/APPLICATION

As anti-tau therapy is developed for Alzheimer's and other tauopathies, 18F-PI-2620 PET/MRI seems a promising candidate for quantifying disease burden in vivo.

SSJ17-03 Hybrid PET-MR Imaging in Neurodegenerative Disorders: Are Age-Matched Controls Needed to Evaluate FDG Hypometabolism Patterns?

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S505AB

Participants
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PURPOSE

Neurodegenerative disorders demonstrate lobar patterns of parenchymal volume loss with associated decreased glucose metabolism. Limited data exists comparing semi-quantitative metabolic fluorodeoxyglucose (FDG) uptake on PET/MR imaging in patients with suspected dementia using an age-matched or non-age matched control brain atlas. This retrospective study compares semi-quantitative Z-scores provided by MIM Software in PET/MRI imaging of suspected dementia patients utilizing an age-matched versus non-age matched brain atlas.

METHOD AND MATERIALS

70 patients (37 female, 33 male, mean age 70) with suspected neurodegenerative disorder underwent hybrid FDG PET/MRI brain imaging. Patients were categorized by dementia subtype into Alzheimer's disease (AD), Frontotemporal dementia (FTD), and Lewy

Body Dementia (LBD). A Z score subset was obtained both in comparison with age-matched controls (minimum of 5 controls +/- 5 years of age) and a non-age matched control brain atlas which included a total of 43 individuals (19 female, 24 male; mean age 63.8 +/- 10 years). A two-tailed paired T-test was performed to compare the corresponding average Z scores.

RESULTS

26 patients with suspected AD (mean age 70) had mean parietal lobe Z-score values of -1.82 and -1.68, when compared to age-matched (AMC) and non-age matched controls (NAMC), respectively (p = 0.82); temporal lobe Z scores when compared to AMC and NAMC were -1.15 and -1.35, respectively (p = 0.69). 31 patients with suspected FTD (mean age 72) had mean Z-score values in the frontal lobes of -1.09 and -1.21 when compared to AMC and NAMC, respectively (p = .78); temporal lobe Z scores were -0.55 and -0.74 when compared to AMC and NAMC (p = 0.55). 13 patients with suspected LBD (mean age 66) had mean occipital, parietal, and temporal lobe Z scores of -2.61, -1.85, and -0.77 for AMC and -2.46, -1.98, and -0.943 for NAMC, respectively [p-values for AMC versus NAMC in the occipital, parietal, and temporal lobe were 0.54, 0.92, and 0.67 respectively].

CONCLUSION

Our semi-quantitative PET/MRI approach to recognize lobar patterns of brain hypometabolism in patients with neurodegenerative disorders demonstrates no significant difference when comparing patients to AMC or NAMC.

CLINICAL RELEVANCE/APPLICATION

Without the need for age-matched controls, a semi-quantitative approach to dementia can be more easily applied in the routine assessment of patients with underlying neurodegenerative disease.

SSJ17-04 18F-FDG PET/CT in Immunocompetent Patients with Primary Central Nervous System Lymphoma: Differentiation from Glioblastoma and Correlation with DWI

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S505AB

Participants
Wen Jianbo, Shanghai , China (*Presenter*) Nothing to Disclose
Geng Daoying, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

18F-fluorodeoxyglucose (FDG) positron emission tomography (PET)/computed tomography (CT) is useful for the detection of cancerous lesions, and FDG uptake is related to the apparent diffusion coefficient (ADC) derived from diffusion-weighted imaging (DWI) of extracranial tumors. The purpose of our study was to investigate the ability of FDG PET/CT in distinguishing primary central nervous system lymphoma (PCNSL) from glioblastoma multiforme (GBM) and to explore the relationship between 18F-FDG uptake and the ADC in patients with PCNSL.

METHOD AND MATERIALS

We reviewed 92 patients (40 with PCNSL and 52 with GBM) who underwent FDG PET/CT scans at disease onset. The maximum standardized uptake value (SUVmax), tumor to normal contralateral cortex activity (T/N) ratio, SUVmean, metabolic tumor volume (MTV), and total lesion glycolysis (TLG) of tumor lesions were calculated. Receiver operating characteristic (ROC) curves were generated to determine the diagnostic performance for FDG PET-related parameters to differentiate PCNSL from GBM. Twenty-eight patients with PCNSL (with 34 lesions) also underwent diffusion-weighted imaging. Pearson's correlation analysis was used to assess the relation between SUV- and ADC-derived parameters.

RESULTS

The SUVmax, T/N ratio, SUVmean, and TLG values were significantly higher in PCNSL than in GBM. Comparative ROC analysis indicated that the SUVmax had a greater area under the curve (AUC) of 0.910 than the T/N ratio (0.905, P=.85), SUVmean (0.836, P=.0006), or TLG (0.641, P < 0.0001). The T/N ratio had the highest specificity (94.23%) for differentiating PCNSL from GBM, while the SUVmax had the most optimal sensitivity (92.31%). Further combined analysis of the indices did not significantly improve the AUC. Moderate inverse correlations between the SUVmax, SUVmean, TLG, and the ADC ratio (rADC) were found in PCNSLs (r=-0.526, P=.002; r=-0.504, P=.004; and r=-0.483, P=.006; respectively)

CONCLUSION

The SUVmax and T/N ratio may be reliable measures for differentiating PCNSLs from GBMs. Additionally, FDG metabolism indices were inversely proportional to the rADCs of PCNSL lesions.

CLINICAL RELEVANCE/APPLICATION

(dealing with PET CT) we found a potential benefit for combining PET and MRI scans for PCNSL lesions, as the ADC values on MRI and the intensity of 18F FDG uptake on PET may provide synergistic information on tumor aggressiveness and progno

SSJ17-05 Evaluation of 18F-trifluoromethylated D-cysteine as a Promising PET Tracer in Orthotopic C6 Glioma

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S505AB

Participants
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PURPOSE

To explore the potential application of 18F-trifluoromethylated D-cysteine (S-[18F]CF3-D-CYS), a new sulfur-containing amino acid

PET tracer in evaluating glioma in terms of tumor heterogeneity and boundaries.Further, compared its value with multiparametic MRI and 18F-FDG PET imaging.

METHOD AND MATERIALS

S-[18F]CF3-D-CYS was prepared from multi-step reactions. Small-animal PET imaging with S-[18F]CF3-D-CYS was performed on the same rats bearing orthotopic C6 glioma with 60-min dynamic scan and compared with 2-deoxy-2-[18F]fluoro-D-glucose ([18F]-FDG) and multiparametic MRI. The regions of interest were drawn on tumors and normal brain parenchyma. Further, we compared the imaging with histopathological examinations

RESULTS

Dynamic S-[18F]CF3-D-CYS PET imaging showed tumor uptake was at peak rapidly and then maintained plateau after 10 min p.i.. And there was an avid uptake in tumors and a much low uptake in normal brains in PET images with S-[18F]CF3-D-CYS, thus causing a high uptake ratio of tumor to control brain, which was higher than that in PET images with 18F-FDG (3.15 ± 0.37 vs 1.22 ± 0.05, $P < 0.0001$). S-[18F]CF3-D-CYS PET imaging also depicted clearer boundaries in glioma tumors than those 18F-FDG PET imaging depicted. The uptake extent of S-[18F]CF3-D-CYS was consistent with tumor cell density. Compared with multiparametic MRI, S-[18F]CF3-D-CYS PET imaging can give better differentiation between infiltrating tumor tissue and brain edema.

CONCLUSION

Compared with [18F]-FDG and MRI, S-[18F]CF3-D-CYS PET has an even clear tumor boundary and reflect the tumor heterogeneity. S-[18F]CF3-D-CYS PET might serve as a potential PET tracer with a good performance in diagnosis of glioma

CLINICAL RELEVANCE/APPLICATION

S-[18F]CF3-D-CYS PET is superior than [18F]-FDG and MRI in defining the glioma boundary and tumor heterogeneity and S-[18F]CF3-D-CYS might serve as a potential PET tracer for evaluating glioma.

SSJ17-06 Evaluation of the Potential Role of F-18 FDG PET as a Biomarker in Diagnosing Patients with Anti-Glutamic Acid Decarboxylase 65 (anti-GAD65) Associated Neurologic Disorders Including Stiff-Person Syndrome and Cerebellar Ataxia

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S505AB

Participants
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Lilja B. Solnes, MD, Baltimore, MD (*Abstract Co-Author*) Advisory Board, Progenics Pharmaceuticals, Inc

PURPOSE

To evaluate the role of F-18 FDG PET as a biomarker in anti-glutamic acid decarboxylase 65 (anti-GAD65) associated neurologic disorders including Stiff-person syndrome (SPS) and cerebellar ataxia (CA).

METHOD AND MATERIALS

30 patients with brain F-18 FDG PET who were diagnosed with Anti-GAD65 associated neurologic disorder were analyzed for brain uptake in 47 different clusters compared to 50 asymptomatic controls using NeuroQ™. Among the 30 patients, 19 had isolated SPS, 8 had isolated CA and 3 had co-existing SPS and CA. The whole-body F-18 FDG PET scans were used to subjectively evaluate muscular uptake for 50 patients with antiGAD65 neurologic disorders. ± 1.65 was considered as the threshold for abnormal Z scores.

RESULTS

The Z scores calculated based on the average of the first scan of patients with FBP/RAMP-FBP protocol showed hypermetabolic activity in areas including brain stem, right medial temporal cortex, right lentiform nucleus, right caudate nucleus, bilateral superior lateral temporal cortices, bilateral associative visual cortices, and left superior parietal cortex, while areas including bilateral inferior lateral posterior temporal cortices, left lateral anterior temporal cortex, bilateral middle frontal cortices, bilateral primary visual cortex, bilateral inferior frontal cortices, showed hypometabolic activity. Patients with SPS phenotype showed lower uptake in cerebellum and thalamus and higher uptake in left parietal cortex, while those with CA revealed hypermetabolism in cerebellum and thalamus and hypometabolism in the bilateral parietal cortices. 62% of the patients showed increased muscular uptake. The most common pattern was symmetric shoulder girdle involvement.

CONCLUSION

Anti-GAD65 neurologic disorders comprise rare disorders with evolving diagnostic criteria. Our results showed that thalamus, as well as parietal and cerebellar cortices, are able to distinguish patients with CA vs. those with SPS phenotype. According to literature, normal musculature shows 12.5% increase in FDG PET uptake while our study showed 62% abnormal muscle uptake among these patients. FDG PET has the potential to become a diagnostic biomarker for patients with anti-GAD associated neurologic disorders.

CLINICAL RELEVANCE/APPLICATION

Anti-GAD65 neurologic disorders do not have definitive diagnostic criteria. F-18 FDG PET has the potential to become a diagnostic biomarker for these disorders based on the brain and muscle uptake.

SSJ18

Neuroradiology (Traumatic Brain Injury)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S406B

ER NR

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

FDA Discussions may include off-label uses.

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Sub-Events

SSJ18-01 Detection of Cerebral Microbleeds in American Football Players Using SWI: A Comparison of 3T to 7T MRI

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S406B

Participants
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PURPOSE

American football players (AFP) experience repetitive brain trauma during their career and are at risk for developing a condition known as chronic traumatic encephalopathy. Cerebral microbleeds (CM) are a typical finding of repetitive brain trauma and diffuse axonal injury and show a frequency of about 9% in retired AFP (Casson IR et. al 2014). To our best knowledge all neuroimaging studies on CM in AFP have been performed on 1.5 or 3 T MRI. Ultrahigh field MRI with 7T shows significantly more CM in patients with diffuse axonal injury than 3 T SWI (Moenninghoff C et al 2015).The purpose of this study is to evaluate the diagnostic value of 7T SWI compared to 3T SWI for the detection of CM in AFP.

METHOD AND MATERIALS

Twelve professional AFP were enrolled in this prospective study (mean age: 23,4 years, range: 22-32 years, all male). All patients underwent a MRI scan with SWI imaging of the brain on 3T and 7T. Ultra-high field MR examinations were performed on a 7 T whole-body research system (Magnetom 7 T, Siemens AG, Germany). All examinations at 3 T were performed on a high-end clinical MR system (Magnetom Skyra, Siemens AG, Germany). Both MR systems were used in combination with 32-channel radiofrequency head coils. Image analyses were performed by two neuroradiologist in consensus reading on 3T MRI and on 7T MRI for number of CM and additional findings.

RESULTS

The readers identified a total of three CM in three different AFP in the 3T SWI (Fig. 1a). In the 7T SWI one of these CM was confirmed (Fig. 1b), moreover even two smaller adjacent CM were identified. The other two suspected CM at 3T in the other two AFP were identified at 7T as atypical small intracerebral veins (Fig. 1 c, d). As an additional finding a developmental venous anomaly (DVA) was found in one the AFP, which was well delineated in both 3T and 7T, whereas at 7T a more exact architecture of the DVA was definable.

CONCLUSION

7T SWI improves the depiction of CM. Moreover, 7T SWI allows a more accurate differentiation of lesions that were described as CM at 3T but identified as atypical venous blood vessels at 7T SWI.

CLINICAL RELEVANCE/APPLICATION

7T SWI could enable a more accurate detection of CM and help to understand pathophysiological processes in AFP, nevertheless larger studies at 7T are needed.

SSJ18-02 Influence of Callosal Microstructural Compromise on Interhemispheric Speed of Processing in Mild Traumatic Brain Injury

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S406B

Participants
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Yvonne W. Lui, MD, New York, NY (*Abstract Co-Author*) Research collaboration, Siemens AG; Advisor, Bold Brain Ventures

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PURPOSE

The corpus callosum (CC) is at specific risk in Mild Traumatic Brain Injury (MTBI) and critical for interhemispheric communication. Here we test the hypothesis that microstructural compromise as measured by diffusion MRI affects performance on a novel interhemispheric speed of processing task (IHSPT).

METHOD AND MATERIALS

The study is approved by the institutional review board. 36 MTBI subjects (11 male, 25 female; mean age 36 years) within 4 weeks of injury and 27 controls were included (12 male, 15 female; mean age 37 years). IHSPT measures latency over 80 trials between visual word stimulus presentation to the right vs left visual hemifield. Patients with positive IHSPT values were included (indicating probable left language dominance, necessitating information crossing the CC). Diffusion MRI was performed on 3T (Skyra,Siemens) with 5 b-values (up to 2.5ms/m2 with 60 directions). Diffusion metrics of fractional anisotropy, diffusivity and kurtosis (mean, radial and axial; MD, RD, AD, MK, RK, AK) were calculated as well as compartment-specific white matter microstructure metrics, including axonal water fraction (f), a measure of axon density, intra-axonal diffusion (Daxon), reflective of axonal integrity, and extracellular diffusion along and perpendicular to the axis of the axon (Depar and Dperp), sensitive to glial and inflammatory changes, and changes in myelination, respectively. Region-of-interest analysis was done using freesurfer segmentation of the CC. Relationship between IHSPT performance and diffusion measures was assessed using Pearson's partial correlation in both MTBI and control groups.

RESULTS

In controls, we found correlations between IHSPT and several diffusion measures all localizing to the splenium (MD,RD, AK, and Deperp; $p<0.05$), lost in MTBI subjects. MTBI subjects, on the other hand, showed significant correlations between IHSPT and kurtosis diffusion measures in the genu of the CC (MK, AK, and RK) (Table 1).

CONCLUSION

In MTBI subjects, we find a relationship between CC body microstructural complexity and IHSPT not seen in controls. Furthermore, the normal relationships seen in controls between tissue microstructure and interhemispheric processing are lost after MTBI.

CLINICAL RELEVANCE/APPLICATION

Understanding how white matter injury affects cognitive performance is the critical next step for better assessing MTBI patients. Here we show altered relationships between CC microstructure and specific IHSPT between MTBI patients and controls.

SSJ18-03 Subject-Specific White Matter Abnormalities in Chronic TBI Assessed by Biophysical Modeling Using Simultaneous Multi-Slice Multi-Shell Diffusion MRI

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S406B

Participants
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PURPOSE

Conventional diffusion tensor imaging (DTI), assuming Gaussian distribution of water molecule diffusion, is not able to infer the microstructures cofounded by the effects of fiber crossings and orientation dispersion. Subject-specific analysis is crucial in traumatic brain injury (TBI) care and long-term follow up. The goal of this study is to demonstrate the feasibility of mapping subject-specific white matter abnormalities in chronic TBI using non-Gaussian diffusion MRI (dMRI) reconstruction techniques.

METHOD AND MATERIALS

Participants included 181 active service members diagnosed with possible TBI (M/F=180/1, age=35.40 ±7.88 years) and 43 non-TBI controls (M/F=31/12, age=40.35±5.99 years). 3T dMRI with inter-slice acceleration factor of 3 and inter-plane acceleration of 2 was prescribed using three shells (270 directions in each shell, diffusion gradients=3K, 2K, 1K, isotropic 1.7 mm) scheme. dMRI was preprocessed using TORTOISE package. Diffusion metrics were then reconstructed using several non-Gaussian dMRI models, including bi-tensor free water DTI, mean apparent propagator MRI, neurite orientation dispersion and density imaging model and multi-compartment microscopic diffusion model using the Spherical Mean Technique. For voxel-wise subject-specific analyses, the group-wise means and the variances of the whole brain white matter of non-TBI controls were calculated after transforming to the MNI template and smoothing, and the Mahalanobis distance at each voxel was computed for the individual TBI subject, as well as leave-one-out approach for comparing individual control to the rest of controls.

RESULTS

Fig. 1 shows an example of the subject-specific analysis results of a mild TBI participant. There were no statistical difference of the total volumes of white matter anomalies between TBI and controls, though the TBI group tended to have a larger amount of anomalies.

CONCLUSION

Our results suggested that mapping microscopic features with methods that are not confounded by the effects of fiber crossings and orientation dispersion would have a better understanding of the complexity of axonal pathology in chronic TBI.

CLINICAL RELEVANCE/APPLICATION

Mapping subject-specific microstructural changes might help distinguishing the underlying pathology following brain injury, e.g. neuroinflammation vs axonal degeneration.

SSJ18-04 Relationship Of White Matter Microstructure To Working Memory Function As A Function Of Time-Since-Injury After Mild Traumatic Brain Injury: Diffusion MRI Study

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S406B

Participants
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PURPOSE

Cognitive complaints can be one of the most troubling and persistent symptoms after MTBI[1-2] and there is a need to better understand how working memory deficits[3] relate to detectable microstructural injuries. Here, we aim to discover robust biomarkers that allow for early identification of patients at highest risk of working memory impairments.

METHOD AND MATERIALS

We studied 19 MTBI(mean,30y.o) and 20 normal subjects(NC;mean,33y.o). Diffusion MRI was performed on 3T(Skyra,Siemens) with 5 b-values. Diffusion metrics of FA, diffusivity and kurtosis (mean/radial/axial) were calculated. Auditory-verbal working memory was assessed using WAIS-IV[4]:Digit Span Forward(DSF), Backward(DSB) and Sequencing(DSS), and Letter-Number Sequencing(LNS). Region-of-interest(ROI) analyses were performed to assess the relationship between diffusion measures and working memory performance using Pearson's partial correlation with age/sex as covariates(family-wise-corrected $p<0.05$). Subgroups were also defined according to their working memory performance and time-since-injury(Table2). Subgroup comparisons were done using MANCOVA with age as covariate.

RESULTS

There was a significant correlation between axial kurtosis(AK) and DSB in the right superior longitudinal fasciculus(SLF) in MTBI($r=0.69$), not present in NC(Table 1). In MTBI, we also found loss of the normal relationship between FA and LNS that was present in the right posterior corona radiata(pCR) in NC($r=0.67$). Time-since-injury and division of subjects into high/low performer groups(z-score=1) influenced some of the relationships between regional diffusion measures and performance on working memory(Fig.1).

CONCLUSION

We show differences in the relationship between diffusion measures and working memory performance in MTBI and healthy subjects. Furthermore, preliminary results suggest both time-since-injury and relative performance level on working memory provide additional insight into these relationships.

CLINICAL RELEVANCE/APPLICATION

Our study elucidates microstructural changes in relation to working memory after MTBI, and suggest the potential utility for early identification of patients with working memory deficits.

SSJ18-05 Region-Based Blood-Brain Barrier Disruption in Mild Traumatic Brain Injury: Quantification Using DCE MR Imaging and Automatic Segmentation Method

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S406B

Participants
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Roh-Eul Yoo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To explore region-based blood-brain barrier disruption in mild traumatic brain injury (mTBI) patients with post-concussion syndrome

(PCS) using quantitative dynamic contrast-enhanced (DCE) MR imaging parameters and automatic segmentation method and to explore its clinical implications.

METHOD AND MATERIALS

Forty-one consecutive patients with PCS after mTBI and 29 controls, who had undergone MR imaging including DCE MR imaging at our institution between October 2016 and April 2018, were included in this retrospective study. After performing 3D T1-based brain segmentation with the FreeSurfer software package, mean Ktrans values from DCE MR imaging (derived using Patlak model) were analyzed at bilateral cerebral/cerebellar white matters, bilateral cerebral/cerebellar gray matters, corpus callosum, and brainstem. The Mann-Whitney U-test was performed to compare mean Ktrans between mTBI patients and controls. Ktrans values were correlated with neuropsychological test results using Mann-Whitney U-test and Spearman rank correlation in mTBI patients.

RESULTS

The median Ktrans (x10-1min-1) at bilateral cerebral gray matters was significantly higher in mTBI patients (0.010 [interquartile range: 0.008-0.013]) than in controls (0.008 [interquartile range: 0.007-0.012]) (P = .042). Ktrans tended to be higher in both the subgroup with the time interval between injury and MR imaging of 3 months or less and those with the interval longer than 3 months. Ktrans at bilateral cerebral gray matters was significantly higher in patients with atypical performance in auditory continuous performance test (commission errors) than in those with average or good performance (P = .041). In ROC analysis, Ktrans at bilateral cerebral gray matters had a sensitivity of 89% and a specificity of 70% for differentiating the two groups at a cut-off value of 0.009x10-1min-1. Ktrans at other regions were not significantly different between mTBI patients and controls.

CONCLUSION

BBB disruption was observed throughout bilateral cerebral gray matters in mTBI with PCS and the extent of BBB disruption as reflected by Ktrans was greater in patients with atypical performance in a neurocognitive test.

CLINICAL RELEVANCE/APPLICATION

DCE MR imaging can clearly depict BBB disruption in mTBI patients with PCS and is recommended as part of a MR study for the patients with otherwise normal conventional MR imaging findings.

SSJ18-06 The Application of Delayed-Contrast MRI (DCM) for Depicting Subtle BBB Disruption in TBI

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S406B

Participants
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PURPOSE

TBI is a highly complex disorder caused by primary and secondary injury mechanisms. Alternations in gliovascular signaling are not established as a key secondary injury. Moreover, little is known regarding the long terms effects of BBB disruption. Here we studied the feasibility for applying DCM for depicting subtle BBB disruption in TBI and the correlation with histology of blood vessels coverage by astrocytes (BVCA).

METHOD AND MATERIALS

24 mice were followed by DCM 1/8/29/64/98 and 133 days post closed head injury. BBB disruption maps were calculated from the MRIs and BBB disruption levels in the lesions vicinity were calculated. Extracted brains were sectioned and stained for astrocytes and vessels. The percent of BVCA was calculated from samples within the lesion vicinity. In addition, 10 TBI mice and 6 controls were scanned 15 months post TBI, and 5 patients were scanned 1 year post TBI.

RESULTS

Significant BBB disruption levels were depicted in the maps in the lesion vicinity in all mice post TBI. Lesion volumes as depicted in the BBB maps up to 1 week post TBI were x2.5 larger than the enhancing volume on T1-Gd ($p<0.02$). Disruption levels decreased linearly with time between days 1 and 133 ($r2=0.93$, $p<0.002$). Significant correlation was found between the disruption level calculated from MRI and BVCA for the different time points ($r2=0.77$, $p<0.05$). When scanned 15 months post TBI, disruption levels depicted in the ipsilateral ventricle were significantly higher for TBI mice vs control ($p<0.03$). Preliminary clinical results in 5 TBI patients show subtle BBB disruption, undetectable by standard MRI, depicted for all patients. Initial analysis suggests several possible disruption patterns (local disruption in the brain tissue and the midline, local blood-CSF disruption, subarachnoid, ventricular and wide-spread).

CONCLUSION

DCM enables depiction of significant BBB disruption, with higher sensitivity than T1-Gd, up to long times post injury. Correlation between MRI-based disruption levels and BVCA observed in the animal model may be explained by alterations in gliovascular signaling resulting from TBI.

CLINICAL RELEVANCE/APPLICATION

DCM may be applied for depicting subtle BBB disruption induced by TBI up to long times post injury. This may be used for prognosis and treatment monitoring. The correlation with BVCA may be used to study the mechanism of secondary damage.

SSJ19

Neuroradiology/Head and Neck (Image Analysis, Non-Artificial Intelligence)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S404CD

HN NR

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

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSJ19-01 Development and Evaluation of a High-Resolution Structural Template for Studies in Older Adults

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S404CD

Participants
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PURPOSE

Human brain structural MRI templates with low spatial resolution lack important fine details due to partial volume effects. The purpose of this work was to introduce a novel approach for high-resolution template construction based on principles of super-resolution, and using this technique, to develop a high-resolution structural template of the older adult brain.

METHOD AND MATERIALS

T1-weighted brain MRI data from 222 non-demented older adults (65-95 age-range, male:female=1:1) participating in the Memory and Aging Project were used in this work. The raw images (1mm isotropic) were rigidly and non-linearly aligned in a 0.5mm resolution space. The resulting non-linear deformations were utilized to map the image intensities of the rigidly transformed 0.5mm resolution images to exact physical locations in the 0.5mm template space, eliminating interpolations that occur in conventional template-building method. The final intensity in each voxel in template space was calculated as the weighted average of the intensities contained in that voxel using a Gaussian kernel. The new template, referred to as IIT-Aging_0.5mm, was quantitatively compared to other high-resolution templates of the older and younger adult brain, in terms of image quality and in terms of the spatial normalization accuracy achieved when they are used as references for alignment of structural images from a large number of older adults.

RESULTS

The IIT-Aging_0.5mm template has higher image sharpness, exhibited by larger high spatial frequency content in the normalized power spectra. Fine structures were resolved in IIT-Aging_0.5mm compared to MCALT_0.5mm and IIT-Aging. Visual inspection revealed atypical brain features (artifacts) in the cortex of MCALT_0.5mm (red circles), which are not present in the other templates. The accuracy of inter-subject spatial normalization was higher when using IIT-Aging_0.5mm. The IIT-Aging and IIT-Aging_0.5mm templates required lower deformation.

CONCLUSION

The IIT-Aging_0.5mm template is a high-quality, high-resolution structural template of the older adult brain that provides higher spatial normalization accuracy than other templates, even for normalization of lower resolution older adult data.

CLINICAL RELEVANCE/APPLICATION

The IIT-Aging_0.5mm template is a high-resolution template containing important fine details of older adult brain and allows higher spatial normalization accuracy for normalization of older adult data

SSJ19-02 T1w and DTI Templates of the Older Adult Brain in a Common Space: Development and Evaluation

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S404CD

Participants
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PURPOSE

The demand for multimodal MRI atlas of the older adult brain is increasing as large amounts of data are generated in aging studies. This work developed high quality T1-weighted (T1w) and diffusion tensor imaging (DTI) templates of the older adult brain in the same space through a proposed iterative multimodal template construction strategy.

METHOD AND MATERIALS

T1w and DTI data were collected on 202 non-demented older adults (50% male,65.2-94.9 yrs) from Rush Memory and Aging Project. DTI data were aligned to the raw T1w images. In the proposed approach, each iteration has two steps. In step1, a temporary T1w template is generated and the resulting transformations are also applied to the DTI data. In step2, a temporary DTI template is generated and the resulting transformations are also applied to the T1w data. The quality of the templates at each iteration was assessed by the average standard deviation of normalized T1w data, the average pair-wise Euclidean distance of tensors (DTED) and the coherence of primary eigenvectors (COH). The spatial matching between the two templates was assessed by the Spearman's rank correlation between the white matter tissue probability map and the FA map. The final templates were compared with other templates in terms of spatial normalization accuracy when used as a reference for normalization of data from older adults. The average cross-correlation and standard deviation of normalized T1w data and the DTED and COH of normalized DTI data were compared.

RESULTS

It is shown that the spatial normalization of the T1w and DTI data used to construct the templates improves(p<10-10) and the spatial matching between the T1w and DTI templates also improves(p<10-10), suggesting better quality of the templates with more iterations. The final T1w and DTI templates in this work allow higher spatial normalization accuracy of data from older adults compared to other available templates(p<10-10).

CONCLUSION

This work proposed a new multimodal templates construction approach and generated T1w and DTI templates of the older adult brain in the same space, which allow better spatial normalization of T1w and DTI data from older adults compared to other available templates.

CLINICAL RELEVANCE/APPLICATION

The templates developed in this work allow higher spatial normalization accuracy of both T1w and DTI data from older adults in common space.

SSJ19-03 Enhanced White Matter Connectome of the IIT Human Brain Atlas

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S404CD

Participants
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PURPOSE

The purpose of this work was two-fold: a) to enhance the white matter connectome of the IIT Human Brain Atlas through an improved tractography strategy and use of more precisely defined gray matter labels and b) to evaluate how representative the new connectome is of young adult participants of the Human Connectome Project (HCP).

METHOD AND MATERIALS

Data: i) the HARDI and DTI templates of the IIT Human Brain Atlas (v.4.1), ii) more precisely defined gray matter labels generated for the atlas and iii) the structural and diffusion MRI preprocessed data of 20 unrelated young adult HCP participants with balanced sex and age. Connectome construction: Whole brain anatomically-constrained tractography, spherical-deconvolution informed filtering (SIFT), and 84 Desikan-Killiany regions were applied on the IIT HARDI template and 20 HCP datasets to generate 21 connectomes, each containing 6972 edges. Connectome evaluation: The streamlines of the edges survived filtering of each connectome were transformed to the other 20 connectome spaces by DTI registration and the tract density images (TDI) were generated. F1 scores for each edge's spatial volumes between one connectome and the other 20 connectomes were computed. Pearson's correlation coefficients were also computed for TDI maps between all 20 pairs. These processes were repeated for each connectome in their spaces and the F1 scores and the Pearson's correlations were averaged. One sample t-tests were used to test the IIT connectome if the average F1 score and Pearson's correlation were significantly different than those of the HCP participants.

RESULTS

TDI and edge density images of the new IIT connectome has shown good correspondence with other studies. The IIT connectome has no significantly different average F1 scores and significantly higher average Pearson's correlations (p<0.0001) than those of the HCP group over the different numbers of survived edge, indicating that the IIT connectome is representative of individual HCP connectomes.

CONCLUSION

A new version of the IIT white matter connectome was developed and compared to those of 20 young adult HCP participants. It was demonstrated that the IIT connectome is representative of individual HCP connectomes.

CLINICAL RELEVANCE/APPLICATION

The new IIT white matter connectome will facilitate atlas-based analyses of the whole brain connectome.

SSJ19-04 Multiscale Modeling of Intra-Regional and Inter-Regional Connectivities and Their Alterations in Major Depressive Disorder

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S404CD

Participants
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PURPOSE

Resting-state functional magnetic resonance imaging (rs-fMRI) studies have focused primarily on characterizing the connectivity among discrete brain regions. A major drawback is that it fails to provide a mechanistic understanding of brain cognitive function or dysfunction at cellular and circuit levels. To overcome this limitation, we developed a Multiscale Neural Model Inversion (MNMI) framework that linked microscale circuit interactions with macroscale network dynamics and estimated both local coupling and inter-regional connections based on blood oxygen-level dependent (BOLD) rs-fMRI.

METHOD AND MATERIALS

The fMRI data was obtained from a single-center, large-cohort first-episode, treatment-naïve MDD rs- fMRI database, consisting of 66 MDD adults and 66 matched normal controls (NC). We used biologically plausible Wilson-Cowan oscillators to model the dynamics of local neural circuits consisting of excitatory and inhibitory neural populations (Fig. 1). Different brain regions are connected via long-range fibers with initial strength estimated from their respective structural connectivity. The neural activity of each region was converted to BOLD signals with corresponding functional connectivity (FC) matrix using a hemodynamic model. The local and inter-regional connection parameters were optimized via stochastic optimization procedures to minimize the error between the simulated and the empirical FC matrices.

RESULTS

The recurrent excitation and inhibition within the dorsal lateral prefrontal cortex (dlPFC) were found to be reduced in MDD, consistent with the commonly accepted hypothetical model of MDD. In addition, recurrent excitation in the thalamus was found to be abnormally elevated, which may be responsible to abnormal thalamocortical oscillations often observed in MDD.

CONCLUSION

The MNMI framework was able to characterize potential intra-regional pathophysiological mechanisms of MDD, thus could be better than the conventional inter-regional FC analysis.

CLINICAL RELEVANCE/APPLICATION

Understanding impaired circuit dynamics via multiscale neural modeling helps to identify both biomarkers and pathologies of MDD, which is necessary to develop more effective diagnosis and treatment.

SSJ19-05 Carotid Plaque Vulnerability on Magnetic Resonance Imaging and Risk of Future Ischemic Events: A Systematic Review and Meta-Analysis

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S404CD

Participants
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PURPOSE

Magnetic resonance imaging (MRI) can characterize carotid plaque features, including intraplaque hemorrhage (IPH), lipid-rich necrotic core (LRNC), and thin-ruptured fibrous cap (TRFC), that have an increased tendency to cause future cerebrovascular ischemic events. We performed a systematic review and meta-analysis of studies evaluating the association of MRI-identified high-risk plaque features, including IPH, LRNC, and TRFC, with risks of subsequent ischemic events of stroke or transient ischemic attack

(TIA) over a follow up duration of >=3 months.

METHOD AND MATERIALS

Multiple databases were searched for relevant publications between January 2000 and December 2018. Studies reporting outcomes of future ischemic events of stroke or TIA for individual MRI-identified high-risk carotid plaque features over a follow up duration of >=3 months were included. Random effects meta-analysis was performed to estimate odds ratios (OR) and 95% confidence intervals (CI) comparing outcomes between MRI-positive and MRI-negative groups.

RESULTS

Fifteen studies including 2,350 patients were included (Figure). The annual rate of future ischemic events was 11.9% for MRI-positive IPH, 5.4% for LRNC, and 5.7% for TRFC. IPH, LRNC, and TRFC were associated with increased risk of future ischemic events (OR 6.37; 95%CI, 3.96 to 10.24), (OR 4.34; 95% CI, 1.65 to 11.42), and (OR 10.60, 95% CI 3.56 to 31.58); respectively.

CONCLUSION

The findings strengthen the assertion that MRI-positive 'high-risk' or 'vulnerable' plaque features, including IPH, LRNC, and/or TRFC can predict risks of future ischemic events of stroke or TIA.

CLINICAL RELEVANCE/APPLICATION

The current study findings lend support to the assertion that plaque morphological and compositional factors are extremely important in understanding the natural history of carotid atherosclerotic disease and should potentially be considered in guiding treatment for these patients.

SSJ19-06 Influence of Artifact Corrections on MRI Signal Intensity Ratios for Assessment of Gadolinium Brain Retention

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S404CD

Participants
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PURPOSE

To prospectively study the effect of flow artifact compensation and intensity inhomogeneity correction on brain signal intensity ratios in T1-weighted MR images in study participants who had previously received multiple doses of gadobutrol.

METHOD AND MATERIALS

This prospective study included 76 participants who received five or more gadobutrol-enhanced scans between 2007 and 2017. A control group of 25 participants without gadolinium-based contrast agent application in their history was included for comparison. Unenhanced brain MRI including two T1-weighted spin-echo sequences with and without flow artifact compensation was performed in all participants. Both sequences were reconstructed with and without intensity inhomogeneity correction and signal intensity ratios were assessed (dentate nucleus-to-pons and globus pallidus-to-thalamus ratios).

RESULTS

Using flow artifact compensation, a lower proportion of participants had to be excluded from the final analysis of the dentate nucleus-to-pons ratio due to flow artifacts (15 % versus 45 %, $p<0.001$). Without intensity inhomogeneity correction, a difference was found between the study and the control groups for the dentate nucleus-to-pons ratio ($p=0.004$), but not for the same sequence reconstructed with intensity inhomogeneity correction ($p=0.29$). For the globus pallidus-to-thalamus ratio, no difference was found between the study and control group.

CONCLUSION

The application of an intensity inhomogeneity correction algorithm has a significant impact on brain nucleus signal intensity ratios for the assessment of gadolinium brain retention.

CLINICAL RELEVANCE/APPLICATION

Differences in brain signal intensity ratios in T1-weighted MR images have beenreported as indicator of gadolinium brain retention.

SSJ20

Neuroradiology (Stroke 3)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S404AB

ER NR

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

Participants
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Seena Dehkharghani, MD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSJ20-01 Technical Outcomes and Early Experience of a Centrifugally-Trained Interventional Radiology Stroke Service

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S404AB

Participants
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Kelvin K. Hong, MD, Baltimore, MD (*Abstract Co-Author*) Scientific Advisory Board, Boston Scientific Corporation; Scientific Advisory Board, BTG International Ltd; Research support, BTG International Ltd;

PURPOSE

Despite level 1A evidence for efficacy, rapidly accessible IR stroke care is not universally available. Judicious establishment of new IR stroke centers is one approach to improve access to care. We describe the development of a centrifugally-trained IR stroke team and the initial year of independent practice.

METHOD AND MATERIALS

A team of interventional radiologists learned best practices for stroke intervention with on-site proctoring by an experienced neurointerventionalist who was flown by a helicopter-physician transport system to proctor each case performed during the training period. Patient eligibility for and appropriateness of endovascular thrombectomy (EVT) was determined using DAWN criteria. Technical success of EVT was assessed using the Thrombolysis in Cerebral Infarction (TICI) scale. Secondary endpoints included time metrics of workflow upon arrival to the ED, early neurologic recovery, 90-day mortality and intervention-related complications. We compared our outcomes of our study with those of the DAWN trial and HERMES meta-analysis.

RESULTS

30 total cases of EVT were retrospectively reviewed. TICI 3 or 2b technical success was achieved in 83%, not significantly different from the rate observed in HERMES when using two-tailed proportional analysis. No cases of intervention-related intraparenchymal hemorrhage, hematoma or arterial perforation/dissection occurred. Major early neurologic recovery was observed in 36% of cases compared to 50% in HERMES. 90-day mortality was observed in 10% of cases, similar to 15.3% in HERMES. The median interval from patient arrival to the ED to groin puncture was 104 minutes, compared to 109 minutes in the DAWN trial.

CONCLUSION

When comparing the performance of our centrifugally-trained IR stroke team with the HERMES meta-analysis, there was no significant difference in the technical efficacy of EVT nor any increased occurrence of intervention-related complications. There was also no significant difference in the median interval of time between patient arrival to the ED and groin puncture when compared to the DAWN trial.

CLINICAL RELEVANCE/APPLICATION

We describe a proof-of-concept model of a centrigully-trained IR stroke team as a possible approach to improve access to interventional stroke care.

SSJ20-02 Cost-Effectiveness of Thrombectomy for Ischemic Stroke Patients Presenting Beyond 6 Hours of Last Known to Be Well Based on the AURORA Meta-Analysis

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S404AB

Participants

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PURPOSE

The AURORA meta-analysis (Analysis of Pooled Data from Randomized StUdies of ThROmbectomy MoRe than 6 hours After Last Known Well) included patients that were randomized to endovascular thrombectomy (EVT) or to medical management (MM) presenting with large vessel occlusion stroke beyond 6 hours of symptom onset or last known to be well. Based on five pooled trials, EVT showed clear clinical benefits. We aimed to determine the cost-effectiveness of EVT in this context.

METHOD AND MATERIALS

A decision model based on Markov simulations estimated lifetime costs and quality-adjusted life years (QALY) associated with EVT or MM (Figure 1). The analysis was performed in a United States setting from a societal perspective. Input parameters for the model were based on most recent and best available evidence (Table 1), including pooled outcome data from patients randomized in five trials (DAWN, DEFUSE 3, ESCAPE, REVASCAT, POSITIVE, Figure 2). Probabilistic sensitivity analyses (PSA) were performed using 10,000 Monte Carlo simulations to estimate uncertainty. Incremental costs (IC), incremental effectiveness (IE), and incremental cost-effectiveness ratios (ICER) were derived. Cost-effectiveness acceptability rates were determined for varying willingness-to-pay (WTP) thresholds.

RESULTS

Based on outcome data of 458 patients randomized within the AURORA meta-analysis, the base-case analysis identified EVT as the strategy that resulted in incremental QALYs and cost-savings over the projected lifetime compared to MM (IC: -$17,902; IE: +1.71 QALYs; ICER: EVT dominant). Adjusting for all input parameter uncertainty in PSA, EVT was the preferred strategy with acceptability rates of >99.9% at all WTP thresholds ranging from $10,000 to $150,000 per QALY (Figure 3). Simulations led to 94.46% dominant/cost-saving iterations (Figure 4).

CONCLUSION

EVT is projected to provide considerable long-term clinical benefit whilst also leading to considerable long-term cost-savings in the management of patients with large vessel occlusion stroke presenting beyond 6 hours of symptom onset or last known to be well

CLINICAL RELEVANCE/APPLICATION

The expanded EVT indication beyond traditional time windows increases the need for EVT. Based on the projected health and cost benefits, healthcare investments are justified to cover this new demand.

SSJ20-03 Correlation of ASPECTS with CT Perfusion Core Volume in Large Vessel Occlusion Ischemic Strokes: A Real World Experience

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S404AB

Participants
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PURPOSE

The Alberta Stroke Program Early CT Score (ASPECTS) and CT perfusion (CTP) are commonly used to predict the ischemic core in acute ischemic strokes (AIS). CT angiogram source images (CTA-SI) can also provide additional information to identify the extent of ischemia. Our objective was to investigate the correlation of non-contrast CT (NCCT) ASPECTS and CTA-SI ASPECTS with CTP core volumes and final infarct volumes (FIV).

METHOD AND MATERIALS

We utilized a single institutional, retrospective registry of consecutive patients with AIS with large vessel occlusion (LVO) between May 2016 and May 2018. We graded ASPECTS both on NCCT and CTA-SI blinded to CTP results, measured CTP core using automated RAPID software (CBF<30%) and calculated FIV using follow up CT/MRI within 5 days of stroke onset. We used Pearson's correlation coefficients to evaluate the correlation between continuous variables.

RESULTS

A total of 58 patients fit the inclusion criteria of LVO and imaging work up of NCCT, CTA, and CTP. The mean age was 64.1±16.1 years and 41.4% were female. The median NCCT ASPECTS was 7 (IQR, 6-9), CTA-SI ASPECTS was 5 (IQR, 4-7), and CTP core was 14.5 ml (IQR, 0-45 ml). There was a moderate correlation between NCCT ASPECTS and CTP core (correlation coefficient, R= -0.57, p<0.0001) and between CTA-SI ASPECTS and CTP core (correlation coefficient, R= -0.48, p=0.0002). The correlation coefficient between FIV and NCCT ASPECTS was -0.54 (p<0.0001), FIV and CTA-SI ASPECTS was -0.48 (p=0.0004), and FIV and CTP core was 0.66 (p<0.0001). The optimal NCCT ASPECTS cutoff score to detect CTP core of 70 ml was 5 (sensitivity 0.57, specificity 0.84, Youden J 0.41) and the optimal CTA-SI ASPECTS was 4 (sensitivity 0.71, specificity 0.75, Youden J 0.46).

CONCLUSION

There was a moderate correlation between NCCT and CTA-SI ASPECTS in predicting CTP defined ischemic core and final infarct volumes.

CLINICAL RELEVANCE/APPLICATION

Our findings emphasize the need for further investigation into the use of CTA-SI ASPECTS for evaluating infarct extent in large vessel occlusions.

SSJ20-04 Successful Endovascular Thrombectomy Significantly Reduces Infarct Growth in both Early and Late Time Windows, but not for Patients with "Large" Admission Infarcts

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S404AB

Participants
Fabio Noro, MD, MS, Brookline , MA (*Presenter*) Nothing to Disclose
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PURPOSE

Endovascular thrombectomy (EVT) of acute stroke patients with large vessel occlusion (LVO) and small infarcts (<50ml) has been proven to be of benefit up to 24-hrs post ictus. Our purpose was to investigate the relationship between degree of recanalization and infarct growth, stratified by admission infarct volume and time-post-ictus.

METHOD AND MATERIALS

We retrospectively studied 223 consecutive LVO patients who underwent EVT between 6/1/2012 and 12/31/2017. 92/233 met inclusion criteria including available admission MR-DWI and follow-up CT or MR 12-hrs to 5-days post-procedure. Infarct growth was calculated as [final-admission infarct volume] / [admission volume] * 100, (measured as L*W*H/2). Degree of recanalization was determined according to the AOL and TICI scores, as good (AOL 2B/3, TICI 3/4), poor (AOL 0/1, TICI 0-2), or intermediate (everything in-between). Patients were stratified according to admission infarct volume (< vs > 50 ml) and time-post-ictus at presentation (< vs > 6 hours).

RESULTS

92/233 patients; 53 men/39 women. Mean age 68. LVO location included 25 ICA, 84 M1, and 27 M2. Success of recanalization was 43/92 (47%) good, 19/92 (21%) intermediate, and 30/92 (32%) poor. There were 72/92 (78%) and 20/92 (22%) patients with admission infarct volume less than and greater than 50 ml, respectively. There were 68/92 (74%) and 24/92 (26%) patients treated less than and greater than 6-hrs post-ictus, respectively. Mean infarct growth was significantly different among the 3 recanalization groups (good 13.4 ml, 76%; intermediate 45.5 ml, 203%; and poor 102.1 ml, 482%; p<0.01). These differences remained significant when stratified by time-post-ictus (10.8 vs 42.7 vs 116.4 ml, and 81 vs 194 vs 498 %; p<0.01) in the early window group; and remained significant in the late window group (24.5 vs 56.0 vs 80.6 ml, and 58 vs 235 vs 464 %; p<0.01). These differences also remained significant when stratified by admission infarct volume (9.0 vs 46.4 vs 118.4 ml, and 87 vs 229 vs 630 %; p<0.01) in the <50 ml group; but did not remain significant in the >50 ml group (30.0 vs 40.7 vs 57.4 ml, and 37 vs 66 vs 63 %; p=0.4).

CONCLUSION

Successful, robust recanalization following EVT results in significantly less core infarct growth - compared to intermediate and poor recanalization - for both early (<6hrs) and late (>6 hrs) time-window patients. Similarly, intermediate recanalization results in less infarct growth compared to poor recanalization. There was no significant benefit of EVT for infarct growth, however, for the subgroup with large (>50 ml) admission infarct volumes.

CLINICAL RELEVANCE/APPLICATION

EVT has been proven to benefit stroke patients up to 24 hours post ictus in the DAWN and DEFUSE-3 trials. We have shown that the degree of core infarct growth is significantly impacted by the degree of recanalization, and that this effect is equally robust in both early and late time windows.

SSJ20-05 Multi-Phase CT Angiography Registration and Subtraction Optimization to Improve Distal Arterial Occlusion Detection in Acute Stroke

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S404AB

Participants
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PURPOSE

In the context of an ischemic stroke, subtracting multi-phase whole-brain CT-angiography images may reveal a delayed vessel sign. However, this operation results in noisy images and is prone to patient motion between acquisitions. The purpose of the study is to develop a post-processing pipeline that automatically reduces motion and noise resulting from multi-phase CT-angiography subtraction, thereby improving the detection of distal arterial occlusion.

METHOD AND MATERIALS

To minimize motion between acquisitions, multi-phase images must be registered. During this process, a similarity metric is computed iteratively by random sampling of voxels from a region of interest (ROI). We tested registration methods targeting different ROIs, namely, the head, the skull, the calvaria and the cochleae. To reduce noise, we applied a smoothing Gaussian filter and a color gradient to highlight the areas corresponding to delayed contrast opacification (i.e. subtraction image voxels with positive values). We tested noise-reduction methods with different sigma parameters and color gradient thresholds. The motion- and noise-reduction methods were tested on 35 anonymized studies with a clinical suspicion of stroke. Method performances were evaluated by four radiologists who were blinded to the method-specific parameters. Registration methods were further evaluated using Dice similarity coefficients (DSC).

RESULTS

The motion-reduction method using the calvaria registration ROI was the most effective according to radiologists' assessment ($p < 0.01$) and to DSC ($p < 0.05$). The noise-reduction method with a sigma of 1.5 and a threshold of 1 HU was most highly ranked by radiologists ($p < 0.01$). Based on the best post-processed subtraction image, radiologists were in moderate agreement for the presence of delayed perfusion ($\kappa = 0.59$).

CONCLUSION

We evaluated different methods to reduce motion and noise resulting from subtracting multi-phase CT-angiography images. This allowed us to design a post-processing pipeline to assist radiologists in detecting distal arterial occlusion in the context of an acute stroke.

CLINICAL RELEVANCE/APPLICATION

We developed a multi-phase CT-angiography post-processing pipeline based on optimized registration and images subtraction to improve distal arterial occlusion detection in acute stroke.

Printed on: 10/29/20

SSJ21

Physics (Diagnostic X-Ray Imaging)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: N228

PH

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

FDA Discussions may include off-label uses.

Participants
Ingrid Reiser, PhD, Chicago, IL (*Moderator*) Spouse, Editor, IEEE Transactions on Communications
Bob Liu, PhD, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ21-04 Weakly Supervised Learning for Classifying A Cardiomegaly Disease from Normal and Other Diseases on Chest Radiographs

Tuesday, Dec. 3 3:30PM - 3:40PM Room: N228

Participants
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PURPOSE

To develop a weakly supervised classification for screening of cardiomegaly disease with chest radiograph (CXR).

METHOD AND MATERIALS

We collected a total of 16,730 CXRs including normal (n = 6903), abnormal CXRs with cardiomegaly (n = 1184) and other five disease patterns including nodule, consolidation, pleural effusion, pneumothorax, interstitial opacity (n = 8619) from our institution. All CXRs were annotated by 5 - 10 years experienced thoracic radiologists. These datasets were randomly split into 70 percent for training, 10 percent for tuning, and 20 percent for final evaluation. To classify cardiomegaly, other disease patterns, and normal, we used densenet169 with convolutional neural network (CNN) for weakly supervised learning. When this algorithm was trained, normal and other disease patterns were randomly extracted from train datasets to balance the number of cardiomegaly. The performance of this classifier was evaluated with statistical analysis such as sensitivity, specificity, and accuracy.

RESULTS

In the test dataset, the algorithm showed 98.18% accuracy in classification of normal, cardiomegaly, and other diseases CXR. Sensitivity and specificity of CNN was measured at 81.85%, 93.06%, and 96.79%, and 95.45%, 94.35%, and 90.15% for cardiomegaly, other disease patterns, and normal CXRs, respectively.

CONCLUSION

Weakly supervised learning with deep CNN demonstrated high diagnostic performance in the classifying normal, cardiomegaly, and others disease patterns CXRs.

CLINICAL RELEVANCE/APPLICATION

Automated classifier with weakly supervision shows high diagnostic performance in classifying cardiomegaly from normal and others disease patterns CXRs, which could be used as a screening tool for cardiomegaly disease with CXR

SSJ21-01 Quantitative Flow Velocity Analysis of 1000 Frames Per Second (fps) High Speed Angiography (HSA) Image Sequences

Tuesday, Dec. 3 3:00PM - 3:10PM Room: N228

Participants
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Stephen Rudin, PhD, Buffalo, NY (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation

PURPOSE

As minimally invasive image-guided endovascular interventions continue to replace invasive surgical procedures, quantification of parameters for impact evaluation such as blood velocity distributions and their changes due to the deployment of interventional devices become more important. We are developing a unique high spatial and high temporal resolution capability based on analysis of 1000 fps angiographic sequences for measuring such blood velocities in the intracranial vessels.

METHOD AND MATERIALS

A prototype system based on an Xcounter Actaeon photon counting detector (PCD) with 100 um pixels was used with a standard c-arm source set to 70 kVp, 100 mA to take a sequence of 1 ms exposures of a 3D-printed patient-specific aneurysm model connected to a pulsatile pump. Contrast was auto-injected into the phantom via a catheter maneuvered a short distance proximal of the aneurysm. Sequential frames were subtracted from one another creating a difference image where the contrast front would appear dark. Measurement of velocity from successive images was achieved by manually tracking the location of the center of mass of contrast fronts as they progressed through the phantom.

RESULTS

Over 200 individual points were sampled from the image sequence corresponding to different points of time and different locations throughout the phantom having varying vessel diameter. For this study, the average measured velocity for points sampled from the inflowing portion of the vessel was found to be 91.7 cm/s while for the outflow vessel the average velocity was 135.3 cm/s due to its reduced diameter. Points measured within the aneurysm sac had an average velocity of 80.0 cm/s, though directionality was highly dependent on location.

CONCLUSION

Detailed velocities of simulated intracranial blood flow as demonstrated here could be a valuable means of evaluating the impact of an interventional device deployment during planning, delivery, and post-deployment stages.

CLINICAL RELEVANCE/APPLICATION

A new way to measure intracranial vascular flow velocities with 1000 fps angiography has great potential to benefit the planning, conduct, and outcome of endovascular image guided interventions.

SSJ21-02 Analogous Lubberts Effect in Single Photon Counting Semiconductor Detectors

Tuesday, Dec. 3 3:10PM - 3:20PM Room: N228

Participants
Ke Li, PhD, Madison, WI (*Presenter*) Nothing to Disclose

PURPOSE

DQE loss due to depth (z)-dependent x-ray conversion gain and MTF in scintillator detectors was analyzed by G Lubberts half a century ago. The effect is associated with the spatial transport of optical quanta, which is not applicable to direct-conversion photon counting detectors (PCDs). However, mechanisms exist in PCDs to create variations of the MTF and the so-called x-ray multiplicity along z. The purpose of this work was study a Lubberts-like effect in PCDs and analyze the potential impacts on the detector design.

METHOD AND MATERIALS

Four major physical factors may contribute to depth-dependent PCD response: the escape fraction of K-fluorescent x-rays, height of voltage pulse generated by the motion of charge carriers, the lateral diffusion width of charge carriers, and the voltage (energy) threshold level. To analyze how the z-dependence of the PCD output is linked to each factor, a parallel + serial cascaded systems model of PCD was leveraged. Accuracy of the model in predicting DQE was experimentally validated using a CdTe-based PCD operated under 4 different radiation conditions and 40 threshold levels. Using the model as a theoretical tool, the impacts of each physical factor to the variation of PCD output along z was analyzed.

RESULTS

For a PCD with 2 mm CdTe, 3 μs mean electron lifetime, 20 keV low energy threshold, and 0.1 mm charge-collecting pixel electrode located at the back-end of CdTe, the Lubberts fraction (L) is 0.94 at zero-frequency and 0.91 at 5 lp/mm for a typical 120 kV CT spectrum. The Lubberts loss is primarily caused by the z-dependencies of K-escape fraction and electric (E) field; contribution of diffusion is negligible. When a front-end pixel design was used, an across-the-board improvement in L (>=4%) was achieved for the same input condition.

CONCLUSION

Compared with scintillator detectors, an improvement in the average Lubberts fraction was found in PCD, adding another benefit to this technology. The remaining small but non-negligible Lubberts loss is primarily caused by variations of K-escape fraction and E-field along z. Location of the pixel electrode needs to be optimized based on the input x-ray energy and pixel size in order to minimize the remaining Lubberts loss.

CLINICAL RELEVANCE/APPLICATION

As DQE is closely related to diagnostic image quality and dose efficiency, understanding the DQE-degrading Lubberts effect and engineering the corresponding remedy have direct clinical relevance.

SSJ21-03 Study of a Single-Shot Dual-Energy Flat Panel Detector with High Detective Quantum Efficiency

Tuesday, Dec. 3 3:20PM - 3:30PM Room: N228

Participants
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PURPOSE

Dual-energy (DE) imaging is well-known to aid in diagnosis by reducing anatomical noise and enabling material classification. Current approaches to DE imaging have trade-offs, such as motion artifacts due to the two exposures required or low sensitivity due to losses in a middle filter. Recently, a triple-layer flat panel detector (FPD) for use in single-shot DE imaging was proposed to address these trade-offs by eliminating motion artifacts while preserving high sensitivity. The purpose of this study is to evaluate the feasibility of such a detector by building and studying a prototype. Various image quality metrics are measured and clinical images are examined.

METHOD AND MATERIALS

An FPD prototype consisting of three stacked sensors each with its own cesium iodide (CsI) scintillator was used for all measurements. This detector generates three images per exposure: a digital radiography (DR) image -equivalent to one obtained with a conventional detector- and two tissue-subtracted (TS) images obtained through logarithmic subtraction: a bone and a soft-tissue image. To evaluate DR image quality, detective quantum efficiency (DQE) and modulation transfer function (MTF) were measured as per IEC 62220-1-1:2015 for multiple radiation quality (RQA) beams. The triple-layer detector's TS capabilities were qualitatively evaluated by studying three chest X-ray images obtained from an on-going clinical trial.

RESULTS

DQE and MTF on par with state-of-the-art single-layer DR detectors were observed across all RQA beams used, since the triple-layer design allows for a large total amount of CsI without increasing scintillator blur. The obtained clinical DE TS images showed good tissue separation and uniformity with no motion or alignment artifacts visible.

CONCLUSION

The high DQE and MTF measured indicate that the addition of DE capabilities is not detrimental to the main function of the triple-layer FPD as a DR detector, while the TS image quality indicates that it is a potential replacement to current DE technologies. We conclude that the triple-layer FPD design is promising for clinical use since both high-quality DR and DE images can be obtained in a single exposure.

CLINICAL RELEVANCE/APPLICATION

DE imaging is known to aid in diagnosis in certain clinical applications. The triple-layer FPD design is a compelling alternative to current technologies that could improve DE quality and adoption.

SSJ21-05 Comparison of Software for Retrospective Calculation of Applied Pressure in Mammography

Tuesday, Dec. 3 3:40PM - 3:50PM Room: N228

Participants
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CONCLUSION

The de Groot-script to calculate mean breast contact area is a useful tool for small datasets where obvious outliers can be removed after visual inspection, but should not be used in larger sets to prospectively predict the effect of the introduction of pressure-based compression in mammography.

Background

The subjectivity of 'appropriate' compression in mammography may cause concerns for variations in pain, dose and image quality. An objective compression guideline is possible by using a paddle with an indicator for the applied pressure (force per unit contact area). To study its impact on clinical practice, comparison with previously applied pressures is necessary. We compare two methods to retrospectively calculate pressure from mammogram pairs before (force-based) and after implementing the pressure-based paddle: Proprietary software (Volpara Analytics) and our own script (de Groot et.al., MedPhys 41: 023501).

Evaluation

Applied force was retrospectively obtained from the DICOM header of 826 randomly selected CC-view mammographic image pairs (2009: force-based, 2014: pressure-based). Mean breast contact area were calculated from all mammograms using Volpara and de Groot-script. Subsequently, applied pressure (force over contact area) was calculated. In both the force- and pressure-based group the applied pressure was higher with a much larger standard deviation when using de Groot-script compared to Volpara. (Force-based: Volpara 22.1±10.0 kPa, de Groot: 26.6±17.6 kPa, Pressure-based: Volpara 16.2±6.3 kPa, de Groot: 130.3±1888.0 kPa).

Discussion

The applied pressures as calculated with the de Groot-script in the pressure-based group were unrealistically high. In previous publication from our group, data obtained from de Groot-script were only used on small datasets after visual inspection of the results, something that is time-consuming in large datasets.

SSJ21-06 Material Characterization with Spectral Photon-Counting Radiography - An Experimental Approach

for Crystal Arthropathies

Tuesday, Dec. 3 3:50PM - 4:00PM Room: N228

Participants
Florian A. Huber, Zurich, Switzerland (*Presenter*) Nothing to Disclose
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PURPOSE

We aimed to assess whether spectral photon-counting radiography (SPCR) was able to differentiate the three most common crystals involved in crystal arthropathies, and secondly to compare SPCR with dual-energy CT (DECT).

METHOD AND MATERIALS

Industry-standard cylindrical solid rods of monosodium urate (MSU), calcium pyrophosphate (CPP) and calcium hydroxyapatite (HA) in three different clinically relevant concentrations (MSU: 200, 400 and 600 mg/ml, CPP and HA: 50, 100 and 200 mg/ml) were first imaged with SPCR, using a vendor X-ray tube and a prototype detector. Four energy thresholds were set at 15, 25, 30 and 35 keV. All samples were subsequently scanned with a dual-source dual-energy CT (DECT) of the latest generation. Respective attenuation values (AV), Hounsfield units (HU) and effective atomic numbers (Zeff) of the different rods were compared among each other and between imaging modalities.

RESULTS

MSU, CPP and HA showed statistically significant differences in AV, HU and Zeff with both imaging modalities (Zeff MSU: 6.52-6.96; CPP: 7.47-9.47; HA: 7.57-9.56). For each material, AV/HU/Zeff differed significantly among different concentrations (all $p < 0.001$; except between MSU at low vs. medium concentrations with DECT, $p = 1$). Mean Zeff measured with SPCR and DECT were comparable ($p = 0.9$). For each respective concentration, Zeff was significantly different between CPP and HA ($p <= 0.04$).

CONCLUSION

Characterization of the three most common crystals involved in crystal arthropathies is comparable between SPCR and DECT, with MSU clearly distinguishable from calcium-containing crystals. Zeff and attenuation values of CPP and HA show some overlap complicating their clear-cut differentiation. Future research should focus on findings in vivo.

CLINICAL RELEVANCE/APPLICATION

We present experimental results of a novel imaging technique approach for the characterization of crystalline compositions. This could impact the future diagnostic workup of crystal arthropathies, with inherent impact on patient management.

SSJ22

Physics (Photon Counting Detector CT)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: N226

CT PH

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

FDA Discussions may include off-label uses.

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Sabee Y. Molloi, PhD, Irvine, CA (*Moderator*) Research Grant, Canon Medical Systems Corporation

Sub-Events

SSJ22-01 Low Dose Ultra-High Resolution Sinus and Temporal Bone Imaging Using Photon-Counting Detector (PCD) CT and an Additional Tin Filter

Tuesday, Dec. 3 3:00PM - 3:10PM Room: N226

Awards
Trainee Research Prize - Fellow

Participants
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Wei Zhou, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Shengzhen Tao, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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John I. Lane, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Matthew Carlson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG
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PURPOSE

To reduce radiation dose while maintain high resolution in sinus and temporal bone (T-bone) CT scans using photon-counting detector (PCD) CT with an additional tin (Sn) filter.

METHOD AND MATERIALS

A head phantom was scanned on a clinical energy-integrating detector (EID) CT and a PCD-CT system. EID-CT scans were acquired using routine clinical protocols with120kV, 13.5 mGy for sinus, and 120kV, 49 mGy for T-bone exams which also employed a comb filter for ultra-high resolution (UHR) imaging. PCD-CT data were acquired using UHR mode (32x0.25 mm collimation), Sn-100kV, 10 mGy for both sinus and T-bone acquisitions. Patients referred for clinically indicated sinus and T-bone exams were scanned with PCD-CT following their clinical scans. Sinus scans were performed using 120kV, 95mAs, 13.6mGy for EID-CT, and Sn-100kV, 350 mAs, 7 mGy for PCD-CT. T-bone images were acquired using 120kV, 300mAs, 65mGy on EID-CT (comb filter-based UHR), and Sn-100kV, 500 mAs, 10 mGy on PCD-CT using UHR mode. Sinus images were reconstructed using H70 kernel, 0.75mm slice thickness, and T-bone images were reconstructed using a U70 kernel, 0.6mm slice thickness. Image contrast and noise were measured in uniform regions. Dose reduction was evaluated using the percentage change in image noise between EID-CT and PCD-CT for a given reconstruction kernel.

RESULTS

Sinus phantom results showed lower noise on PCD-CT (110 HU, 10mGy) compared to EID-CT (150 HU, 13.5mGy), yielding a total dose reduction of 72% if matched image noise is targeted. Phantom results using T-bone protocol showed lower image noise for PCD-CT (129 HU, 10 mGy) at 79% lower dose compared to EID-CT (148 HU, 49mGy). Sinus patient images showed lower noise on PCD-CT (129 HU, 7mGy) than EID-CT (152 HU, 13.6mGy) at 49% lower acquisition dose for PCD-CT without compromising spatial resolution. At matched image noise and kernel, this corresponds to a total dose reduction of 76%. Patient T-bone images showed comparable image noise between EID-CT (65mGy) and PCD-CT (10mGy) at six-fold reduced dose for PCD-CT.

CONCLUSION

We have demonstrated 72 to 84% dose reduction for sinus and T-bone imaging using PCD-CT with an additional Sn filter in comparison to the current clinical protocols.

CLINICAL RELEVANCE/APPLICATION

Using ultra-high resolution PCD-CT with additional tin filter, the image quality can be preserved while the patient radiation dose can be reduced to about one-fifth of the current clinical dose.

SSJ22-02 Comparison of Low Dose Image Quality in Conventional and Photon-Counting CT

Tuesday, Dec. 3 3:10PM - 3:20PM Room: N226

Participants
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PURPOSE

To compare the task-based performance of conventional (EID) CT and photon-counting CT (PCCT) in low dose imaging conditions.

METHOD AND MATERIALS

The largest section of a multi-tier phantom (Mercury Phantom, Gammex) was imaged using a prototype photon-counting CT scanner (Siemens, Germany) containing conventional and photon-counting subsystems. The largest section (36 cm diameter) was used to simulate the most difficult clinical imaging scenario. The phantom contains two sections: a uniform section for noise measurement and a section with five cylindrical inserts (8.5 mg/mL I, air, water, polystyrene (fat), bone) for resolution and detectability measurements. Images were acquired at matched low doses (1.7, 2, 2.5, 3, 4, 6 mGy CTDIvol) and reconstructed with a clinical protocol (medium-soft kernel (I40), 3 mm slices). An automated program was used to evaluate noise in the noise region and contrast, contrast-to-noise ratio (CNR), and detectability index (d') of bone and iodine inserts.

RESULTS

Noise was slightly higher in EID images (29.9-53.7 HU) than PCCT images (28.7-51.7 HU). Photon-counting images showed improved contrast in both bone (9.5%) and iodine inserts (12.9%) leading to improvements in CNR of 10.8% for bone and 14.0% for iodine. CNR improvement was found to be significant ($p < .01$) for both inserts. Detectability index improved for both bone (3.1%) and iodine (10.1%) with p-values of .05 and .01 respectively.

CONCLUSION

Photon-counting CT images had slightly lower noise and improved contrast compared to conventional CT at low doses. This further translated into improved contrast-to-noise ratio and detectability index for both iodine and bone.

CLINICAL RELEVANCE/APPLICATION

Photon-counting CT offers improved performance over conventional CT for low dose imaging tasks in terms of noise, contrast-to-noise ratio, and detectability index.

SSJ22-03 K-edge Photon Counting CT-Based Virtual Nonenhanced CT Imaging

Tuesday, Dec. 3 3:20PM - 3:30PM Room: N226

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PURPOSE

Virtual noncontrast (VNC) images derived from contrast enhanced dual energy CT (DECT) data can obviate the need for a separate noncontrast CT scan. An important premise of DECT-based VNC imaging is that the attenuation coefficient of an arbitrary material can be represented by a linear combination of two energy-dependent basis functions. However, this assumption is violated by the presence of iodine (I) K-edge. As a result, erroneous subtractions occur to calcium in the VNC images. The purpose of this work was to investigate the use of photon counting CT (PCCT) to accomplish K-edge PCCT imaging to improve the quantitative accuracy of VNC reconstruction.

METHOD AND MATERIALS

An experimental PCCT system was used to scan objects with known material types and concentrations: 50 and 25 mg/mL $CaCl_2$, 20 and 10 mg/mL iodine, and a mixture of $CaCl_2$ (25 mg/mL) and iodine (10 mg/mL). The energy bin width and position (bin 1: [15, 34] keV; bin 2: [34, 55] keV; bin 3: [55, 80] keV) were optimized to provide the highest overall accuracy for iodine and $CaCl_2$ concentration estimation. Similarly, the beam filtration (160 mg/cm2 of iodine) was optimized to achieve K-edge imaging. Three-material decomposition was performed using the multi-bin PCCT data. The CT number enhancement due to iodine was found from the iodine basis image, and was then subtracted from the full energy bin attenuation image to generate the final VNC image. These were then compared with VNC images from a commercial DECT system with projection domain material decomposition.

RESULTS

For the two objects that do not contain iodine (50 and 25 mg/mL CaCl2), their CT numbers were incorrectly reduced by 130±5 and 67±5 HU in DECT-based VNC images. The CT number errors for 20 and 10 mg/mL iodine, and the CaCl2-iodine mixture were -5±7, -3±5, and -74±7 HU, respectively, in DECT VNC images. In comparison, CT number errors of K-edge PCCT VNC images were -2±2 HU (50 mg/mL CaCl2), 3±13 HU (25 mg/mL CaCl2), -4±12 HU (20 mg/mL iodine), -4±4 HU (10 mg/mL iodine), and -3±8 HU (iodine-CaCl2 mixture).

CONCLUSION

K-edge PCCT-based VNC imaging effectively removes iodine signal while preserving the CT number accuracy of non-iodine structures such as bone and calcifications.

CLINICAL RELEVANCE/APPLICATION

VNC images derived from contrast enhanced PCCT can obviate the need for a separate noncontrast CT scan, reducing dose and scan time and providing important baseline tissue attenuation information.

SSJ22-04 Material Decomposition of Clinical Full-Field Photon Counting CT Data Using a 'One-Step' Direct Estimation Approach

Tuesday, Dec. 3 3:30PM - 3:40PM Room: N226

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PURPOSE

To demonstrate feasibility of material decomposition of clinical photon-counting head CT data using the constrained 'one-step' Spectral CT Image Reconstruction (cOSSCIR) method. The cOSSCIR method directly estimates the basis material images from the photon counts data, which allows constraints to be placed on the basis images to improve the decomposition.

METHOD AND MATERIALS

Head CT data of a human subject was acquired on a clinical full-field photon-counting CT prototype with silicon detectors (Prismatic Sensors, Sweden). Calibration data of a polyvinyl chloride (PVC) and polyethylene step wedge phantom was also acquired and used to estimate the effective spectra and a pileup correction for each energy bin. The cOSSCIR algorithm directly estimated the PVC and polyethylene basis material images from the photon-counts data using an optimization-based algorithm. The basis image were combined to form virtual monoenergetic images.

RESULTS

Basis material images of PVC and polyethylene were successfully reconstructed by the cOSSCIR algorithm, representing the composition of bone and soft tissue, respectively. Additional investigations are underway to evaluate the performance of cOSSCIR in correcting metal artifacts due to dental hardware and to compare the results to other material decomposition approaches

CONCLUSION

The results demonstrate feasibility of proposed cOSSCIR algorithm to reconstruct basis material images from clinical photon-counting head CT data.

CLINICAL RELEVANCE/APPLICATION

The cOSSCIR method previously demonstrated the ability to reduce metal artifacts in experimental photon counting images of phantoms. This study demonstrates the feasibility of using cOSSCIR for clinical head CT images, which can be degraded by dental metal artifacts.

SSJ22-05 Scan Protocol Design and k-Edge Imaging in a Clinical Whole-Body Photon-Counting CT

Tuesday, Dec. 3 3:40PM - 3:50PM Room: N226

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PURPOSE

To investigate the influence of threshold settings on the contrast-to-noise ratio (CNR) in a whole-body photon-counting (PC) CT system using potential novel high-Z contrast agents and to propose accordant scan protocols for clinical practice.

METHOD AND MATERIALS

Semi anthropomorphic phantoms of different sizes (XS=10×10 cm, S=20×30 cm, M=25×35 cm, L=30×40 cm) are measured at tube voltages between 80 kV to 140 kV using a prototype photon-counting CT system (SOMATOM CounT, Siemens, Germany). The phantoms are equipped with vials containing potential high-Z contrast agents (elements I, Gd, Yb, W, Bi). The PC detector intrinsically acquires data using two energy bins with the first bin covering an energy range of [20 keV, T] and the second bin covering [T, eU] with U being the tube voltage. The threshold T is varied in steps of 5 keV between the available 50 keV to 90 keV. The resulting bin images are combined in a statistically optimal manner to maximize the CNR of the contrast agent relative to the soft tissue background. The resulting CNR is evaluated as figure of merit in all bins and the combined images for all tube voltages, phantom sizes and contrast agents.

RESULTS

While CNR varies in individual bins as a function of threshold settings, the CNR in the combined images is nearly constant and independent of the thresholds used for image acquisition. This holds true for each given combination of patient size and tube voltage and is verified for all available contrast media in measurements and accompanying simulations. Furthermore, the effect of the agents' k-edges can be seen in the acquired data. Potentially, the remaining freedom to set T can be used to enable clinical k-edge imaging which is illustrated using Ytterbium.

CONCLUSION

An adaption of threshold settings for patient size or tube voltage is not required in clinical practice as an image with maximum CNR can always be provided by combination of bin images. Hence, the thresholds could be chosen on-demand to enable other applications, e.g. material decomposition with high-Z contrast agents exploiting k-edges of the elements used therein.

CLINICAL RELEVANCE/APPLICATION

Maximum CNR in PC-CT can always be provided independently of the thresholds. Hence, novel scan protocols can be designed enabling applications on-demand, e.g. using high-Z contrast agents.

SSJ22-06 Experimental Feasibility of Photon-Counting Spectral X-Ray Phase-Contrast Computed Tomography

Tuesday, Dec. 3 3:50PM - 4:00PM Room: N226

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PURPOSE

To evaluate the potential of the combination of photon-counting spectral CT and grating-based differential phase-contrast (gbDPC) CT.

METHOD AND MATERIALS

We propose a novel imaging approach, namely spectral differential phase-contrast CT, which merges the modalities of attenuation based and phase-contrast based imaging. Thereby, we introduce a new polychromatic forward-model for spectral phase-contrast imaging with multi-bin photon counting detectors, which uses spectral attenuation and phase-contrast information simultaneously by correlating the electron density determined by each modality. We performed a dual-energy gbDPC CT scan of a phantom containing tissue simulating materials. The data was acquired with a photon-counting detector (FliteX1, Direct Conversion AB, Danderyd, Sweden) equipped with two energy thresholds per pixel, which were placed at 23 and 64 keV. The phase contrast information was extracted by using a Talbot-Lau interferometer in step-and-shot mode. The phantom has been imaged with the following parameters: 140 kVp, 8000mAs, 1200 tomographic angles, 5 phase-steps per angle.

RESULTS

Similar to conventional spectral CT the inversion of the proposed forward-model yields basis-material line-integrals, which are reconstructed afterwards to obtain material specific volume data. Compared to conventional spectral X-ray imaging a considerably lower noise level in the basis-material images can be observed in experimental measurements. We observe a reduction of the variance by a factor of up to 3 for a constant radiation dose at the position of the sample without a significant loss in image resolution. Apart from basis-material images, the proposed method provides X-ray dark-field images, which arise due to small-angle scattering at microscopic structures.

CONCLUSION

Spectral differential phase-contrast CT yields material-specific images with strongly reduced image noise compared to conventional spectral CT. Different from conventional spectral CT an additional X-ray dark-field image is obtained.

CLINICAL RELEVANCE/APPLICATION

The basis-material images obtained in spectral CT suffer from noise amplification when compared to conventional CT images. Spectral differential phase-contrast CT is capable of diminishing this noise amplification, providing material specific images with strongly reduced radiation dose delivered to the patient.

SSJ23

Physics (CAD/Machine Learning, Quantitative Imaging)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: N229

PH BQ AI

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

Participants

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Sub-Events

SSJ23-01 Automatic Prediction of Coronary Heart Disease Events Using Coronary and Thoracic Aorta Calcium among African Americans in the Jackson Heart Study

Tuesday, Dec. 3 3:00PM - 3:10PM Room: N229

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PURPOSE

Coronary artery calcium (CAC) and thoracic aorta calcium (TAC) are predictors of CHD events. Given that CAC and TAC identification is time-consuming, methods for automatic quantification in CT have been developed. Hence, we investigate whether subjects who will experience a CHD event within 5 years from acquisition of cardiac CT can be identified using automatically extracted calcium scores.

METHOD AND MATERIALS

We included 2532 participants (age 59±11, 31% male) of the Jackson Heart Study without CHD history: 111 participants had a CHD event within 5 years from CT acquisition, defined by death certificates and medical records. For each subject a cardiac CT scan(GE Healthcare Lightspeed 16Pro, 2.5mm slice thickness, 2.5mm increment, 120kVP, 400mAs, ECG-triggered, no contrast) was available. Per-artery Agatston CAC scores (left anterior descending, left circumflex, right coronary artery) and TAC volume were automatically extracted with a previously developed AI algorithm. Scores were log transformed, combined with age and sex and all continuous variables were normalized to zero-mean and unit variance. We evaluated 3 models with 3-fold cross-validation where subjects were classified according to occurrence of CHD event using LASSO regression with 1) age, sex and CAC scores, 2) age, sex and TAC scores, and 3) all variables. Performance was evaluated with the area under the ROC curve (AUC).

RESULTS

In 1468 (58%) subjects no CAC and in 1240 (49%) no TAC was found. In remaining scans, median (range) CAC score was 78.7(1.6-5562.1): 49.5(0.0-4569.4), 0.0(0.0-2735.3), 3.9(0.0-3242.7) in the LDA, LCX and RCA, respectively. Median TAC volume was 116.8(4.7-7275.9). Prediction of CHD events using Model 1, 2 and 3 resulted in an AUC (95% CI) of 0.721(0.672-0.771), 0.735(0.686-0.785) and 0.727(0.678-0.776). Differences between the ROC curves were not significant (Model 1 and 2: p=0.80; 1 and 3: p=0.29; 2 and 3: p=0.76).

CONCLUSION

Identification of subjects at risk of a CHD event can be performed using automatically extracted CAC or TAC scores from cardiac CT.

CLINICAL RELEVANCE/APPLICATION

Prediction of CHD events from cardiac CT using TAC instead of CAC is feasible and may be advantageous in scans acquired without ECG-triggering or low image resolution.

SSJ23-02 Identifying Changes in Regional Autonomy of the Brain Using Resting State-Functional MRI in Patients with HIV-Associated Neurocognitive Disorder

Tuesday, Dec. 3 3:10PM - 3:20PM Room: N229

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PURPOSE

To evaluate a machine learning framework using Mutual Connectivity Analysis (MCA) for investigating changes in brain regional autonomy in patients with HIV-Associated Neurocognitive Disorder (HAND) using resting-state fMRI (rsfMRI).

METHOD AND MATERIALS

A total of 120 rsfMRI runs (3T, EPI sequence, TR=1.65s, 250 volumes, 3 runs per subject) were acquired in a cohort of 40 age-matched subjects (20 HIV+, 16 of whom had HAND symptoms, 20 HIV- controls). Regional activity was estimated by averaging voxels belonging to regions obtained using the Automated Anatomical Labeling atlas. Using MCA (DSouza et al, NeuroImage 2018), we investigate, if discernable changes exist in self-influence of brain regions, i.e. regional autonomy, once patients show HAND symptoms. MCA reveals non-linear measures of influence, which conventional correlation-based approaches cannot estimate. With these measures as features, a support vector machine classifier was trained to distinguish between healthy controls and subjects with HAND. Additionally, feature selection revealed regional connections that differed between the groups. For both feature selection and classification, strict data separation (90% train/10% test) was carried out in a 100-iteration cross-validation scheme. Area Under the receiver operator characteristics Curve (AUC) and accuracy (ACC) was used to quantitatively evaluate diagnostic quality.

RESULTS

Classification with MCA measures performed significantly better ($p<0.05$, Wilcoxon signed-rank test) with AUC=0.86±0.17 and ACC=0.78±0.16 than conventional correlation analysis with AUC=0.58±0.29 and ACC=0.57±0.18. Feature selection revealed regions of the frontal cortex, temporal pole, and default mode network affected by HAND, which is in line with other literature on HAND.

CONCLUSION

Our results suggest that an analysis capturing regional autonomy is more discriminative than conventional measures for imaging-based identification of patients with HAND, as MCA-derived nonlinear network measures significantly outperform correlation-based analysis in capturing relevant differences between patient groups. In addition, studying relevant features can identify specific brain regions affected by HAND-related activity changes.

CLINICAL RELEVANCE/APPLICATION

MCA is a novel method for investigating brain connectivity changes in HIV-related neurologic disease. Such changes can potentially serve as useful imaging biomarkers for therapy monitoring of HAND.

SSJ23-03 Independent Prospective Evaluation of a Quantitative MRI Biomarker for Early Response Prediction in Treatment of Multiple Myeloma

Tuesday, Dec. 3 3:20PM - 3:30PM Room: N229

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PURPOSE

Predicting early response to treatment of multiple myeloma (MM) is challenging. This study evaluated the generalizability of a MRI biomarker that we developed for this task using a prospective test set from an ongoing two-site study.

METHOD AND MATERIALS

With IRB approval and informed consent, 35 pairs of pre- and post-treatment spinal MR scans with an average interval of 2.4±1.1 months were prospectively collected from 35 MM patients who underwent a variety of therapeutic regimens in two hospitals in US and China. The MRI data were acquired with GE or Philips 1.5 T or 3.0 T scanners. We have previously developed a 3D dynamic intensity entropy transformation (DIET) method to transform MR signal to a voxelwise quantitative entropy enhancement value, from which predictor variables were derived and combined into a DIET response index (qERI) to assess treatment response. The qERI was trained in a retrospective data set with 64 MRI cases from patients who underwent bone marrow transplant, and achieved an area under the receiver operating characteristic (ROC) curve (AUC) of 0.89 in leave-one-case-out testing in our previous study. In this study, we applied our DIET method directly without re-training to the pairs of MRI scans of 35 new patients to predict clinical outcomes.

RESULTS

Of the 35 patients, 22 and 13 were clinically diagnosed as responders and non-responders, respectively, by using International Myeloma Working Group Uniform Response Criteria (URC) in more than 6-month fellow-up. Using a decision threshold previously chosen with the developmental set, the qERI correctly predicted 20 responders (90.9% sensitivity) and 10 non-responders (76.9% specificity) at an AUC of 0.79. Of 20 qERI-responders, URC initially determined 2 as non-responders at 3-month time point and re-assessed them as responders in 6-month follow-up. The agreement between the DIET method and the clinical outcome reached 0.86 (30 of 35) with a kappa value of 0.69.

CONCLUSION

The substantial agreement between qERI prediction and clinical outcomes demonstrated that qERI has the potential for early assessment of the clinical outcome of MM response, which usually requires longer-term follow-up, to a wide variety of treatment regimens.

CLINICAL RELEVANCE/APPLICATION

Quantitative MRI-based biomarker may improve the accuracy and efficacy for early assessment of treatment response for MM, allowing clinicians to optimize therapy of individual patients.

SSJ23-04 Standardization in Quantitative Imaging: A Multi-Center Comparison of Radiomics Feature Values Obtained by Different Software Packages on Digital Reference Objects and Patient Datasets

Tuesday, Dec. 3 3:30PM - 3:40PM Room: N229

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PURPOSE

Radiomics features are being increasingly proposed for clinical applications such as predicting patient response to therapy or prognosis. The purpose of this work was to investigate the agreement among these features when computed by several groups utilizing different software packages with standardized feature definitions and common image datasets designed to identify possible differences.

METHOD AND MATERIALS

Nine sites from the NCI's Quantitative Imaging Network PET-CT working group participated in this project. Nine common quantitative imaging features were selected for comparison including features that describe morphology, intensity, shape and texture. A standard lexicon developed by the International Biomarker Standardisation Initiative (IBSI) was adopted as the feature definition reference. The common image data sets were: (a) two sets of 3D Digital Reference Objects (DROs) developed specifically for this effort (200mm and 50 mm diameter objects): a uniform sphere, a sphere with intensity variations, and a complex shape object with uniform intensity; and (b) 10 patient image scans from the LIDC dataset using a specific lesion in each scan. To eliminate variation in feature values caused by segmentation differences, each object (DRO or lesion) was accompanied by a Volume of Interest (VOI), from which the features were calculated. Feature values for each object (DRO or lesion) were reported. The percent coefficient of variation (CV) was calculated across software packages for each feature on each object.

RESULTS

10 sets of results were obtained for the DROs. Six of the nine features demonstrated excellent agreement with CV < 1%. Larger variations (CV>= 13%) were observed for the remaining three features. Only 2 sets of results from patient datasets were obtained so far, but similar trends were observed with the exception being kurtosis, which showed higher CV than in the DROs.

CONCLUSION

By computing common radiomics features on a common set of objects using the same VOIs for each object, we have shown that while several features agree strongly across software packages, others do not. This highlights the value of feature definition standardization as well as the need to further clarify definitions for some features.

CLINICAL RELEVANCE/APPLICATION

Remaining disagreement in the community as to radiomic feature definitions and implementation details should be resolved before radiomic analysis becomes part of routine practice.

SSJ23-05

Participants

Liver and Lung Texture Feature Redundancy in Conventional and Photon-Counting CT

Tuesday, Dec. 3 3:40PM - 3:50PM Room: N229

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PURPOSE

To evaluate relative contribution of different acquisition and reconstruction protocols for the extraction of radiomics features of lung and liver, in photon-counting (PCCT) and energy integrated detector (EID) CT.

METHOD AND MATERIALS

A texture phantom containing lung and liver texture modules was imaged with a prototype photon-counting CT scanner (Siemens, Germany) using conventional and photon-counting subsystems. The phantom was scanned at 80 and 140 kV, matching clinical standards for lung and abdominal imaging respectively, and 5 different mAs values (14, 50, 100, 200, 274). Images were reconstructed with several different kernels appropriate for each clinical task, with uniform slice thickness and pixel size. Three 4.1 x 4.1 x 8 mm3 regions of interest (ROIs) were extracted from each image and analyzed for twenty texture features. Feature redundancy was defined as features presenting an intra-class correlation coefficient of >0.9.

RESULTS

For liver texture, all features extracted from EID data showed some redundancy while three features (Variance, Gray Level Non-Uniformity, Short Run High Gray Level Emphasis) extracted from PCCT data did not correlate with any other features. Fifteen of twenty features showed less (average: 33%) redundancy in PCCT data when compared to EID data, and 3 were more redundant (average 19%). For lung texture, all features extracted from both PCD and EID images showed some level of redundancy. Eleven features showed less (average 16%) redundancy while 8 had increased (average 20%) correlation with other features.

CONCLUSION

Radiomic features extracted from photon counting data showed less redundancy between individual texture features extracted from liver but not for lung.

CLINICAL RELEVANCE/APPLICATION

Sensitivity of radiomics features to CT acquisition and reconstruction parameters can introduce nonbiological differences to these values. Improvements in CT acquisition techniques could resemble more accurate representation of biologically important features.

SSJ23-06 Predictive Ability of Radiomic Features Calculated Using 2D versus 3D Region-of-Interest: A Multi-Energy CT Study of Lymphadenopathy in Head and Neck Cancer Patients

Tuesday, Dec. 3 3:50PM - 4:00PM Room: N229

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PURPOSE

Examine the hypothesis that radiomic features calculated using entire tumor volume as region-of-interest (ROI) are more predictive than features based on the central tumor slice.

METHOD AND MATERIALS

This study concerns the use of primary tumor radiomic features for predicting cervical nodal metastases. Dual energy CT data from 87 patients with head-and-neck squamous-cell-carcinoma were reconstructed at 21 energies (40, 45... 140 keV). Each of the 94 matrix-derived texture features was calculated 64 ways (4 voxel sizes, 4 binning algorithms, 4 gray level discretizations), in 2D and 3D. A promising feature was defined as having absolute Spearman correlation > 0.3 with the outcome. The number of such features was plotted vs energy, for 2D and 3D. The correlation between the same feature in 2D and 3D was calculated, and the median correlation value for a feature set was plotted vs energy. Feature sets used were (a) all features, and (b) promising features in 2D/3D. Net improvement fraction (NIF) was defined as number of features more predictive in 2D minus number of features more predictive in 3D divided by total features. This was plotted vs energy. To evaluate the relation of performance to tumor size, the entire analysis was performed on 3 cohorts: (A) all 87 patients, (B) patients with fewer than median number of tumor slices, (C) patients with more than median number of tumor slices.

RESULTS

For cohorts (A) and (C), the number of promising features were greater in 2D than in 3D; the opposite was seen for (B). Correlation between 2D and 3D features was best for (A) and worst for (C). NIF was positive for (A) and (C), i.e., 2D better than 3D, but negative for (B). While some curves show energy dependence, the stated results are true for all energies.

CONCLUSION

For our dataset, 3D features only outperform 2D features for small tumors (fewer than median number of slices). For large tumors or all tumors considered together, 2D outperforms 3D. A possible explanation is that the heterogenous parts of the tumor are key for radiomic discrimination, reflecting the "tumor habitat", and for larger tumors, these are less well represented in the whole volume.

CLINICAL RELEVANCE/APPLICATION

Counter-intuitively, whole tumor volume radiomic analysis may not be the ideal approach. Central-slice-only analysis or sub-segmentation may be required for optimal radiomic biomarker development.

SSJ24

Radiation Oncology (Gastrointestinal Malignancies)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: S402AB

GI RO

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

Participants
Edward Y. Kim, MD, Seattle, WA (*Moderator*) Nothing to Disclose
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Sub-Events

SSJ24-01 Radiomics of Sulfur Colloid SPECT/CT to Predict Radiation-Induced Hepatotoxicity in Hepatocellular Carcinoma Patients

Tuesday, Dec. 3 3:00PM - 3:10PM Room: S402AB

Participants
Stephanie K. Schaub, MD, Seattle, WA (*Presenter*) Nothing to Disclose
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PURPOSE

Wide variability exists in our ability to predict radiation-induced liver disease (RILD) in hepatocellular patients (HCC) treated with radiotherapy (RT). An unmet need exists for objective metrics to risk stratify patients, especially among those at highest risk with baseline Child-Pugh (CP)-B/C cirrhosis. We hypothesized that a radiomic signature derived from 99m-Tc sulfur colloid sulfur colloid (SC) SPECT/CT scans could inform on RILD risk prediction in HCC patients.

METHOD AND MATERIALS

92 consecutive HCC patients with underlying cirrhosis treated with RT (n=45 SBRT; n=47 proton RT) were retrospectively reviewed for clinical data including CP score, prior liver-directed therapy (LDT), vascular invasion, gross tumor volume (GTV), and RILD-specific death. Pre-treatment SC SPECT imaging of the uninvolved liver was mined to obtain 33 radiomic features. Univariate analysis was performed using Fine & Gray competing risk regression models to evaluate associations between radiomic features and RILD-death, with tumor progression, additional LDT, and non-RILD deaths treated as competing risks. Bonferroni multiple testing adjustment was applied such that a=0.05/33.

RESULTS

Patients had 33% CP-B/C class, 32% vascular invasion, 52% prior LDT, and median GTV was 33cc. During a median follow-up of 11 months, 8 RILD-related deaths occurred, all in patients with CP-B/C. 24/33 radiomic features were significantly associated with RILD-death ($p<0.0015$), with the strongest predictors being dissimilarity and zone percentage (both HR 0.1 per 1-SD increase), which measure image heterogeneity at the locoregional level. In contrast, the only clinical feature predictive of RILD-death was CP-B/C. Within the CP-B/C subgroup (n=30), 8 features retained statistical significance for RILD-death risk prediction, with kurtosis being the most significant (HR 1.4, $p<0.0001$). Among these patients, 6/15 with kurtosis above the median had RILD-death compared with 2/15 with kurtosis below the median. Further multivariate analysis was not performed due to few RILD-deaths.

CONCLUSION

Radiomic SC SPECT signatures may provide an objective biomarker for predicting RILD-specific death that may further stratify risk beyond Child-Pugh class.

CLINICAL RELEVANCE/APPLICATION

Radiomic signatures derived from pre-treatment sulfur colloid SPECT/CT may offer improved hepatotoxicity risk prediction in hepatocellular carcinoma patients treated with radiotherapy.

SSJ24-02 Recurrence and Patient-Related Factors in Hepatocellular Carcinoma Patients Treated with Stereotactic Body Radiation Therapy

Tuesday, Dec. 3 3:10PM - 3:20PM Room: S402AB

Awards

Trainee Research Prize - Resident

Participants
Mona Arbab, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
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Mary Maluccio, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Feng-Ming Kong, MD,PhD, Cleveland, OH (*Abstract Co-Author*) Speakers Bureau, Varian Medical Systems, Inc
Susannah Ellsworth, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Ryan Rhome, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Stereotactic Body Radiation Therapy (SBRT) is used in patients with HepatoCellular Carcinoma (HCC).In this study,we evaluate factors associated with failure.

METHOD AND MATERIALS

This is a retrospective analysis of HCC patients treated between 6/2007 and 1/2017. Failure was defined as: in-field (within 80% isodose line), out-field (outside 80% isodose line within the liver), and distant (outside the liver). Biological effective dose (BED) was calculated using alpha/beta = 10. Absolute lymphocyte count (ALC) nadir was defined as the lowest ALC within 2 months after SBRT and low ALC nadir was described as ALC <0.5 k cell/uL. Statistical analysis was done using chi-squared testing, logistic regression, and Kaplan-Meier methods.

RESULTS

113 patients with a median age of 63 years (IQR 57-69 years) were included. 71% were male; 72% had Child Pugh A, 61% had ECOG of 1 and 13.2% received liver transplant. The most common cause of HCC was hepatitis C (59%).The median tumor size was 25 mm (range 11-148 mm). The median dose of SBRT was 46.5 Gy (range 20-50 Gy) with median BED of 112.5 (range of 72-124.8). With median follow-up of 22 months (range 0-122), 26 (23%) of patients had failure: 5 (19%) were in-field, 16 (62%) were out-field, and 7 (27%) were distant metastases. 2 patients had concurrent in- and out-field failure. Progression free survival was 20.5 months (range 2-97 months) and the mortality rate was 36% and 54% in patients with any type of failure. In univariate analysis, pre-treatment alpha fetoprotein (AFP), on-treatment AFP and International Normalized Ratio (INR) were associated with risk of any failure (p=0.02, p=0.04 and p=0.04). 3-month post-treatment AFP was associated with risk of distant failure (p=0.03). Pre-treatment AFP was associated with any failure in multivariate analysis (p=0.01). BED or dose were not associated with any failure. Patient with low ALC nadir had lower overall survival (OS, 14.5 months versus 28 months, p-value=0.006). OS decreased to 9.5 months in patients with ALC nadir of <0.2 k cell/uL. In-field failure was associated with improved OS (p=0.03) and distant failure with higher rate of mortality (p=0.0001).

CONCLUSION

Pre-RT and on-treatment AFP in addition to INR can predict future failure. Survival can be impacted by low ALC nadir.

CLINICAL RELEVANCE/APPLICATION

Pre-RT AFP and INR can predict failure.Lower ALC nadir can impact survival in HCC patients treated with SBRT.

SSJ24-03 Developing a Prediction Model Based on MRI for Pathological Complete Response after Neoadjuvant Chemoradiotherapy in Locally-Advanced Rectal Cancer

Tuesday, Dec. 3 3:20PM - 3:30PM Room: S402AB

Participants
Lijuan Wan, Beijing, China (*Presenter*) Nothing to Disclose
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PURPOSE

The aim of this study was to build an appropriate diagnostic model for predicting pathological complete response (pCR) after neoadjuvant chemoradiotherapy (nCRT) in patients with locally advanced rectal cancer (LARC) by combining magnetic resonance imaging (MRI) parameters with clinical factors.

METHOD AND MATERIALS

Eighty-four patients with LARC who underwent MR examination before and after nCRT were enrolled in this study. MRI parameters including cylindrical approximated tumor volume (CATV) and relative signal intensity of tumor (rT2wSI) were measured, corresponding reduction rates (RR) were calculated, as well as MR tumor regression grade (mrTRG) and other conventional MRI parameters were assessed. Logistic regression analysis with lasso regularization were performed and the appropriate prediction model for pCR was built up. An external cohort of thirty-six patients was used as the validation group for testing the model. Receiver operating characteristic (ROC) analysis was used to assess the diagnostic performance.

RESULTS

In the development and the validation group, 17 patients (20.2%) and 11 patients (30.6%), respectively, achieved pCR. Two CATV related parameters (CATVpost and CATVRR), one rT2wSI related parameters (rT2wSIRR), and mrTRG were the most important parameters for predicting pCR and were retained in the diagnostic model. In the development group, the area under the receiver-operating characteristic curve (AUC) for predicting pCR is 0.88 (95% CI 0.78-0.97, p<0.001), with a sensitivity of 82.4% and a specificity of 83.6%. In the validation group, the AUC is 0.84 (95% CI 0.70-0.98, p=0.001), with a sensitivity of 81.8% and a specificity of 76.0%.

CONCLUSION

A diagnostic model including CATVpost, CATVRR, rT2wSIRR, and mrTRG was useful for predicting pCR after nCRT in patients with LARC and can increase the confidence of the organ-preserving strategy.

CLINICAL RELEVANCE/APPLICATION

Our study dealt with building an appropriate diagnostic model for predicting pCR in patients with LARC. We proved that parameters like cylindrical approximated tumor volume (CATV) after nCRT (CATVpost) and reduction rate of CATV (CATVRR) are also useful in assessing pCR. These findings could contribute to the medical community by enabling prescription of a patient-tailored treatment.

SSJ24-04 Evaluation of Pre-Treatment MR Elastography for the Prediction of Radiation-Induced Liver Disease

Tuesday, Dec. 3 3:30PM - 3:40PM Room: S402AB

Participants
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PURPOSE

MR elastography (MRE) is an established noninvasive imaging technique for quantifying liver stiffness for diagnosing fibrosis. The study purpose was to evaluate whether liver stiffness (LS) using MRE is associated with risk of developing radiation induced liver disease (RILD) in patients receiving radiation therapy (RT) for liver tumors.

METHOD AND MATERIALS

We identified patients who received RT (>=20 Gy) between 2010 and 2018 for primary liver cancer (hepatocellular or cholangiocarcinoma) or liver metastases, had an MRE exam <=6 months prior to RT, and had post-RT labs. LS was calculated as the mean across ROIs on 4 MRE slices. Based on previous studies, LS<3 kPa was considered normal and LS>=3.0 kPa as representing fibrosis. RILD was defined as an increase in Child-Pugh (CP) score of >=2 from baseline within 6 months of RT. Univariate Cox models were used to assess correlation.

RESULTS

95 patients were identified. Median age: 65 years, range [30,87]. 48 had primary liver cancer and 47 had liver metastases. Mean pre-RT LS was 3.9 kPa [1.8, 8.7]. Mean LS for patients with primary vs. metastatic tumors was 5.0 kPa vs 3.0 kPa (p<0.001). 19 patients (20%) developed RILD. Mean pre-RT LS was 5.1 kPa for patients who developed RILD vs. 3.6 kPA for patients who did not. Pre-RT LS>3.0 kPa was associated with increased risk of post-RT RILD (hazard ratio (HR) 9.3, 95% confidence interval (CI) 2.1, 40.4; p=0.003). Kaplan Meier analysis showed that 6-month survival-free of RILD for baseline LS<=3.0 kPa was 91% (95% CI: 76, 100) compared to 52% (95% CI: 35, 76) for LS>3.0 kPa. Additionally, BMI (HR 1.12 per 1 point BMI; 95% CI: 1.0, 1.2; p=0.005) and presence of cirrhosis (histologic or clinical evidence) (HR 4.9, 95% CI: 1.8, 12.0; p=0.002), were correlated with the development of post-RT RILD; whereas age, gender, CP score, gross tumor volume, and RT parameters (dose, fractions, or modality) were not significantly associated with risk of RILD.

CONCLUSION

Elevated pre-RT LS measured by MRE was associated with an increased risk of RILD in patients receiving high dose RT for liver tumors.

CLINICAL RELEVANCE/APPLICATION

Risk of radiation-induced liver disease (RILD) has limited the use of radiation therapy for management of liver cancer; MRE determined pre-RT liver stiffness may be a non-invasive predictor of RILD.

SSJ24-05 Early Results of Radiographic Response and Clinical Outcomes with 177Lu-DOTATATE in a Real-World Academic Clinical Practice

Tuesday, Dec. 3 3:40PM - 3:50PM Room: S402AB

Participants
Sai Duriseti, MD,PhD, St. Louis, MO (*Presenter*) Nothing to Disclose
Michael C. Roach, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Hyun Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Research Grant and Speakers Bureau, Varian Medical Systems, Inc; Research Grant and Speakers Bureau, ViewRay, Inc

PURPOSE

Treatment of advanced midgut neuroendocrine tumors with 177Lu-DOTATATE improves outcomes compared to octreotide alone as 2nd line therapy as demonstrated in the recent NETTER-1 trial. After its FDA approval, an increasing number of centers are implementing this therapy. Here we describe early efficacy of this treatment in the Department of Radiation Oncology at Washington University in St. Louis School of Medicine, including initial uptake verification, quantitative radiographic response, and early clinical outcomes with respect to patient clinical status and early serologic response.

METHOD AND MATERIALS

Patients were treated with 200 mCi of 177Lu-DOTATATE with a goal of delivering 4 infusions, each 2 months apart. After the 1st infusion, patents obtain an In-11 (111In) DOTATATE single photon emission computed tomography (SPECT) scan to verify uptake. After the 2nd infusion, we obtain a CT and/or MRI scan for response assessment. Depending on initial radiographic findings, we either continue with treatment, or reassess with a Fluorine-18 (18F) deoxyglucose or DOTATATE PET scan. Blood samples were collected between each treatment, as well as in the peri-infusion setting.

RESULTS

As of 4/1/2019, 39 patients have been treated at our institution. A total of 27 SPECT/CT scans were obtained after initial infusion or mid-treatment (after 2nd infusion) CT or MRI course of therapy. A total of 17 patients have completed all 4 treatments. 1 patient did not complete the full course of therapy. Of the 17 patients who completed therapy at time of analysis, follow up imaging was available for 16.

CONCLUSION

177Lu-DOTATATE delivery is feasible at a tertiary outpatient medical centers. Acute toxicities, distribution of uptake after infusion, and interval imaging at mid-way through treatment as well as at time of progression/failure will be reviewed. Early analysis of biomarkers and other factors predictive of clinical outcomes will be discussed as well.

CLINICAL RELEVANCE/APPLICATION

As the burden of patients surviving with metastatic tumors increase, the indications for targeted radiopharmaceuticals is expanding. Understanding real-world outcomes for novel radiopharmaceuticals helps refine these therapeutics.

SSJ24-06 Value of Contrast Enhanced Ultrasound with Perfusion Quantitative Analysis during Radiotherapy of Pancreatic Ductal Adenocarcinoma

Tuesday, Dec. 3 3:50PM - 4:00PM Room: S402AB

Participants
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PURPOSE

To evaluate the value of contrast enhanced ultrasound (CEUS) with perfusion quantitative analysis in monitoring the therapeutic effect of pancreatic ductal adenocarcinoma (PDAC) during radiotherapy.

METHOD AND MATERIALS

From October 2017 to March 2019, 21 patients with histopathologically confirmed local advanced PDAC were included (15 men, 6 women; mean age, 65 years ± 2). All patients treated with chemoradiotherapy (CRT). The radiotherapy dose was 50.4Gy/28Fx with S-1 40mg bid orally taken in radiotherapy day. CEUS were performed before and 4 weeks after CRT. All ultrasound examinations were performed by an ACUSON Oxana 2 ultrasound equipment (Siemens Medical Solutions, USA) with a C6-1 convex array transducer (1-6MHz). Time intensity curves (TICs) were created with SonoLiver (TOMTEC Imaging Systems). Quantitative perfusion indexes were generated and compared inside the PDAC lesion with 5×5 mm region of interest (ROI), including maximum intensity (MI), rise time (RT), mean transit time (MTT) and time to peak (TTP).

RESULTS

While comparing before and after radiotherapy, no significant difference could be found by conventional B mode ultrasound. After created CEUS TIC with perfusion quantitative analysis, significant decrease could be found in MI before and after radiotherapy (41.78 ± 20.15 dB vs 24.79 ± 18.12 dB).

CONCLUSION

Depending on its unique advantages such as non-radiation, effective and convenient, CEUS with perfusion quantitative analysis may be useful to evaluate the therapeutic effect during the radiotherapy of PDAC patients.

CLINICAL RELEVANCE/APPLICATION

CEUS with perfusion quantitative analysis might be a potential imaging method during follow up and observe of the clinical radiotherapy therapeutic effect in PDAC patients.

SSJ25

Vascular/Interventional (Aortic Disease)

Tuesday, Dec. 3 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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Raisa J. Durrani, MD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSJ25-01 The Growth of Common Iliac Aneurysms (CIA) Coexisting with Abdominal Aortic Aneurysm (AAA): Correlation with AAA and Predictive Factors

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E352

Participants
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Joseph Leach, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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Michael D. Hope, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Common iliac aneurysms (CIA) frequently coexist with abdominal aortic aneurysm (AAA), and expand over time with risk of rupture. Previous studies of CIA growth rely mostly on ultrasound, which may not be accurate and reproducible enough to characterize slowly growing CIAs. Intraluminal thrombus (ILT) has been studied as a marker of growth in AAA, but has not been studied in CIA yet. This study aims to examine the factors associated with growth of CIAs using serial CTA with multiplanar reconstruction (MPR).

METHOD AND MATERIALS

Data were collected from a single center from January 2000 to May 2018 in patients undergoing AAA surveillance. The maximal diameter of coexisting CIA was measured on CTA with MPR. Correlation of the baseline diameter and growth rate between CIA and AAA was evaluated. The presence of ILT in CIA and AAA was compared. Multivariate regression analysis was used to investigate the factors associated with CIA growth.

RESULTS

Seventy-one AAA patients (median age, 76 years old; all male) with 106 CIAs were identified, and were followed up for a median of 2.2 years (range, 0.6-9.2 years). The CIAs had baseline diameter of 2.3±0.6 cm with growth rate of 0.9±1.3 mm/year. CIA growth was positively correlated with AAA growth (r=0.43, P<0.01), whereas the baseline diameter of CIA and AAA were not significantly correlated (P=0.88). The presence of ILT in CIA was associated with that in AAA (P<0.01). Multivariate regression analysis showed that CIA baseline diameter, AAA baseline diameter, and smoking were positively related to CIA growth. In CIAs with diameters of 2-3cm (n=60), which consisted the largest subgroup (56.7%), the growth rate of CIA with ILT was more than double that of CIAs without ILT (1.6 mm/year vs. 0.7 mm/year, P=0.017).

CONCLUSION

CIA baseline diameter, AAA baseline diameter, and smoking are predictive of CIA growth. In CIAs of 2-3cm, presence of ILT predicts faster aneurysm growth and this important feature should be described in the radiology report so that shorter-interval surveillance can be considered.

CLINICAL RELEVANCE/APPLICATION

CIA baseline diameter, AAA baseline diameter, and smoking are predictive of CIA growth. In CIAs of 2-3cm, presence of ILT could be a risk factor for fast growth and may prompt earlier follow-up.

SSJ25-02 Diagnostic Imaging Using Contrast-Enhanced Ultrasound (CEUS) in Comparison to Other Non-Invasive Imaging Strategies in the Management of Patients with Possible Endoleak Type I/III after Endovascular Aortic Repair: A Cost-Effectiveness Analysis

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E352

Participants
Matthias F. Froelich, MD, Mannheim, Germany (*Presenter*) Consultant, Smart Reporting GmbH
Wolfgang G. Kunz, MD, Munich, Germany (*Abstract Co-Author*) Grant, Medtronic plc
Dirk-Andre Clevert, MD, Muenchen, Germany (*Abstract Co-Author*) Speaker, Siemens AG Speaker, Koninklijke Philips NV Speaker, Bracco Group Speaker, Samsung Electronics Co, Ltd

Johannes Ruebenthaler, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the cost-effectiveness of contrast-enhanced ultrasound (CE-US) in comparison to noninvasive imaging strategies in patients with possible type I or type III endoleak after endovascular aortic repair (EVAR).

METHOD AND MATERIALS

A decision model based on Markov simulations estimated lifetime costs and quality-adjusted life years (QALY) associated with the imaging strategies contrast-enhanced ultrasound (CE-US), Duplex ultrasound (DU-US), contrast-enhanced computed tomography angiography (CE-CT), and contrast-enhanced magnet resonance imaging angiography (CE-MR). United States healthcare data were used for analysis. Model input parameters were based on best available and most recent evidence (Table 1). Starting age was 70 years. The prior probability of a type I / III endoleak was set at 12.8 %, the reported frequency of type I / III endoleaks in literature. Probabilistic sensitivity analyses (PSA) were performed using 30,000 Monte Carlo simulations to estimate model uncertainty. The percentage of cost-effective iterations was determined for different willingness-to-pay (WTP) thresholds.

RESULTS

The base-case analysis showed that CE-US is dominant over CE-CT and CE-MR in the proposed model. CE-US led to increased lifetime QALYs compared to DU-US (9.56 QALYs vs. 9.53 QALYs) at slightly higher lifetime costs ($20,050 vs. $19,868). Therefore, CE-US was the optimal strategy in the base-case analysis for a WTP threshold of $100,000/QALY. In PSA, CE-US was the strategy with the highest percentage of cost-effective iterations if the WTP threshold was set higher than $10,000/QALY. In accordance with contemporary WTP thresholds and adjusting for model uncertainty, CEUS was determined as the most cost-effective strategy.

CONCLUSION

In patients undergoing endoleak surveillance after EVAR, CE-US is a cost-effective strategy for the detection and evaluation of type I and type III endoleaks.

CLINICAL RELEVANCE/APPLICATION

CE-US should be considered as surveillance imaging modality of choice in patients after EVAR.

SSJ25-03 Thoracic Endovascular Aortic Repair or Medical Treatment in Patients with Acute Uncomplicated Type B Aortic Dissection

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E352

Participants
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Lixia Wang, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Chuansheng Zheng, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of this retrospective study was to further assess the early and long-term (10-year) outcomes of thoracic endovascular aortic repair (TEVAR) in patients with acute uncomplicated type B aortic dissection (TBAD) compared with those receiving best medical treatment (BMT).

METHOD AND MATERIALS

Between February 2008 and March 2018, 357 patients with acute uncomplicated TBAD were retrospectively identified and divided into 2 groups, the TEVAR group (n = 191) and the BMT group (n = 166). Information about baseline characteristics and details of medical and endovascular management, in-hospital clinical events, length of stay, and in-hospital mortality were collected from the electronic medical record database. Initial diagnostic and follow-up computed tomography angiography images were retrieved from the imaging archiving system. The anatomic characteristics, extent of the dissection, thrombosis status of the false lumen and postoperative complications were retrospectively evaluated and documented. The final survival state was determined via the review of hospital admitting notes or telephone follow-up.

RESULTS

Clinical history was similar between groups. Although there is no significantly difference in in-hospital/30-day mortality rate, patients in TEVAR group had significantly higher early event rates than those in the BMT group (12.0% vs. 3.0%; p = 0.001). Late event rates were significantly higher in the BMT group compared with the TEVAR group (p = 0.004). Kaplan-Meier estimates demonstrated that patients in the BMT group had significantly more rupture and aortic enlargement than those in the TEVAR group (p = 0.014; p= 0.030, respectively). The cumulative survival rates from all causes of death at 1, 3, 5 years were 96.8%, 96.0%, 90.0% in the TEVAR group and 93.7%, 87.9%, 82.4% in the BMT group. Log-rank tests revealed a significantly higher all-cause mortality rate in the BMT group versus the TEVAR group (p = 0.020).

CONCLUSION

Despite more early complications, TEVAR has proven to be an effective treatment for acute uncomplicated TBAD in this study, with lower late event rates and mortality than BMT during the long-term follow-up.

CLINICAL RELEVANCE/APPLICATION

(dealing with acute uncomplicated type B aortic dissection) 'TEVAR has an advantage in stabilizing the dissected aorta, inducing aortic remodeling processes and promoting false lumen thrombosis, and it is recommended to consider it when formulating a treatment plan.'

SSJ25-04 Aortic Changes Following Acute Uncomplicated Medically-Managed Stanford Type B Aortic Dissection

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E352

Participants
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Thomas C. Bower, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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Thanila A. Macedo, MD, Rochester , MN (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To characterize longitudinal changes in the descending thoracic aorta following acute uncomplicated medically-managed Stanford Type B aortic dissection (SBAD).

METHOD AND MATERIALS

Longitudinal study of medically-managed SBAD after index admission to a single center between 1995-2015. Repeated measurements of the descending thoracic aorta were made using centerline oblique reformats of CT and MR imaging. Aorta-related events were captured including death, descending thoracic aorta aneurysm (max total diameter >40 mm), rupture, repair/fenestration, and intimomedial flap changes. Joint modelling was used to study the relationship between changing aortic anatomy and hazard of an aorta-related event.

RESULTS

There were 94 patients identified with medically-managed SBAD. Of those, 74 (79%) survived the index hospitalization and had imaging available. The median [IQR] radiological follow-up was 3.1 years [1.1-7]. Measurements were taken from 442 studies (399 CT, 90%). At index admission, 11 (16%) had a complex intimomedial flap, 47 (64%) a totally patent false lumen, and the median maximum total aortic diameter was 42 mm [37-47]; this was located in proximity to the left subclavian artery origin (zone 3) for 42 patients (57%). The growth velocity of the maximum total aortic diameter over 0-6 months was 2 mm/month [95%CI: 1.3-2.6], 6-12 months was 0.4 mm/month [-1-1.8], and 1-5 years was 0.1 mm/month [0-0.2]. In follow-up, 49 patients (66%) had an aorta-related event [18 aneurysmal degenerations (36.7%), 2 ruptures (4%), 22 repairs (45%), 4 flap changes (8.2%), 3 deaths (6.1%)] with event-free-survival of 70% at 6 months [61-81], 57% at 1 year [47-69], and 34% at 5 years [24-47]. Joint modelling demonstrated univariate association between risk of aorta-related event and maximal total descending aortic diameter (HR [95%CI]: 1.026 [1.02-1.031], p<0.0001), true lumen diameter at point of maximal total diameter (0.983 [0.968-0.998], p=0.03), and maximal false lumen diameter (1.013 [1.003-1.022], p=0.009).

CONCLUSION

For medically-managed SBAD, changes in the descending thoracic aorta over time, including maximum total, false lumen, and true lumen diameters, were associated with the hazard of aorta-related event.

CLINICAL RELEVANCE/APPLICATION

This study relates changing aortic anatomy to clinically-relevant outcomes for medically-managed Stanford Type B aortic dissection which can be used to inform management decisions.

SSJ25-05 Prediction of Abdominal Aortic Aneurysm Growth Rate Using Radiomic Feature Analysis of FDG PET-CT

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E352

Participants
Pratik Adusumilli, MBChB, Leeds , United Kingdom (*Presenter*) Nothing to Disclose
Mohammed Waduud, MRCS, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Marc Bailey, MRCS, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andrew F. Scarsbrook, FRCR, York, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Radiomics allows objective and quantitative assessment of medical images by analysing distribution and relationships of pixel grey levels. The technique has been used extensively to study tumours, however, the potential use for prediction of growth of abdominal aortic aneurysms (AAA) has not been established. The aim of this study was to explore the correlation between radiomic features extracted from FDG PET-CT and AAA growth.

METHOD AND MATERIALS

Patients with an unrepaired AAA who underwent FDG PET-CT between January 2009 and December 2016 for malignancy evaluation were selected from an institutional database. Patients underwent subsequent AAA surveillance with serial ultrasound. Radiomic feature analysis was performed with LIFEx software. Regions of interest were drawn over the AAA and blood pool within the aortic arch on the PET scan. Ratio of AAA SUV to blood pool (BP) activity was calculated along with 40 radiomic features. Bivariate Pearson correlation was calculated with Bonferroni correction for multiple testing. A control group of patients without AAA were also analysed. AAA growth rate was calculated using initial and final aortic calibre measurements for the trial group and normal aortic growth rates in the control group.

RESULTS

50 patients (mean age 74 years, 40 male) were included in the study. A correlation was considered significant if it had a p value of < 0.001 in the trial group and no correlation in the control group. There was no correlation between AAA:BP SUV ratio and

aneurysm growth. Significant correlations were found between AAA growth rate and GLCM Homogeneity (a measure of local homogeneity), GLCM Contrast (a measure of local variation) and GLCM Dissimilarity (a measure that defines the variation of grey level pairs in an image). The Pearson correlation and significance for these features were .483; 0.001, -.428; 0.0001 and -.462; 0.001 respectively.

CONCLUSION

Radiomic features extracted from AAA at FDG PET-CT may provide useful risk stratification metrics which could be used to identify patients at higher risk of rupture. Further evaluation in a larger prospective cohort with a more advanced method of estimating AAA growth is required to validate these initial findings.

CLINICAL RELEVANCE/APPLICATION

Radiomic features extracted from AAA at FDG PET-CT might be considered as a risk stratification tool in future studies to predict aneurysms at higher risk of significant expansion.

SSJ25-06 Investigation of the Quality Reserve Provided by Digital Variance Angiography in Fenestrated and Branched Endovascular Aortic Aneurysm Repair Setting

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E352

Participants
Eric Verhoeven, MD,PhD, Nuremberg, Germany (*Abstract Co-Author*) Nothing to Disclose
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Viktor I. Orias, MD, Budapest, Hungary (*Presenter*) Clinical Research and Development Specialist, Kinepict Health Kft

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PURPOSE

Kinetic imaging is a novel image processing algorithm providing enhanced image quality in X-ray angiography setting. The algorithm produces so;called Digital Variance Angiography (DVA) images. The study objective was to assess the quality reserve of DVA images by comparing the performance to standard digital subtraction angiography (DSA) in fenestrated and branched endovascular aortic aneurysm repair (F/B-EVAR) setting.

METHOD AND MATERIALS

Retrospective evaluation of image data of 30 patients undergoing F/B-EVAR at our institution without any preselection. The signal-to-noise ratio (SNR) of DSA and DVA images was measured and compared. The same raw image data were used to generate dynamic DSA and DVA runs. The videos were compared by six experts in a randomized blinded questionnaire. Fleiss' Kappa-test was used to determine interrater agreement.

RESULTS

DVA images provided 1.49 times higher SNR than DSA (median value, Q1-Q3 interval 1.14-1.81). Evaluators preferred DVA over DSA images in 85.9% of comparisons. The interrater agreement was 91.3% and Fleiss's kappa was 0.21 ($p<0.001$).

CONCLUSION

DVA-imaging enhances angiographic image quality compared to DSA-imaging in F/B-EVAR setting. The observed quality reserve of DVA provides opportunities to reduce both radiation-dose and the amount of contrast agent. A prospective study based on these results could confirm the achievable amount of dose reduction without significant image quality loss.

CLINICAL RELEVANCE/APPLICATION

Digital Variance Angiography (DVA) is a novel medical image processing method that significantly improves the image quality of X-ray angiograms compared to Digital Subtraction Angiography The quality reserve of DVA may allow a substantial amount of radiation dose reduction in the F/B-EVAR setting without affecting the quality and diagnostic value of angiograms. Further prospective research is necessary to determine the precise refinement of dose protocols.

SSJ26

Vascular/Interventional (Biliary and Portal Hypertension)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E350

GI IR VA

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

Participants
Mona B. Ranade, MD, Brookfield, WI (*Moderator*) Nothing to Disclose
Seetharam C. Chadalavada, MD,MS, Cincinnati, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSJ26-01 Clinical Effectiveness of Percutaneous Endoscopic Holmium Laser Lithotripsy for Symptomatic Intra/Extrahepatic Biliary Stones

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E350

Participants
Riccardo Muglia, MD, Pieve Emanuele , Italy (*Presenter*) Nothing to Disclose
Dario Poretti, MD, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose
Ezio Lanza, MD, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesca Colapietro, Pieve Emanuele , Italy (*Abstract Co-Author*) Nothing to Disclose
Felice D'Antuono, MD, Rocchetta Sant'Antonio, Italy (*Abstract Co-Author*) Nothing to Disclose
Vittorio Pedicini, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To retrospectively assess the efficacy, safety and follow-up of percutaneous endoscopic holmium laser lithotripsy for symptomatic intra/extrahepatic biliary stones.

METHOD AND MATERIALS

We retrospectively evaluated 28 patients (M:F=19:9, median age=68.5 years) with intrahepatic and/or extrahepatic biliary stones, undergoing 43 percutaneous, transhepatic lithotripsies with holmium laser from 2012 to 2018 in a single center.Data collected were: patient characteristics; location and amount of stones; post-procedural symptoms and complications; length of hospital stay; clinical success rate.Endoscopic retrograde cholangiopancreatography was precluded due to bilio-enteric anastomosis in 12/28 (43%) patients, distal gastrectomy in 5/12 (18%), and for prior biliary interventions followed by a fistula, ultimately leading to biliary stenosis in 11/28 (39%).

RESULTS

Twenty patients (71%) received one only lithotripsy, three (11%) underwent two procedures, five (18%) had 3 or more lithotripsies.Multiple interventions were scheduled due to the elevated amount of stones to treat (13/15, 87%) or for new symptomatic biliary stones (2/15, 13%) during follow-up.Stones were localized in intrahepatic ducts (21/43, 49%), extrahepatic ducts (15/43, 33%) or both in intra- and extrahepatic ducts (8/43, 18%).Treatments lasted averagely 115 minutes; we fragmented 1 to 3 stones in 12 treatments (28%) and more than 3 stones in 31 (72%).After lithotripsy, 15 patients (53%) had sepsis with positive hemoculture treated with antibiotics, 2 (7%) had mild intrahepatic bleeding, treated conservatively. Only 1/15 septic patient was admitted in the intensive care unit and discharged after 26 days.Median hospital stay was 5.5 days (range 2-42).Our cohort was followed up for a median time of 17.5 months (0-66) from the first treatment.Twenty-two patients (79%) reached clinical success after lithotripsy, while six (21%) experienced further cholangitis and were readmitted for antibiotic therapy (3/6) or ERCP (3/6).

CONCLUSION

Percutaneous endoscopic holmium laser lithotripsy is effective in treating symptomatic intrahepatic and extrahepatic biliary stones, though burdened by a high incidence of postoperative sepsis.

CLINICAL RELEVANCE/APPLICATION

Percutaneous endoscopic holmium laser lithotripsy could be considered an option for first-line treatment of symptomatic intrahepatic and extrahepatic biliary stones, when ERCP is precluded.

SSJ26-02 Comparison of Percutaneous Endobiliary Radiofrequency Ablation with Stent Placement versus Stent Placement Alone for Treating Malignant Biliary Obstruction: Is There an Added Benefit?

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E350

Participants
Wei Cui, Guangzhou, China (*Presenter*) Nothing to Disclose
Jiaping Li, Guangzhou , China (*Abstract Co-Author*) Nothing to Disclose
Xiaoming Chen, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To retrospectively compare the outcomes of endobiliary radiofrequency ablation and stent placement (RFA-Stent) with stent placement alone (Stent) in treating unresectable malignant biliary obstruction (MBO).

METHOD AND MATERIALS

The study was approved by the institutional review board, and the requirement to obtain informed consent was waived. Seventy patients (mean age, 61.4 years; 45 men [64.3%]) who underwent RFA-Stent and 63 (mean age, 65.6 years;34 men [54.0%]) who underwent Stent for unresectable MBO from June 2013 to June 2018 were included. Overall survival (OS), primary and secondary stent patency (PSP, SSP), complications were compared according to level of biliary obstruction (subgroup): Type A (distal, Bismuth Types I and II biliary obstruction) and Type B (Bismuth Types III and IV biliary obstruction). Survival curves were calculated by performing the Kaplan-Meier method and compared by using the log-rank test and Cox regression models.

RESULTS

PSP and SSP were significantly longer for the RFA-Stent group than the stent group (PSP: 8.5 months vs. 4.5 months, $P < 0.001$; SSP: 9.0 months vs. 5.1 months, $P < 0.001$), but with OS being comparable (6.0 months vs. 4.5 months, $P = 0.160$). In subgroup analysis, RFA-Stent showed significant OS (8.0 months vs. 5.0 months; $P = 0.026$) benefits compared to Stent in patients with Type A MBO, but with comparable outcomes in patients with Type B MBO (5.0 months vs. 3.2 months; $P = 0.962$). The PSP and SSP was improved in both subgroups (Type A, PSP: 8.5 months vs. 4.5 months; $P= 0.002$; SSP: 9.0 months vs. 5.0 months, $P < 0.001$; Type B, PSP: 8.0 months vs. 6.0 months, $P = 0.045$; SSP: 12.0 months vs. 6.0 months, $P = 0.005$, respectively). The rate of complication was comparable for the RFA-stent group when compared to the stent group (all $P > 0.05$). In Cox analysis, RFA-Stent modality, performance status score 0, A type of biliary obstruction, total bilirubin<=166.8μmol/L and total bilirubin decrease value after stent placement procedure greater than 21.5μmol/L were favorable prognostic factors for OS. RFA-Stent modality, total bilirubin<= 166.8μmol/L were favorable prognostic factors for PSP. RFA-Stent modality, age older than 65 years, total bilirubin <= 166.8μmol/L were favorable prognostic factors for PSP (all $P < 0.05$).

CONCLUSION

In this retrospective study, RFA-Stent was associated with improved stent patency in patients with MBO. In addition, RFA-Stent may be associated with improved survival in patients with Type A MBO.

CLINICAL RELEVANCE/APPLICATION

RFA-Stent was associated with improved stent patency in patients with MBO. In addition, RFA-Stent may be associated with improved survival in patients with Type A MBO.

SSJ26-03 Effect of Intra-Gastric Satiety-Inducing Device on Food Intake, Body Weight Gain, and Satiety-Related Hormones in Rat Model

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E350

Participants
Yingen Luo, Beijing, China (*Presenter*) Nothing to Disclose
Jiaywei Tsauo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
He Zhao, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Jingui Li, Beijing , China (*Abstract Co-Author*) Nothing to Disclose
Xiao Li, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the effect of an intra-gastric satiety-inducing device (ISD) on food intake, body weight gain, and satiety-related hormones in a rat model.

METHOD AND MATERIALS

The institutional animal care and use committee approved this study. Thirty-two male Sprague Dawley rats weighing 250-300g were randomly divided into four groups of eight each. The ISD (constructed in-house) used was comprised of a 4-mm-diameter 1.5-cm-length straight nitinol stent for the lower esophagus, and one (single-disk) or two (double-disk) 2.5-diameter flat star-shaped nitinol disks for the fundus of stomach. Single-disk and double-disk group rats underwent peroral placement of a single- and double-disk ISD, respectively, and control group rats underwent peroral placement of an ISD with no disk. To prevent migration, the stent part of the ISD was surgically fixed to the esophageal wall using sutures. All operations were performed under direct visualization *via* a laparotomy with fluoroscopy assistance. Sham group rats underwent sham operation. All rats were supplied with food and water ad libitum and were euthanized 4 weeks after the operation.

RESULTS

Technical success was achieved in all rats. One rat in double-disk group died 2 weeks after the operation due to gastric perforation. The remaining rats survived until the end of the study without any complications. The mean food intake over the 4 weeks after the operation was significantly different between the four groups (all $P < .05$). Specifically, the mean food intake was significantly lower in both ISD groups than it was in the control and sham groups (all $P < .05$) but was not significantly different between the single- and double-disk ISD groups ($P > .05$) and the control and sham groups ($P > .05$). The mean body weight gain 4 weeks after the operation was significantly different between the four groups ($P < .05$). Specifically, the mean body weight gain was significantly lower in the double-disk ISD group than it was in the single-disk ISD, control, and sham groups (all $P < .05$), and was significantly lower in the single-disk ISD group than it was in the sham group ($P < .05$), but was not significantly different between the single-disk ISD and control groups ($P > .05$). The mean fasting serum ghrelin and leptin levels 2 and 4 weeks after the operation were not significantly different between the four groups ($P > .05$).

CONCLUSION

ISD could reduce food intake and body weight gain but does not affect satiety-related hormones in a rat model.

CLINICAL RELEVANCE/APPLICATION

ISD might be an effective treatment for obesity which can overcome existing problems. (This is a proof-of-concept animal study.)

SSJ26-04 Non-Invasive Assessment of Portal Hypertension in HBV-Related Liver Cirrhosis with Spectral CT Iodine Density: A Correlation Study with HVPG

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E350

Participants
Jian Dong, PhD, Beijing, China (*Presenter*) Nothing to Disclose
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Changchun Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the feasibility of spectral CT iodine density in evaluation of portal hypertension by correlation with hepatic venous pressure gradient (HVPG) in patients with liver cirrhosis.

METHOD AND MATERIALS

Thirty-one patients (F/M,13/18, mean age 44.2 ± 7.8 years old) with liver cirrhosis were recruited in this study, and they were all performed three phases contrast enhanced spectral CT within 1 week before TIPS, with HVPG recorded during the interventional surgery. All CT raw data were reconstructed at 1.25 mm slice thickness, and liver and spleen volume were measured in venous phase images. Iodine density (in milligrams per milliliter) were measured on iodine-based material decomposition images. Multiple regions of interest (ROIs) in liver parenchyma, aorta and portal vein were selected from three slices of images with portal vein trunk as the central one, and mean liver parenchymal iodine density from arterial phase, venous phase and delayed phase were recorded. Quantitative indices of iodine density (ID) of liver (IDLAP) and spleen (IDSAP) parenchyma for arterial phase, venous phase (IDLVP) and (IDSVP), ID of portal vein in venous phase (IDPVP) were measured and correlated with HVPG, with statistical significance as $P<0.05$.

RESULTS

For Child-Pugh stage in 31 patients, 12 were grade A, 15 grade B, and 4 grade C. Correlation of quantitative indices with HVPG were as following: (1) no correlation was found between liver and spleen volume, IDLAP, IDSAP, IDSVP and IDLVP with HVPG; (2) IDPVP was found to be independently correlated with the HVPG ($P<0.01$); (3) With threshold set as 54.3, IDPVP demonstrates 69.5% sensitivity, 62.1% specificity, 72.6% positive predictive value and 64.7% negative predictive value in the diagnosis of clinically significant portal hypertension (HVPG >=12mmHg), respectively.

CONCLUSION

Spectral CT Iodine density demonstrates feasibility in evaluation of clinically significant portal hypertension in liver cirrhosis as a noninvasive imaging modality.

CLINICAL RELEVANCE/APPLICATION

It is possible to evaluate clinically significant portal hypertension with quantitative index of iodine density in spectral CT noninvasively.

SSJ26-05 Intravascular Ultrasound (IVUS) Guided Transjugular Intrahepatic Portosystemic Shunts (iTIPS): One-Year Clinical Outcomes

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E350

Participants
Philip A. Velez, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
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Olaguoke K. Akinwande, MD , Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Seung Kwon Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Christopher D. Malone, MD, St. Louis, MO (*Presenter*) Nothing to Disclose

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PURPOSE

Use of intravascular ultrasound (IVUS) to guide portal vein puncture for transjugular intrahepatic portosystemic shunts (iTIPS) has increased in recent years, showing improved procedural metrics such as procedure time, contrast, and radiation doses over conventional techniques. Here we aim to evaluate the one-year clinical outcomes of patients undergoing iTIPS placement at our institution.

METHOD AND MATERIALS

All patients having undergone iTIPS placement between January 2016-March 2018 with 1-year clinical follow up were retrospectively analyzed. Medical records were reviewed for TIPS indication, clinical and demographic data, procedural details, clinical outcomes, and need for TIPS revisions. Clinical success was defined as requiring a decrease need or discontinuation of paracentesis/thoracentesis or absence of variceal bleeding for those respective primary indications. Technical success, 30-day complication rate, and need for TIPS revisions through one year post procedure were evaluated.

RESULTS

A total of 43 patients underwent iTIPS for refractory ascites (58%), control or secondary prevention of variceal bleeding (38%), or other (4%) with median Na-MELD of 14 (range 7-25). Technical success rate was 98%, with only one procedure having been aborted due to unfavorable anatomy and presence of portal vein thrombus, and was successfully reattempted with IVUS 1 month later. Complications within 30 days were only seen in 2 patients (4.7%) consisting of acute respiratory failure and heart failure decompensation. There were no bleeding complications. The clinical success rate at one year was 88.4%. 13 patients (30%) underwent revision(s) within one year. However, of these revisions only 4 (9%) had clinical evidence of TIPS malfunction (3 with reaccumulated ascites burden and 1 with variceal rebleed).

CONCLUSION

Use of IVUS for TIPS placement is highly technical successful with low 30-day complication rates and provides durable 1 year efficacy in controlling ascites and variceal bleeding. While the revision rate over 1 year was 30%, only a minority of these manifested with clinical signs of TIPS malfunction.

CLINICAL RELEVANCE/APPLICATION

iTIPS not only provides improved procedural metrics as previously reported, but shows durable 1-year clinical success, acceptable revision rates, and low 30-day complications.

SSJ26-06 Creation of a Haptic 3D Printed Simulator for TIPS Training in Augmented and Virtual Reality

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E350

Participants
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Adriene Eastaway, MD, Sandy, UT (*Abstract Co-Author*) Nothing to Disclose
Gabriel C. Fine, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Abigail R. Cogman, DO, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Michael D. Weintraub, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Claire Kaufman, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Keith B. Quencer, MD, Salt Lake City, UT (*Abstract Co-Author*) Research support, Cook Group Incorporated
Brendan Crabb, BS, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Edward P. Quigley III, MD,PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

TIPS creates artificial channel within the cirrhotic liver from inflow portal vein to outflow hepatic vein. TIPS morbidity and mortality is high due to patient risk factors and complex anatomy.

METHOD AND MATERIALS

Our developments in 3D printing biomimetic haptic simulators coregisters patient specific anatomy to produce a realistic VR/AR environment. Patient CTA images (Siemens, Germany) are converted to 3D objects using Mimics (Materialis, Belgium). Individual models of liver, portal, hepatic, caval veins, arteries, and bones were used to create multicolor virtual models of operative field. Each model components are individually 3D printed. Osseous structures are printed using fused deposition modeling on Fusion 3D and Ultimaker 3 printers, using polylactic acid (PLA). Hollow vessels were made in Formlabs elastic resin and connected to 3D printed manifolds and pumps. Liver is molded into 3D printed reusable liver mold. VR model, patient CT abdomen images are coregistered and overlaid upon haptic simulator using the Novarad Opensight software (Novarad Corporation, South American Fork, UT) and Microsoft HoloLens augmented reality platform (Microsoft Corporation, Redmond, WA.

RESULTS

Trainees in AR/VR/MR environment can see virtual model while doing TIPS on realistic 3D-printed haptic model. Prior to patient procedure, they can practice critical skills: TIPS creation, stent deployment, TIPS remodeling.

CONCLUSION

Virtual reality/augmented reality (VR/AR) is a critical training tool for patient-specific image-guided procedures such as TIPS. Training VR/AR simulation environments prior to performing TIPS enhances user confidence, decrease complications, procedural time, and radiation exposure. We demonstrate an ideal TIPS teaching model utilizing 3D printed haptic simulator, the Microsoft HoloLens, and the co-registered haptic/virtual simulator using the Novarad Opensight Software.

CLINICAL RELEVANCE/APPLICATION

To create 3D printed patient specific transjugular intrahepatic portosystemic shunt (TIPS) simulators fused with virtual reality (VR) and augmented reality (AR) to improve trainee performance, decrease procedure time, radiation dose, and clinical morbidity and mortality.

VSIO32

Interventional Oncology Series: Colorectal Liver Metastases

Tuesday, Dec. 3 3:15PM - 5:15PM Room: S405AB

GI IR OI RO

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

FDA Discussions may include off-label uses.

Participants
Constantinos T. Sofocleous, MD, PhD, New York, NY (*Moderator*) Consultant, General Electric Company; Consultant, Johnson & Johnson; Consultant, Terumo Corporation; Research support, BTG International Ltd; Research support, Johnson & Johnson; ; ;
Sarah B. White, MD, Milwaukee, WI (*Moderator*) Research support, Guerbet SA; Research support, Siemens AG; Research support, Instylla; Research support, InSightec Ltd; Consultant, Guerbet SA; Consultant, BTG International Ltd; Consultant, Cook Group Incorporated; Consultant, Strategies MD

Sub-Events

VSIO32-01 Immunotherapy in the Treatment of CRC: Synergy with Interventional Oncology

Tuesday, Dec. 3 3:15PM - 3:30PM Room: S405AB

Participants
Ursina Teitelbaum, Philadelphia, PA (*Presenter*) Nothing to Disclose

VSIO32-02 Is a Cure Possible in Patients Undergoing Liver Resection with mCRC?

Tuesday, Dec. 3 3:30PM - 3:45PM Room: S405AB

Participants
Michael D'Angelica, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Be able to define the rate of cure after complete resection of cure after resection of colorectal liver metastases. 2) Be able to discuss the factors associated with differences in rate of cure. 3) Be able to discuss the role of surgery in the treatment of colorectal liver metastases.

VSIO32-03 Rad Onc: Is XRT a Good Alternative to Ablation? Any Data Specifically for CLM?

Tuesday, Dec. 3 3:45PM - 4:00PM Room: S405AB

Participants
Karyn A. Goodman, MD, Aurora, CO (*Presenter*) Scientific Advisory Board, RenovoRx

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LEARNING OBJECTIVES

1) Appreciate the clinical outcomes of SBRT for metastatic liver disease, in particular colorectal liver metastases. 2) Understand the selection criteria for SBRT for liver metastases 3) Compare the appropriateness and outcomes of SBRT versus ablation for liver metastases in various treatment scenarios. 4) Assess the potential for combining SBRT with other liver-directed therapies.

VSIO32-04 Increases in Cell Proliferation and Angiogenesis Markers in Untreated Tumors Following Radiofrequency Ablation of Liver Tumors

Tuesday, Dec. 3 4:00PM - 4:10PM Room: S405AB

Participants
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Jens Ricke, MD,PhD, Berlin, Germany (*Abstract Co-Author*) Research Grant, Sirtex Medical Ltd Research Grant, Bayer AG
Haixing Liao, PhD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To elucidate potential systemic off-target effects of radiofrequency ablation (RFA) in distant non-treated hepatocellular carcinoma

(HCC) and liver metastases of colorectal cancer.

METHOD AND MATERIALS

A prospective, national multicenter single-arm trial (THIAMAT) was performed on 9 patients undergoing 2 treatment sessions scheduled 2 weeks apart to treat multiple histologically confirmed HCC (n=3) or oligometastatic colorectal cancer (n=6) with RFA. In each session, core biopsy of a target tumor was obtained using coaxial technique prior to the RFA. This enabled comparison of the potential effects of the first treatment upon remote, non-ablated tumors. Samples were stained with immunohistochemistry of Ki-67 and CD34 to measure proliferation index and microvascular density, respectively. At least 5 high power fields for each patient and each staining were obtained and evaluated for positive stained cells by 3 blinded experienced readers. Pre- and post-treatment data were compared with 2-tailed Student t test.

RESULTS

Of 7 patients with diagnostic quality material on both biopsies, 4 (57.1%) demonstrated a statistically significant increase in one or both markers. CD34 was increased in 3 of 7 patients (42.8 %), (2x, 2x and 3x fold increases, all $p<0.01$). Ki-67 was statistically significant increased in 2 patients (5.1±3.0 to 18.6±12.9 and 2.6±1.3 to 15.4±3.6; $p<0.01$, both comparisons), with 1 patient having significant increases in both markers. An additional patient had several clusters of increased Ki-67 positive staining compared to baseline, which did not reach significance using parametric statistical testing ($p=0.15$).

CONCLUSION

RFA of liver tumors can induce increased proliferation and promote angiogenesis in distant non-treated tumors. These preliminary data provide further evidence of potentially systemic off-target effects put into motion by interventional oncologic treatment in the clinical setting. Further ongoing data collection may provide better understanding of underlying mechanisms and thus offer valuable insights into potential options for new diagnostic and therapeutic approaches to improve patient care by mitigating this unwanted phenomenon.

CLINICAL RELEVANCE/APPLICATION

Insights on mechanisms of potential off-target effects of minimally invase treatment may lead to development of combination therapies that can potentiate the effect of these procedures and thus provide better patient care.

VSIO32-05 IR: Role of Ablation in the Treatment of mCRC-Could It Ever Replace Resection?

Tuesday, Dec. 3 4:10PM - 4:25PM Room: S405AB

Participants
Constantinos T. Sofocleous, MD, PhD, New York, NY (*Presenter*) Consultant, General Electric Company; Consultant, Johnson & Johnson; Consultant, Terumo Corporation; Research support, BTG International Ltd; Research support, Johnson & Johnson; ; ;

VSIO32-06 IR: Role for IAT in mCRC-What is the Evidence for Abscopal Effects?

Tuesday, Dec. 3 4:25PM - 4:40PM Room: S405AB

Participants
Riad Salem, MD, MBA, Chicago, IL (*Presenter*) Research Consultant, BTG International Ltd Research Grant, BTG International Ltd Consultant, Eisai Co, Ltd Consultant, Exelixis, Inc Consultant, Bristol-Myers Squibb Company Consultant, Dove

LEARNING OBJECTIVES

1) Learn about intra arterial therapies. 2) Discuss long-term outcomes and compare to surgical treatments.

ABSTRACT

VSIO32-07 Radioembolization-Induced Chronic Hepatotoxicity: A Multi-Center Study

Tuesday, Dec. 3 4:40PM - 4:50PM Room: S405AB

Participants
Brian M. Currie, MD , Philadelphia, PA (*Presenter*) Nothing to Disclose
Daniel B. Brown, MD, Nashville, TN (*Abstract Co-Author*) Research Support, Sirtex Medical Ltd Consultant, C. R. Bard, Inc Consultant, BTG International Ltd
Nicholas Fidelman, MD, San Francisco, CA (*Abstract Co-Author*) Research Grant, BTG International Ltd
Steven C. Rose, MD, San Diego, CA (*Abstract Co-Author*) Stockholder, Sirtex Medical Ltd Proctor, Sirtex Medical Ltd Scientific Advisory Board, Surefire Medical, Inc Consultant, Surefire Medical, Inc Stockholder, Surefire Medical, Inc Consultant, Embolx, Inc Consultant, Guerbet SA Consultant, XLSciTech, Inc
Sarah B. White, MD, Milwaukee, WI (*Abstract Co-Author*) Research support, Guerbet SA; Research support, Siemens AG; Research support, Instylla; Research support, InSightec Ltd; Consultant, Guerbet SA; Consultant, BTG International Ltd; Consultant, Cook Group Incorporated; Consultant, Strategies MD
Ghassan El-Haddad, MD, Tampa, FL (*Abstract Co-Author*) Advisory Board, Actinium Pharmaceuticals, Inc; Advisory Board, Oncoinvent, AS; Research Consultant, Canon Medical Systems Corporation; Speaker, Novartis AG;
Sharon W. Kwan, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Etay Ziv, MD,PhD, New York, NY (*Abstract Co-Author*) Research Grant, Johnson & Johnson;
Nahyun Jo, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rony Avritscher, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Matthew S. Johnson, MD, Indianapolis, IN (*Abstract Co-Author*) 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, Surefire Medical, Inc Research support, Surefire Medical, Inc Research Consultant, Johnson & Johnson Research Consultant, Avantec
Michael C. Soulen, MD, Lafayette Hill, PA (*Abstract Co-Author*) Consultant, F. Hoffmann-La Roche Ltd; Consultant, Guerbet SA; Research support, Guerbet SA; Research support, BTG International Ltd; Proctor, Sirtex Medical Ltd;

For information about this presentation, contact:

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PURPOSE

The acute and subacute hepatic sequelae of trans-arterial radioembolization (TARE) are relatively well-characterized, but there is a paucity of literature evaluating delayed hepatotoxicity. Previous single-institution studies have been limited by the use of qualitative criteria for liver dysfunction and lack of rigorous attribution of toxicities. The objective of this multicenter study was to identify and describe TARE-related chronic hepatoxicity using standardized quantifiable metrics and multidisciplinary adjudication.

METHOD AND MATERIALS

IRB-approved multi-center retrospective analysis of all neuroendocrine tumor patients from 10 institutions receiving TARE from 2005-2018 and surviving at least one year from the initial TARE (n=166). Patients were evaluated for the presence or absence of Grade 3 or above hepatic toxicities occurring at least 6 months after TARE. The mean age of patients was 56 with a slight male predominance at 52%. Adjudication of hepatic decompensation was performed by a multidisciplinary panel from each institution comprised among hepatology, radiation oncology, medical oncology, and interventional oncology.

RESULTS

There were 57 patients (34%) who developed chronic Grade 3 and above hepatic toxicities with a total of 68 Grade 3 and 26 Grade 4 events, with ascites being the most common. There are least five deaths attributed to hepatic decompensation (3%), without evidence of underlying disease progression or another more plausible precipitant. Patients developing toxicities were more frequently treated with prior locoregional therapy 32% vs. 21% ($p = 0.18$) but received less cumulative activity, 67 vs. 78 mCi ($p = 0.18$). There was no difference in the number or treatments received (1.7 vs. 1.9) or the number of patients with intrahepatic tumor volume greater than 50% (29% vs. 28%).

CONCLUSION

Delayed hepatic toxicity occurred in 34% of patients following radioembolization with five fatalities adjudicated to be a result of the treatment. Patients treated with prior locoregional therapies may be predisposed to developing chronic toxicity.

CLINICAL RELEVANCE/APPLICATION

Chronic liver injury stemming from radioembolization remains an incompletely characterized phenomenon that leads to substantial morbidity and mortality. Fully elucidating this process would significantly impact patient care.

VSIO32-08 **Tumor Board**

Tuesday, Dec. 3 4:50PM - 5:15PM Room: S405AB

MSAS34

Reality Check: The Continuing Collision of Health, Technology, and Design (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Dec. 3 3:30PM - 5:00PM Room: S105AB

LM

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

Participants
Morris A. Stein, BArch, Phoenix, AZ (*Moderator*) Nothing to Disclose
William A. Undie, PhD, RT, Houston, TX (*Presenter*) Nothing to Disclose
Morris A. Stein, BArch, Phoenix, AZ (*Presenter*) Nothing to Disclose
Carlos L. Amato, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mstein@hksinc.com

LEARNING OBJECTIVES

1) Understand how and why to prepare for new ways of delivering healthcare imaging technologies and the design implications for people, place and function. 2) Describe why it is dangerous to overestimate technology and lose human touch. 3) Obtain a new perspective to help navigate and plan for new technology work flow and operational success.

ABSTRACT

Explore how the continuing relationship of medicine and health technology has changed the world of healthcare design and where it has not. Consider how successful previous predictions and visions were and the likelihood of a predictable future. This presentaiton loks to multiple forces of change that can potentially influence future heath facilites' planning and desgin. Presenters will propose what-if scenarios and have taken a further step to extrapolate these trends and formulate possible visions for the future. They wil share research focused on solutions that combine health, technology and design.

Printed on: 10/29/20

MSCC34

Case-based Review of Nuclear Medicine: PET/CT Workshop-Advances in PET (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Dec. 3 3:30PM - 5:00PM Room: E450B

BQ CT NM

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

FDA Discussions may include off-label uses.

Participants

Chadwick L. Wright, MD,PhD, Columbus, OH (*Moderator*) Nothing to Disclose

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wright.491@osu.edu

Sub-Events

MSCC34A Fluciclovine/PSMA PET Cases

Participants

Andrei Iagaru, MD, Emerald Hills, CA (*Presenter*) Research Grant, General Electric Company Research Grant, Progenics Pharmaceuticals, Inc Research Grant, Advanced Accelerator Applications SA

LEARNING OBJECTIVES

1) List some of the molecular imaging targets that are used in prostate cancer. 2) Understand underlying biology and mechanism of action for some of the new PET radiopharmaceuticals in prostate cancer. 3) Discuss patterns of prostate cancer appearance when using some of the new PET radiopharmaceuticals.

ABSTRACT

Data from the American Cancer Society suggests that prostate cancer will continue to be the leading cancer diagnosis in men with 164,690 estimated new cases and will have the second highest mortality (after lung cancer) with 29,430 estimated deaths for 2018 in the United States. Initial and subsequent treatment of prostate cancer may involve surgery, radiation therapy, hormonal therapy, chemotherapy, or a combination of these. Additional molecular pathways in prostate cancer lead to the identification of new targets that may be amenable to diagnostic and therapeutic intervention with novel agents. Areas of interest for the Nuclear Medicine and Molecular Imaging community include mainly aminoacid analogues (Fluciclovine) and the prostate specific membrane antigen (PSMA), but also gastrin releasing peptide receptors (GRPR).

MSCC34B Somatostatin Receptor PET Cases

Participants

Corina Millo, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

millocm@nih.gov

LEARNING OBJECTIVES

1) Understand the rational and complexity of imaging neuroendocrine tumors. 2) Describe different categories of SSTR-2 positive tumors and their molecular characteristics relevant to the imaging algorithm. 3) Discuss the impact of molecular imaging on management of neuroendocrine tumors.

ABSTRACT

Neuroendocrine tumors (NET) are unique in that they overexposes the somatostatin receptor (SSTR). This can be leveraged in imaging by labelling somatostatin analogs with radiation to image the location of tumors. DOTATATE is a SSTR analog, that when labeled with Gallium-68 can be used to image neuroendocrine tumors with very high sensitivity and specificity. It is important to remember that although SSTR PET using Ga68 DOTATATE is very effective, conventional imaging using either CT or MRI will remain the most common imaging modality for NET patients over time. Beyond imaging, SSTR analogs can be labeled with beta emitters than can be used therapeutically. During this case review session we will discuss a wide range of cases demonstrating both common and esoteric imaging and clinical aspects encountered in patients with SSTR-2 positive tumors.

MSCC34C Response Assessment

Participants

David A. Mankoff, MD, PhD, Philadelphia, PA (*Presenter*) Speaker, Koninklijke Philips NV Consultant, General Electric Company Advisory Board, RefleXion Medical Inc Consultant, Blue Earth Diagnostics Ltd Research Funded, Siemens AG Advisory Board, ImaginAb, Inc Spouse, Owner, Trevarx

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) List applications of molecular imaging as a cancer biomarker. 2) Describe clinical setting for which molecular imaging response approaches are applicable. 3) Discuss investigational agents being investigated for response assessment and early results.

ABSTRACT

This talk will review molecular imaign approaches for cancer, considering molecular imaging as a cancer biomarker to guide treatment decisions and evaluate therpaeutic repsonse. Examples form recent or ongoing multi-center trials will be presented as exmaples of possible future clinical role for molecular imaign cancer biomarkers.

Printed on: 10/29/20

MSES34

Essentials of Trauma Imaging

Tuesday, Dec. 3 3:30PM - 5:00PM Room: S100AB

CA ER HN IR

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

FDA Discussions may include off-label uses.

Participants
Guillermo P. Sangster, MD, Shreveport, LA (*Moderator*) Nothing to Disclose

Sub-Events

MSES34A Cervical Spine Trauma

Participants
A. Orlando Ortiz, MD, MBA, Bronx, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ortizo@nychhc.org

LEARNING OBJECTIVES

1) Review the pertinent imaging anatomy of the cervical spine. 2) Understand the role of various imaging modalities in cervical spine trauma patients. 3) Provide an overview cervical spine injuries with an emphasis on mechanism.

ABSTRACT

The exposure of the cervical spine to traumatic forces such as flexion or extension is associated with serveral types of injury patterns to this segment of the spinal axis. The unique anatomic features of the upper and lower cervical spine further predispose these sub-segments to specific types of traumatic injury. A number of imaging modalities are available to assess patients with cervical spine trauma and modality utilization is dependent on the acuity and extent of the injury, the neurologic condition of the patient and whether or not the patient is able to undergo a specific imaging examination.

MSES34B Blunt and Penetrating Neck Injuries

Participants
Matthew S. Parsons, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

parsonsms@wustl.edu

LEARNING OBJECTIVES

1) Identify pertinent anatomy for traumatic neck injuries. 2) Define the Denver Injury Grading Scale used in blunt cerebrovascular injury. 3) Detect common imaging signs of aerodigestive trauma.

MSES34C Blunt Traumatic Aortic Injuries

Participants
Guillermo P. Sangster, MD, Shreveport, LA (*Presenter*) Nothing to Disclose

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gsangs@lsuhsc.edu

LEARNING OBJECTIVES

1) Identify MDCT imaging findings of traumatic aortic injuries and the ability of the method to characterize different lesion types. 2) Substantiate the advantages of MDCT for the screening of stable patients suspected to have traumatic aortic injuries. 3) Recognize MDCT false positive findings that may be misinterpreted as traumatic aortic injuries.

ABSTRACT

Injuries of the aorta have catastrophic consequences if untreated. Timely accurate diagnosis of the aortic laceration/rupture is key for life saving repair. Images from patients of our Level I trauma center database substantiate the presentation. Mechanisms of traumatic aortic injury are reviewed and the spectrum of injury patterns illustrated including incomplete aortic rupture, complete aortic rupture, pseudoaneurysm, traumatic aortic dissection and acute intramural hematoma. MDCT findings are correlated with angiography before and after surgical or endovascular repair. Examples of false positive traumatic aortic injuries are presented.

MSES34D Interventional Radiology (IR) On-Call: When Time is of the Essence!

Participants

Philip D. Orons, DO, Pittsburgh, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

oronspd@upmc.edu

LEARNING OBJECTIVES

1) Describe methods for transcatheter intervention in traumatic arterial and solid organ injury. 2) Explain rationale for selection of appropriate embolic agent based on angiographic findings. 3) Differentiate between expected finding in blunt versus penetrating injury.

Printed on: 10/29/20

MSRO39

BOOST: Gastrointestinal- Anorectal Cancer eContouring

Tuesday, Dec. 3 4:30PM - 5:30PM Room: S104B

GI OI RO

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

Participants
Edward Y. Kim, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Spencer C. Behr, MD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company; Consultant, Navidea Biopharmaceuticals, Inc; Grant, Navidea Biopharmaceuticals, Inc
Ryan O'Malley, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company

For information about this presentation, contact:

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Special Information

The e-contouring sessions may be used by participating radiation oncologists to fulfill a PQI (practice quality improvement) requirement for ABR (American Board of Radiology) MOC (Maintenance of Certification). Interested radiation oncologist can download a e-contouring PQI template here: https://academy.astro.org/content/econtouring-pqi-template and handouts directing users to the same website will be available at the actual session.

LEARNING OBJECTIVES

1) Develop familiarity with anatomic considerations relevant to radiotherapy planning for rectal cancer. 2) Apply information from diagnostic imaging studies to radiotherapy planning for rectal cancers.

ABSTRACT

Participants in this session will gain familiarity with anatomic considerations relevant to target contour definition for radiation treatment planning for rectal cancer. Expertise will be provided by diagnostic imaging and radiation oncology presenters.

Printed on: 10/29/20

RC401

Interstitial Lung Disease in the Community: A Practical Approach

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E450A

CH CT

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

Participants
Edward Y. Lee, MD, Boston, MA (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify clinical, imaging, and histological manifestations of idiopathic interstitial pulmonary fibrosis (IPF). 2) Categorize high resolution CT findings as consistent with usual interstitial pneumonia (UIP), probable UIP, indeterminate UIP and alternative diagnosis patterns. 3) Recommend the best strategies for managing patients with clinical suspicion of IPF. 4) Review unique nature of pediatric interstitial lung disease. 5) Discuss current pediatric interstitial lung disease classification system. 6) Learn characteristic imaging and pathological findings of pediatric interstitial lung disease. 7) Describe the spectrum of smoking-related interstitial lung diseases and their clinical manifestations. 8) Recognize the HRCT appearances of smoking-related interstitial lung diseases. 9) Identify the most common imaging differential diagnoses of smoking-related interstitial lung diseases. 10) To understand the clinical, histopathological and imaging manifestations of acute/inflammatory and chronic fibrotic hypersensitivity pneumonitis. 11) To get an update of the current understanding w/r the separation of chronic hypersensitivity pneumonitis and fibrotic connective tissue disease - associated interstitial lung disease (CTD-ILD). 12) To categorise the importance of various CT features w/r the radiological diagnosis of fibrotic hypersensitivity pneumonitis versus idiopathic pulmonary fibrosis (IPF) 13) To become more familiar with the multidisciplinary evaluation of patients with suspected CTD-ILD. 14) Understand the clinical workup of patients with interstitial lung disease. 15) Synthesize the numerous serologic tests with a focus on key positives. 16) Identify the key imaging patterns of connective tissue disease associated interstitial lung disease including NSIP, OP, LIP, and NSIP/OP overlap.

Sub-Events

RC401A Idiopathic Interstitial Pulmonary Fibrosis: What We Need to Know

Participants
Gustavo S. Meirelles, MD,PhD, Sao Paulo, Brazil (*Presenter*) Partner, Ambra Saude; Stockholder, Fleury SA; Advisory Board, Boehringer Ingelheim GmbH;

For information about this presentation, contact:

gmeirelles@gmail.com

LEARNING OBJECTIVES

1) Identify clinical, imaging, and histological manifestations of idiopathic interstitial pulmonary fibrosis (IPF). 2) Categorize high resolution CT findings as consistent with usual interstitial pneumonia (UIP), probable UIP, indeterminate UIP and alternative diagnosis patterns. 3) Recommend the best strategies for managing patients with clinical suspicion of IPF.

RC401B Private Tour of Pediatric Interstitial Lung Disease in 2019

Participants
Edward Y. Lee, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review unique nature of pediatric interstitial lung disease. 2) Discuss current pediatric interstitial lung disease classification system. 3) Learn characteristic imaging and pathological findings of pediatric interstitial lung disease.

RC401C Smoking-related Interstitial Lung Diseases

Participants
Carolina A. Souza, MD, Ottawa, ON (*Presenter*) Speaker, Pfizer Inc; Speaker, Boehringer Ingelheim GmbH; Speaker, AstraZeneca PLC; Speaker, F. Hoffmann-La Roche Ltd; Grant, Boehringer Ingelheim GmbH; Advisory Board, AstraZeneca PLC;

For information about this presentation, contact:

csouza@toh.ca

LEARNING OBJECTIVES

1) Describe the spectrum of smoking-related interstitial lung diseases and their clinical manifestations. 2) Recognize the HRCT appearances of smoking-related interstitial lung diseases. 3) Identify the most common imaging differential diagnoses of smoking-related interstitial lung diseases.

RC401D Hypersensitivity Pneumonitis: Is There Anything New?

Participants

Justus E. Roos, MD, Luzern 16, Switzerland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

justus.roos@luks.ch

LEARNING OBJECTIVES

1) To understand the clinical, histopathological and imaging manifestations of acute/inflammatory and chronic fibrotic hypersensitivity pneumonitis. 2) To get an update of the current understanding w/r the separation of chronic hypersensitivity pneumonitis and fibrotic connective tissue disease - associated interstitial lung disease (CTD-ILD). 3) To categorise the importance of various CT features w/r the radiological diagnosis of fibrotic hypersensitivity pneumonitis versus idiopathic pulmonary fibrosis (IPF)

RC401E Connective Tissue Disease-related Interstitial Lung Disease

Participants
Kimberly G. Kallianos, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To become more familiar with the multidisciplinary evaluation of patients with suspected CTD-ILD. 2) Understand the clinical workup of patients with interstitial lung disease. 3) Synthesize the numerous serologic tests with a focus on key positives. 4) Identify the key imaging patterns of connective tissue disease associated interstitial lung disease including NSIP, OP, LIP, and NSIP/OP overlap.

RC403

Current Practice and Emerging Techniques in Coronary CT

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E351

CA CT

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

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

Sub-Events

RC403A Interpreting and Reporting Coronary CTA Using CAD-RADS

Participants
Ricardo C. Cury, MD, Coral Gables, FL (*Presenter*) Research Grant, General Electric Company; Stock options, Cleerly

For information about this presentation, contact:

rcury@baptisthealth.net

LEARNING OBJECTIVES

1) Describe the CAD-RADS classification with clear examples. 2) Discuss appropriate use of the CAD-RADS lexicon in reporting Coronary CT Angiography. 3) Discuss recommendations to facilitate decision making regarding further patient management after Coronary CT Angiography.

RC403B CT Derived Fractional Flow Reserve

Participants
Geoffrey D. Rubin, MD, Durham, NC (*Presenter*) Consultant, Fovia, Inc; Advisor, HeartFlow, Inc; Consultant, General Electric Company; Advisor, Boehringer Ingelheim GmbH; Advisor, Siemens AG;

For information about this presentation, contact:

grubin@duke.edu

RC403C Myocardial Perfusion Imaging in Cardiac CT

Participants
Brian B. Ghoshhajra, MD, Boston, MA (*Presenter*) Research Grant, Siemens AG

RC404

Articular Discs, Menisci, and Labra: Structure, Function, and Dysfunction Using MRI with Emphasis on the Knee Meniscus, Triangular Fibrocartilage, and Glenoid and Acetabular Labrum

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E451B

MR MK

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

Participants
Donald L. Resnick, MD, San Diego, CA (*Director*) Nothing to Disclose

LEARNING OBJECTIVES

1) To detail the anatomy, composition, and function of several intraarticular structures including the menisci of the knee, the triangular fibrocartilage of the wrist, and the labra of the hip and glenohumeral joint. 2) To correlate the anatomic framework of these structures with their patterns of failure, emphasizing MR imaging. 3) To detail the morphology of the human knee meniscus with particular emphasis on its collagen composition. 4) To illustrate the basic patterns of meniscal failure as displayed on MR imaging. 5) To correlate these patterns of failure with an understanding of meniscal morphology. 6) Compare and contrast the normal anatomy and function of the labrum in two main main-ball-socket joints, the hip and shoulder. 7) Identify common labral disorders in the shoulder and hip and recognize imaging findings that distinguish them from normal variants.

Sub-Events

RC404A Meniscus of the Knee

Participants
Donald L. Resnick, MD, San Diego, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To detail the morphology of the human knee meniscus with particular emphasis on its collagen composition. 2) To illustrate the basic patterns of meniscal failure as displayed on MR imaging. 3) To correlate these patterns of failure with an understanding of meniscal morphology.

ABSTRACT

The morphology of the knee meniscus will be explored, particularly its collagen framework, in an effort to elucidate the basic patterns of meniscal failure as viewed in MR images and during arthroscopy. Particular attention will be given to those structures that influence meniscal function and dysfunction, structures that include the meniscal root ligaments, the popliteomeniscal ligaments, and the capsular ligaments.

RC404B Triangular Fibrocartilage Complex (TFCC) of the Wrist

Participants
Christine B. Chung, MD, Solana Beach, CA (*Presenter*) Nothing to Disclose

RC404C Labrum of the Glenohumeral Joint and of the Hip

Participants
David A. Rubin, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

drubin001@gmail.com

LEARNING OBJECTIVES

1) Compare and contrast the normal anatomy and function of the labrum in two main main-ball-socket joints, the hip and shoulder. 2) Identify common labral disorders in the shoulder and hip and recognize imaging findings that distinguish them from normal variants.

RC405

Neuroradiology: Small Tricks to Avoid Big Misses (Interactive Session)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S406A

NR PD

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

Participants
Ari M. Blitz, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe an evaluation pattern for neonatal encephalopathy, neurometabolic disorders and posterior fossa cystic abnormalities in pediatric patients. 2) List imaging findings that would suggest cerebellar tonsillar descent is due to intracranial hypotension rather than Chiari malformation. 3) List imaging features which predict clinical outcome in the setting of subarachnoid hemorrhage. 4) List three 'do not miss' lesions of the spine.

Sub-Events

RC405A Newborn and Pediatric Brain

Participants
Bruno P. Soares, MD, Burlington, VT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

bruno.soares@uvmhealth.org

LEARNING OBJECTIVES

1) Develop an evaluation pattern for brain MRI in neonatal encephalopathy. 2) Describe imaging patterns of neonatal hypoxic ischemic brain injury. 3) Identify clinical and imaging findings suggestive of an inherited neurometabolic disorder.

RC405B Disorders of CSF Circulation

Participants
Timothy J. Amrhein, MD, Cary, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the characteristic brain and spine imaging findings in spontaneous intracranial hypotension. 2) To describe the characteristic brain imaging findings in Chiari 1 malformation. 3) To describe the characteristic brain imaging findings in idiopathic intracranial hypertension. 4) To identify key imaging features allowing one to differentiate between these different CSF-related pathologies.

RC405C Acute Hemorrhage

Participants
Michael Iv, MD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize causes and mimics of acute subarachnoid hemorrhage. 2) Differentiate between etiologies of acute parenchymal hemorrhage. 3) Describe the importance of specific imaging features in predicting clinical outcome in various settings of acute hemorrhage.

RC405D Spine-Do Not Miss These Lesions

Participants
J. Levi Chazen, MD, New York, NY (*Presenter*) Research funded, Biogen Idec Inc

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jlc2008@med.cornell.edu

LEARNING OBJECTIVES

1) Identify common 'blind spots' on cross-sectional imaging of the spine. 2) Develop search patterns to detect frequently overlooked spine and paraspinous lesions. 3) List five important do-not-miss lesions of the spine.

RC406

Tough Calls in Head and Neck Imaging: Learn the Clues That Will Help You Make Them

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S406B

HN NR

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

Sub-Events

RC406A Tough Calls in Temporal Bone Imaging

Participants
Hugh D. Curtin, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Hugh_Curtin@meei.harvard.edu

LEARNING OBJECTIVES

1) The participant will understand the importance of identifying secondary diagnoses in imaging of otosclerosis. 2) The participant will be able to describe the usefulness of oblique imaging in making 'tough calls' related to the tegmen, lateral canal, and facial nerve canals particularly in cases of cholesteatoma. 3) The participant will be identify the interscalar septum and describe its importance in identifying congenital anomalies of the cochlea.

ABSTRACT

The temporal bone contains some of the most intricate anatomy in the body. Diagnoses are often based on analysis of tiny bone structures. Some diagnoses are obvious but some can be the more subtle "tough calls." Imaging may actually not be simply making or confirming the diagnosis. The "tough call" may be directed toward secondary diagnoses or identifying potential source of complication should the patient go to surgery. The session will focus on the importance of several subtle findings in otologic imaging. The imaging diagnosis of otosclerosis relies mostly on demonstration of subtle demineralization of the otic capsule just anterior to the oval window. It may be difficult to be absolute in identifying this subtle change. Often though the diagnosis is already known and imaging is actually directed towards making sure some other diagnosis that would complicate surgery isn't present. These include superior canal dehiscence, round window closure, ossicular discontinuity and other potential diagnoses that can mimic or complicate treatment of otosclerosis. In cholesteatoma, the diagnosis again is often known and attention may be directed looking for subtle changes in the facial nerve canal, lateral semicircular canal, and tegmen. These "tough calls" may require analysis of oblique reformatted planes. Other "tough calls" include evaluation of the interscalar septum in congenital ear. Identifying labyrinthitis may require MRI.

RC406B Tough Calls in Sinus Imaging

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

For information about this presentation, contact:

ashley.aiken@emoryhealthcare.org

LEARNING OBJECTIVES

1) Develop a standard approach and checklist for the interpretation of the sinus CT in order to make the 'tough' calls. 2) Recognize the imaging appearance of early acute invasive fungal sinusitis and complications of bacterial sinusitis on CT and MRI. 3) Recognize the features that suggest underlying neoplasm or meningocele rather than routine sinonasal inflammatory disease.

ABSTRACT

A specific search pattern for radiographic red flags will help the audience to suspect more aggressive infection, inflammation or tumor 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), complications of bacterial sinusitis and neoplasm. 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 for complicated sinusitis. The complimentary role of MRI to characterize late complications of bacterial and fungal infection will also be covered.

RC406C Tough Calls in H&N Cancer Imaging

Participants
Lawrence E. Ginsberg, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lginsberg@mdanderson.org

LEARNING OBJECTIVES

1) Review some of the blind spots in H&N cancer imaging, with emphasis on avoiding misses and making the tough calls. 2) Discuss

the barriers to making tough calls, including shortfalls in technique, knowledge gaps, pitfalls and the like.

RC407

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

Tuesday, Dec. 3 4:30PM - 6:00PM Room: N226

GU MR

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

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. 10) Understand the pathophysiology of endometriosis. 11) Recognize MRI finding of endometriosis. 12) Avoid the pitfalls of endometriosis imaging. 13) Review common surgical interventions for stress urinary incontinence and pelvic organ prolapse. 14) Describe the MRI technique for imaging synthetic material in the pelvic floor. 15) Recognize normal and abnormal MRI appearances of synthetic materials used in pelvic floor dysfunction.

Sub-Events

RC407A Overview: Why is this Subject Important?

Participants
Susan M. Ascher, MD, Washington, DC (*Presenter*) Nothing to Disclose

RC407B Endometriosis and Adenomyosis: MR Imaging Pearls and Pitfalls

Participants
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the pathophysiology of endometriosis. 2) Recognize MRI finding of endometriosis. 3) Avoid the pitfalls of endometriosis imaging.

RC407C Leiomyomas: Pre- and Post-procedural Imaging-More Than a Roadmap

Participants
Yuliya Lakhman, MD, New York, NY (*Presenter*) Nothing to Disclose

RC407D Slings and Meshes: Guide to MR Imaging of Pelvic Floor Following Surgical Repair

Participants
Gaurav Khatri, MD, Irving, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review common surgical interventions for stress urinary incontinence and pelvic organ prolapse. 2) Describe the MRI technique for imaging synthetic material in the pelvic floor. 3) Recognize normal and abnormal MRI appearances of synthetic materials used in pelvic floor dysfunction.

Active Handout:Gaurav Khatri

http://abstract.rsna.org/uploads/2019/18000692/Active RC407D.pdf

Printed on: 10/29/20

RC408

Emergency Neuroradiology: Interventional Neuroradiology-What the Emergency Radiologist Needs to Know (at 3 AM) (Interactive Session)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S402AB

ER IR NR

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

FDA Discussions may include off-label uses.

Participants

A. Orlando Ortiz, MD, MBA, Bronx, NY (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

ortizo@nychhc.org

Sub-Events

RC408A Cerebrovascular Interventions

Participants
Gregg H. Zoarski, MD, Bel Air, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the endovascular procedures and devices used to treat neurovascular diseases including acute embolic stroke, aneurysms, vascular malformations, intracranial atherosclerosis, venous stenosis and occlusion, and vascular trauma.

RC408B Neck Interventions

Participants
Michele H. Johnson, MD, New Haven, CT (*Presenter*) Scientific Advisory Board, iSchemaView, Inc; Medical Advisory Board, iSchemaView, Inc

RC408C Spine Interventions

Participants
A. Orlando Ortiz, MD, MBA, Bronx, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ortizo@nychhc.org

LEARNING OBJECTIVES

1) To learn how image-guided spine interventions can be used in the early evaluation and management of patients presenting to the emergency department with either neck or back pain. 2) To understand the basic steps required for proper patient preparation prior to these urgent spine interventions. 3) To review specific diagnostic and therapeutic spine interventions with and emphasis on indication and contraindication.

ABSTRACT

Severe neck and/or back pain are a frequent cause of emergency department visits. While many of these patient presentations can be handled by conservative evaluation and management, the access to rapid imaging evaluation will indentify specific pathologic conditions that may subsequently require additional evaluation and treatment. In certain instances this subset of patients may benefit from diagnostic or therapeutic image-guided spine interventions. This presentation will discuss the rationale for the use of these interventions, the basic steps required for proper patient preparation, and the specific types of interventions that might be considered or performed.

RC409

Challenging Abdominal Imaging Cases (Interactive Session)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E353C

GI

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

Special Information

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC409A Challenging Cases: Pancreas/Biliary

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

LEARNING OBJECTIVES

1) Develop an algorithm for evaluating biliary and pancreatic abnormalities through evaluation of challenging cases. 2) Highlight key imaging features that are useful to narrow the differential diagnosis. 3) Increase confidence in the interpretation of complex MR cholangiopancreatography examinations.

RC409B Challenging Cases: CT Colonography

Participants
Courtney C. Moreno, MD, Suwanee, GA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Assess reasons for missing or overcalling polyps on CT colonography examinations. 2) Describe how to avoid pitfalls when interpreting CT colonography examinations. 3) Apply technical advances to improve CT colonography examination quality.

RC409C Challenging Cases: Liver

Participants
Aarti Sekhar, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

aarti.sekhar@gmail.com

LEARNING OBJECTIVES

1) Review challenging liver cases in these categories: perfusional anomalies versus hypervascular lesions; atypical hemangiomas versus malignancy; cyst vs mucinous neoplasm; and FNH versus adenoma. 2) Review areas for improvement in reporting liver cases for pre-surgical planning, with the goal of learning how to 'think like a surgeon'; these topics will be covered: pertinent vascular and biliary anomalies, calculating liver volumes, and staging/reporting of colorectal liver metastases and hilar cholangiocarcinoma.

RC409D Challenging Cases: Rectal MR

Participants
Kartik S. Jhaveri, MD, Mississauga, ON (*Presenter*) Research Grant, General Electric Company; Research Grant, Bayer AG; Speaker, Siemens AG; Speaker, Bayer AG

LEARNING OBJECTIVES

1) Review rectal cancer MRI cases with implications for management. 2) Highlight potential pitfalls in MRI reporting. 3) Showcase uncommon presentations and mimics.

RC410

Advances in Gynecologic Ultrasound

Tuesday, Dec. 3 4:30PM - 6:00PM Room: N227B

GU US

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

Sub-Events

RC410A Uterus and Endometrium: A Primer with Pearls to Perfect Your US Performance

Participants
Loretta M. Strachowski, MD, San Francisco, CA (*Presenter*) Royalties, Reed Elsevier; Speaker, World Class CME

For information about this presentation, contact:

lori.strachowski@ucsf.edu

LEARNING OBJECTIVES

1) Recognize the varied appearance of the endometrium throughout a woman's life. 2) Improve sonographic visualization of the endometrium utilizing technical tips and tricks. 3) Recite a basic differential diagnosis for uterine/cervical masses and endometrial thickening. 4) Apply appropriate terminology when describing abnormal bleeding. 5) Understand the controversies of endometrial thickness cutoffs in postmenopausal bleeding. 6) Appreciate the limitations of US in evaluating myomas, adenomyosis and Mullerian duct anomalies.

RC410B Sonography of GYN Emergencies: Pearls and Pitfalls

Participants
Roya Sohaey, MD, Portland, OR (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize the varied imaging features of adnexal torsion including the limitations of Doppler for this diagnosis. 2) Understand the importance of 3D ultrasound and scanning technique in evaluating the patient with acute heavy bleeding. 3) Appreciate the limitations of ultrasound when evaluating complications from surgery and advanced oncologic disorders which may present with acute symptoms.

ABSTRACT

Ultrasound is often the first 'go to' modality when women present with acute gynecologic symptoms. A case-based symptoms approach will be used to discuss sonographic findings in women presenting with acute pain, heavy bleeding, and post-operative complications. In addition to classic diagnostic findings, atypical findings of common diagnoses will be shown(i.e. isolated fallopian tube torsion). Scanning techniques as well as imaging pearls and pitfalls will be stressed in order to help the participant make an accurate diagnosis using primarily ultrasound.

RC410C Ovarian Cysts and Masses

Participants
Deborah Levine, MD, Boston, MA (*Presenter*) Editor with royalties, Reed Elsevier; Editor with royalties, Wolters Kluwer nv;

For information about this presentation, contact:

dlevine@bidmc.harvard.edu

LEARNING OBJECTIVES

1) Review updated recommendations for suggesting follow-up of adnexal cysts. 2) Improve knowledge of the malignant potential of various sonographic findings. 3) Integrate these findings into daily practice with goal of reducing recommendations for follow-up of benign adnexal cysts and reducing excess surgery for benign masses while improving triage to gynecology-oncology in women with suspicious adnexal masses.

RC410D Ultrasound for Deeply Infiltrative Endometriosis

Participants
Luciana P. Chamie, MD, PhD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

luciana@chamie.com.br

LEARNING OBJECTIVES

1) Define clinical and epidemiological aspects of endometriosis. 2) Define the importance of imaging mapping for deeply infiltrative endometriosis before clinical counseling. 3) Apply the most appropriate technique to investigate endometriosis. 4) Describe the bowel preparation required for the transvaginal ultrasound to investigate endometriosis. 5) Apply the imaging algorithm to map

deeply infiltrative endometriosis. 6) Assess the ultrasonographic findings of deeply infiltrative endometriosis in the most common sites such as bladder, vesicouterine pouch, retrocervical space, vagina, ureters, appendix and rectosigmoid colon.

ABSTRACT

Endometriosis is a very common gynecological disease affecting millions of women in their reproductive life, often causing pelvic pain and infertility. Clinical history and physical examination may suggest endometriosis, but imaging mapping is necessary to identify the disease and mandatory for clinical couseling and surgical planning. Transvaginal ultrasound after bowel preparation is the best imaging modality as the first-line technique to evaluate patients suspected of endometriosis. The bowel preparation is relatively simple and includes the day before and the day of the examination. This method is highly accurate to identify intestinal endometriosis and to determine which layers of the bowel wall are affected. In addition, it provides better assessment of small peritoneal lesions of the retrocervical space, vagina and bladder. Pelvic adhesions can also be evaluated during the exam.

Printed on: 10/29/20

RC411

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

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S504CD

CA CT NM

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

LEARNING OBJECTIVES

1) Understand the technical advancements associated with new scintillation cameras and SPECT-CT and PET-CT cameras. 2) Appreciate the benefits of CT attenuation correction. 3) Appreciate the adjunctive benefits of anatomic definition provided with CT and physiologic/function information provided by SPECT and PET. 4) Improve interpretive skills related to SPECT and PET-CT.

ABSTRACT

Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements in turn have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

Sub-Events

RC411A Advances in Cardiac SPECT

Participants
E. Gordon Depuey, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

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

ABSTRACT

There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The following technical advancements described facilitate implementation of patient-centered imaging. New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. Even with such technical advancements, however, attention to technical detail is essential to assure optimal image quality. Camera and radiopharmaceutical quality control deserve the highest priority. A systematic review of myocardial perfusion SPECT images is essential to recognize artifacts and optimize diagnostic accuracy. Case examples will be presented to reinforce this approach.

RC411B Advances in Cardiac PET

Participants
Sharmila Dorbala, MD,MPH, Boston, MA (*Presenter*) Research Grant, Pfizer Inc; Speaker, General Electric Company; Speaker, AAA; Speaker, Pfizer Inc; Advisory Board, Proclara; ; ; ;

LEARNING OBJECTIVES

1) Review the advantages and disadvantages of myocardial perfusion PET compared to SPECT for evaluation of coronary artery disease. 2) Learn the added value of absolute quantitative parameters derived from PET for assessment of coronary artery disease. 3) Discuss novel clinical applications of cardiovascular PET imaging in systemic diseases. 4) Review Case Examples of Cardiac PETs.

ABSTRACT

Advances in PET detectors, radiotracer availability, clinical software, as well as hybrid PET/CT and PET/MR scanners have revolutionized the clinical and investigative applications of cardiac PET. Cardiac PET myocardial perfusion imaging, in the 1970's, was a predominantly investigative tool, with home-grown software, available at select major academic centers with access to a cyclotron. Over the last decade, with easy access to PET scanners, and to positron emitting perfusion tracers, the use of cardiac PET has exploded -well beyond major academic centers to several hospitals and to large office-based practices. Robust clinical evidence coupled with commercially available software has made quantitative myocardial blood flow assessment, a main-stream clinical application. Hybrid PET/CT scanner applications- calcium score and CT based coronary angiography-have further advanced the applications of cardiac PET. A growing body of recent literature supports the role of targeted molecular PET to image inflammatory, infectious and infiltrative heart diseases. PET/MR is an emerging technology with promising cardiovascular

applications. Each of these exciting developments has transformed cardiac PET from a predominantly investigative tool of the 1970's to the current advanced clinical tool. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.

RC411C Imaging Cardiac Sarcoid

Participants
Sharmila Dorbala, MD,MPH, Boston, MA (*Presenter*) Research Grant, Pfizer Inc; Speaker, General Electric Company; Speaker, AAA; Speaker, Pfizer Inc; Advisory Board, Proclara; ; ; ;

LEARNING OBJECTIVES

1) Interpret cardiac SPECT and PET scans with optimal sensitivity and specificity. 2) Recognize technical and patient-related artifacts. 3) Characterize myocardial perfusion defects whereby patients can be risk stratified with regard to risk of future cardiac events. 4) Formulate reports in a clinically relevant manner.

RC412

Diseases of the Thoraco-abdominal Aorta

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S404AB

CH VA

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

Participants

Phillip M. Young, MD, Rochester, MN (*Moderator*) Consultant, Arterys Inc
Kate Hanneman, MD, FRCPC, Toronto, ON (*Moderator*) Medical Advisory Board, sanofi-aventis Group

LEARNING OBJECTIVES

1) Discuss the epidemiology of aortic dissections. 2) Review multi-modality imaging findings in patients with acute and chronic dissections. 3) Describe protocols for imaging and techniques for accurately measuring aortic aneurysms. 4) Indicate key measurements and observations relevant to the clinician when interpreting aortic aneurysms. 5) Discuss important secondary findings that may indicate increased risk of aneurysm rupture or influence management decisions. 6) Understand the typical imaging features of large vessel vasculitis and its complications. 7) Discuss challenging cases with insights from pathologic correlation. 8) Understand the role of imaging in diagnosis and management of these disorders. 9) Identify the significance of early versus delayed endograft complications. 10) Describe types of endoleaks including fenestrated aortic grafts. 11) Present treatment of endoleaks and follow-up imaging.

Sub-Events

RC412A Imaging of Aortic Dissection

Participants
Kate Hanneman, MD, FRCPC, Toronto, ON (*Presenter*) Medical Advisory Board, sanofi-aventis Group

LEARNING OBJECTIVES

1) Discuss the epidemiology of aortic dissections. 2) Review multi-modality imaging findings in patients with acute and chronic dissections.

RC412B Imaging of Aortic Aneurysm

Participants
Iain D. Kirkpatrick, MD, Winnipeg, MB (*Presenter*) Speaker, Siemens AG

For information about this presentation, contact:

kirkpatrick_iain@hotmail.com

LEARNING OBJECTIVES

1) Describe protocols for imaging and techniques for accurately measuring aortic aneurysms. 2) Indicate key measurements and observations relevant to the clinician when interpreting aortic aneurysms. 3) Discuss important secondary findings that may indicate increased risk of aneurysm rupture or influence management decisions, including the findings of impending aneurysm rupture.

ABSTRACT

Aortic aneurysms are a frequent finding on thoracoabdominal CT, and in an era of minimally invasive treatment it is increasingly important to be able to accurately image, measure and characterize them. This session will discuss how to optimize your scanning protocols for assessing aortic aneurysms as well as how to most accurately measure them. Key measurements and observations useful for clinicians will be reviewed. Signs of impending rupture or which suggest an infectious/inflammatory aneurysm will be discussed, as well as risk assessment for rupture.

RC412C Imaging of Vasculitis

Participants
Phillip M. Young, MD, Rochester, MN (*Presenter*) Consultant, Arterys Inc

LEARNING OBJECTIVES

1) Understand the typical imaging features of large vessel vasculitis and its complications. 2) Discuss challenging cases with insights from pathologic correlation. 3) Understand the role of imaging in diagnosis and management of these disorders.

RC412D Aortic Repair Complications: CT Imaging Findings You Need to Know

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

For information about this presentation, contact:

vrtiska.terri@mayo.edu

LEARNING OBJECTIVES

1) Identify the significance of early versus delayed endograft complications. 2) Describe types of endoleaks including fenestrated aortic grafts. 3) Present treatment of endoleaks and follow-up imaging.

Printed on: 10/29/20

RC414

Interventional Course (Interactive Session)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S404CD

IR

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

FDA Discussions may include off-label uses.

Participants
Steven M. Zangan, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Rakesh C. Navuluri, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Kush R. Desai, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Consultant, Cook Group Incorporated; Consultant, Koninklijke Philips NV; Consultant, The Spectranetics Corporation; Consultant, AngioDynamics, Inc; Consultant, Boston Scientific Corporation; Consultant, W. L. Gore & Associates, Inc

For information about this presentation, contact:

kdesai007@northwestern.edu

Special Information

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

LEARNING OBJECTIVES

1) Recognize vascular and non-vascular conditions and their image-guided treatment in the chest, abdomen and pelvis.

Printed on: 10/29/20

RC415

The Newly Diagnosed Cancer: Different Viewpoints

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E451A

BR MR US

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

Participants
Margarita L. Zuley, MD, Pittsburgh, PA (*Moderator*) Investigator, Hologic, Inc

For information about this presentation, contact:

zuleyml@upmc.edu

LEARNING OBJECTIVES

1) Review the role of ultrasound, MRI, and contrast enhanced mammography in the evaluation of disease extent in the newly diagnosed breast cancer patient. 2) Recognize the advantages and limitations of these three imaging modalities in the assessment of patients' response to neoadjuvant chemotherapy. 3) Be familiar with the evolving management of the axilla.

Sub-Events

RC415A **Role of MRI**

Participants
Constance D. Lehman, MD,PhD, Boston, MA (*Presenter*) Research Grant, General Electric Company Medical Advisory Board, General Electric Company

RC415B **The Newly Diagnosed Cancer: Different Viewpoints: The Role of Ultrasound**

Participants
Regina J. Hooley, MD, Weston, CT (*Presenter*) Consultant, Hologic, Inc

For information about this presentation, contact:

regina.hooley@yale.edu

RC415C **Role of CEM**

Participants
Margarita L. Zuley, MD, Pittsburgh, PA (*Presenter*) Investigator, Hologic, Inc

For information about this presentation, contact:

zuleyml@upmc.edu

Printed on: 10/29/20

RC416

Learning AI from the Experts: Becoming an AI Leader in Global Radiology (Without Needing a Computer Science Degree) (Sponsored by the RSNA Committee of International Radiology Education)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E352

AI

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

Participants
Jeffrey B. Mendel, MD, West Newton, MA (*Moderator*) Advisor, McKesson Corporation
Sudhir Vinayak, MD, Nairobi, Kenya (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

JMendel@pih.org

laurabancroftmd@gmail.com

LEARNING OBJECTIVES

1) Radiologists, particularly those working in global radiology, will gain understanding of the fundamentals of artificial intelligence, current clinical applications and platforms, how to choose and implement AI, and strategies to engage hospital administration and others. 2) Participants will be able to actively lead local decisions about AI in global radiology.

Sub-Events

RC416A Why is AI Different for Global Radiology?

Participants
Jeffrey B. Mendel, MD, West Newton, MA (*Presenter*) Advisor, McKesson Corporation

For information about this presentation, contact:

JMendel@pih.org

LEARNING OBJECTIVES

1) Learn that the resources, spectrum of disease, and healthcare delivery are fundamentally different in low- and middle- income countries compared with high income countries. 2) Learn the unique challenges and opportunities for artificial intelligence in global radiology in the decision-making and implementation of this technology. 3) Discuss the basic parameters for this unique healthcare environment.

RC416B Understanding AI: How Does that Black Box (AI) Work?

Participants
Eliot L. Siegel, MD, Severna Park, MD (*Presenter*) Board of Directors, Carestream Health, Inc; Board of Directors, Mach7 Technologies Ltd; Founder, Parto; Founder, Chios; Founder, Topoderm; Founder, VisualTrauma; Founder, ACREW; Founder, DACREW; Founder, i-Nucs; Committee member, RadSite

RC416C Challenges to AI in Global Health: Application Platforms for Wide-ranging Clinical Imaging Environments

Participants
Matthew P. Lungren, MD, Palo Alto, CA (*Presenter*) Advisor, Nines AI; Shareholder, Nines AI; Advisor, SegMed; Shareholder, SegMed; Advisor, Bunker Hill ; Shareholder, Bunker Hill

RC416D Choosing and Implementing AI: Questions for Global Scientists and Vendors

Participants
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain how ethical decision making varies across cultures. 2) Describe ethical considerations for data use agreements, and AI projects. 3) Discuss approaches to achieving cultural competency.

RC416E Getting a Seat at the AI Table: Challenges and Opportunities for Radiologists and Radiology Societies to Engage Government and Hospital Agencies

Participants
Judy W. Gichoya, MBChB,MS, Portland, OR (*Presenter*) Nothing to Disclose

RC417

Emerging Technology: Contrast Enhanced Ultrasound-Update 2019

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S505AB

US

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

FDA Discussions may include off-label uses.

Participants

David T. Fetzer, MD, Dallas, TX (*Moderator*) Researcher, Koninklijke Philips NV; Researcher, Siemens AG; Consultant, Koninklijke Philips NV; Speakers Bureau, Koninklijke Philips NV; Speakers Bureau, Siemens AG ; ;

For information about this presentation, contact:

David.Fetzer@UTSouthwestern.edu

LEARNING OBJECTIVES

1) Briefly introduce contrast-enhanced ultrasound (CEUS) imaging techniques, and the pharmacology of these unique agents. 2) Reveal how CEUS may definitively characterize indeterminate liver lesions seen by other modalities. 3) Discuss the role of CEUS in the characterization of renal masses, and how Bosniak classification may be applied. 4) Review how CEUS may be used for vascular imaging, such as in aortic endoleak detection and characterization. 5) Evaluate how CEUS may be used as an accurate, reproducible method for tumor perfusion and post treatment analysis.

ABSTRACT

Contrast-enhanced ultrasound (CEUS) has been recognized world-wide as a robust tool that can be applied in a vareity of clinical situations and for various research applications, particularly given its high safety provide. With the recent FDA approval of one agent for use in liver imaging in adults, and hepatic and urological imaging in pediatrics, there has been increased acceptance and use of these techniques throughout the country. However, these agents are not limtied to the liver--the use of CEUS for a range of pathologies and for research is now also possible, and with a variety of agents available. This session will cover opportunities for use of CEUS not only for liver masses, but also for renal, vascular, and tumor perfusion and post treatment imaging.

Sub-Events

RC417A CEUS: A Brief Overview

Participants
David T. Fetzer, MD, Dallas, TX (*Presenter*) Researcher, Koninklijke Philips NV; Researcher, Siemens AG; Consultant, Koninklijke Philips NV; Speakers Bureau, Koninklijke Philips NV; Speakers Bureau, Siemens AG ; ;

For information about this presentation, contact:

David.Fetzer@UTSouthwestern.edu

LEARNING OBJECTIVES

1) Briefly introduce ultrasound microbubble agent formulation and pharmacology. 2) Discuss the unique imaging techniques required for contrast-enhanced ultrasound (CEUS). 3) Highlight ultrasound contrast agent safety profile.

RC417B CEUS: Resolving Indeterminate Liver Lesions Seen by CT/MRI

Participants
Tae Kyoung Kim, MD, PhD, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

taekyoung.kim@uhn.ca

LEARNING OBJECTIVES

1) Identify appropriate indications for performing CEUS for focal liver lesions when CT or MRI findings are indeterminate. 2) Recognize the similarities and differences between CEUS and CT/MRI for imaging focal liver lesions. 3) Understand the advantages of CEUS including real-time assessment of arterial phase enhancement, pure intravascular contrast, disruption-replenishment techniques, and availability in patients with renal failure.

RC417C CEUS: Indeterminate Renal Masses-Is Bosniak Classification Applicable?

Participants
Richard G. Barr, MD, PhD, Campbell, OH (*Presenter*) Consultant, Siemens AG; Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, SuperSonic Imagine; Speakers Bureau, Koninklijke Philips NV; Research Grant, Bracco Group; Speakers Bureau, Siemens AG; Consultant, Canon Medical Systems Corporation; Research Grant, Esaote SpA; Research Grant, BK Ultrasound; Research Grant, Hitachi, Ltd

LEARNING OBJECTIVES

1) To differentiate benign from malignant renal masses on CEUS. 2) Understand the differences between the Bosniak classification and CEUS characterization of renal masses. 3) Apply CEUS to characterize indeterminate renal masses.

RC417D CEUS: Vascular Imaging-Aortic Endoleak Detection and Characterization

Participants
Andrej Lyshchik, MD, PhD, Philadelphia, PA (*Presenter*) Research support, Bracco Group; Advisory Board, Bracco Group; Research support, General Electric Company; Research support, Siemens AG; Research support, Canon Medical Systems Corporation; Speaker, SonoScape Co, Ltd

LEARNING OBJECTIVES

1) To improve basic knowledge on how contrast-enhanced ultrasound could be used for vascular imaging, such as in aortic endoleak detection and characterization.

RC417E CEUS: Assessment of Tumor Perfusion and Post Ablation Therapy

Participants
Hyun-Jung Jang, MD, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn indications, advantages and techniques measuring tumor perfusion with CEUS. 2) To interpret therapeutic efficacy of antiangiogenic treatment and ablation therapy on CEUS. 3) To learn practical tips and pitfalls in interpretation through illustrative clinical cases.

RC418

Challenges and Opportunities for Cancer Screening

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S401CD

OI

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

Participants

Ramona Woitek, MD, Vienna, Austria (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Examine the principles for assessing the evidence of benefit for cancer screening. 2) Assess the current advances in cancer prevention, early detection and genetic evaluation. 3) Describe how more sophisticated risk stratification could lead to tailored screening approaches. 4) Appraise the unintended consequences of screening and the need for new approaches to minimise harm. 5) Appreciate the various ways risk for developing breast cancer can be assessed. 6) Understand the contribution mammographic breast density to risk of developing breast cancer. 7) Recognise the problem of masking caused by breast density. 8) Appreciate the various supplemental imaging methods that can be offered to women with dense breasts. 9) Gain knowledge about the evidence supporting HCC surveillance. 10) Understand the modalities of HCC surveillance. 11) Be aware of main limitations and controversies. 12) Understand and compare the surveillance policies in different countries. 13) Describe the best use of Whole Body MRI for cancer screening. 14) Apply the most appropriate protocol when using Whole Body MRI for cancer screening. 15) Classify the findings detected on a Whole Body MRI for cancer screening.

Sub-Events

RC418A Cancer Screening Advantages and Pitfalls

Participants

Ruth C. Carlos, MD, MS, Ann Arbor, MI (*Presenter*) Editor, Journal of the American College of Radiology; Support, Harvey L. Neiman Health Policy Institute; In-kind support, Reed Elsevier;

RC418B Breast Cancer Risk Adaptive Screening

Participants

Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Presenter*) Research Grant, Hologic, Inc; Research Grant, General Electric Company ; Research Consultant, Alphabet Inc; Research support, Bayer AG; Research collaboration, Volpara Health Technologies Limited

For information about this presentation, contact:

fjg28@cam.ac.uk

LEARNING OBJECTIVES

1) Appreciate the various ways risk for developing breast cancer can be assessed. 2) Understand the contribution mammographic breast density to risk of developing breast cancer. 3) Recognise the problem of masking caused by breast density. 4) Appreciate the various supplemental imaging methods that can be offered to women with dense breasts.

ABSTRACT

There are a number of factors that contribute to the risk of developing breast cancer. In those individuals with a genetic predisposition the lifetime risk can be up to 80%. For those without a genetic predisposition age is still the greatest risk but family history can play a big role as well as breast density. Single nucleotide polymorphisms have a very small risk but can give an additive effect. Together this information can be ised to create a risk profile For those women in the higher categories a more targetted imaging strategy can be used. This is being explored in the WISDOM and MyPEBS trials where frequency of mammography is being varied according to risk. Breast density can mask breast cancers and lead to detection at a later stage or interval cancers. Both have a much prognosis. Supplemental imaging is being advocated to to detect cancers at an earlier stage. However it is important to evaluate the variaous techniquessuch as abbreviated MRI, Contrast enhanced mammography and breast ultrasound. The size, type and grade of additional cancers that are found as well as interval cancer rates are important to estimate the benefits of making such changes to a screening programme.

RC418C Lung Cancer Screening

Participants

Claudia I. Henschke, MD,PhD, New York, NY (*Presenter*) Nothing to Disclose

RC418D Liver Screening for HCC

Participants

Maxime Ronot, MD, Clichy, France (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

maxime.ronot@aphp.fr

LEARNING OBJECTIVES

1) Gain knowledge about the evidence supporting HCC surveillance. 2) Understand the modalities of HCC surveillance. 3) Be aware of main limitations and controversies. 4) Understand and compare the surveillance policies in different countries.

RC418E Whole Body MRI for Cancer Screening

Participants
Giuseppe Petralia, MD, Milano, Italy (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

giuseppe.petralia@ieo.it

LEARNING OBJECTIVES

1) Describe the best use of Whole Body MRI for cancer screening. 2) Apply the most appropriate protocol when using Whole Body MRI for cancer screening. 3) Classify the findings detected on a Whole Body MRI for cancer screening.

RC420

Imaging Evaluation After Stereotactic Radiotherapy

Tuesday, Dec. 3 4:30PM - 6:00PM Room: N230B

BQ RO

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

Participants
William T. Yuh, MD, Seattle, WA (*Moderator*) Nothing to Disclose

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Wyuh@UW.edu

Sub-Events

RC420A Liver Cancer

Participants
Michael I. Lock, MD,FRCPC, London, ON (*Presenter*) Speaker, Bayer AG

LEARNING OBJECTIVES

1) Provide a step-by-step method to distinguish recurrence from normal radiation changes. 2) Discuss recent data that identifies MRI sequences that better identify tumors for radiation oncology purposes. 3) Identify common errors in imaging reports post radiation.

ABSTRACT

Imaging changes after with radiation can be misinterpreted as recurrence or progression. Recent evidence provides insight into timing, MRI sequences and imaging features that can better distinguish 'treatment effects' from 'recurrence'.

RC420B CNS Tumors

Participants
Hui-Kuo G. Shu, MD,PhD, Atlanta, GA (*Presenter*) Speakers Bureau, Varian Medical Systems, Inc; Stockholder, Medtronic plc; Stockholder, Apple Inc; Stockholder, Akebia Therapeutics Inc

For information about this presentation, contact:

hgshu@emory.edu

LEARNING OBJECTIVES

1) List the imaging modalities that are critical for CNS tumor evaluation prior to stereotactic radiosurgery (SRS). 2) Understand how specific imaging techniques for CNS tumors are used for pre-SRS planning. 3) Recognize how specific imaging techniques for CNS tumor are used in longitudinal response assessment for post-SRS clinical decision support.

RC420C Head and Neck Cancer

Participants
Minh T. Truong, MBBS, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of Imaging in the diagnosis of Recurrent Head and Neck Cancer (HNC), including PET/CT and MRI. 2) Understand integrating Imaging into Radiotherapy Simulation and Planning for HN SBRT. 3) Interpretation of Treatment Response to SBRT, including optimal timing and Interpreting treatment effect from persistent or recurrent disease.

ABSTRACT

RC420D Spinal Metastases

Participants
Chia-Lin Tseng, MD, Toronto, ON (*Presenter*) Travel support, Elekta AB

LEARNING OBJECTIVES

1) Explain indications for spine stereotactic body radiation therapy (SBRT) and conventional external beam radiation therapy (EBRT) in spinal metastases. 2) Review potential complications associated with radiation therapy and pattern of failure. 3) Describe the rationale in standardized response assessment of spinal metastases and identify challenges in follow-up assessment. 4) Discuss common language and importance of inter-disciplinary communication between radiation oncology and diagnostic radiology with respect to optimal post-treatment assessment.

RC421

Innovations in Dual- and Multi-energy CT

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S102CD

CT PH

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

Participants
Lifeng Yu, PhD, Rochester, MN (*Coordinator*) Nothing to Disclose

For information about this presentation, contact:

yu.lifeng@mayo.edu

LEARNING OBJECTIVES

1) Review dual-energy CT systems that are commercially available and multi-energy CT systems that are currently under development. 2) Review basic data processing and material decomposition techniques for dual-energy and multi-energy CT data. 3) Review current and potential clinical applications of dual-energy and multi-energy CT.

ABSTRACT

This session will provide an overview of CT systems, data processing, and clinical applications of dual-energy and multi-energy CT.

Sub-Events

RC421A Dual- and Multi-energy CT Systems

Participants
Taly Gilat Schmidt, PhD, Milwaukee, WI (*Presenter*) Research Grant, General Electric Company; Research Consultant, General Electric Company

LEARNING OBJECTIVES

1) Describe and compare the different approaches for acquiring multi-energy CT data. 2) Identify the important features of multi-energy CT systems and how they impact the acquired multi-energy data.

RC421B Dual- and Multi-energy Data Processing

Participants
Katsuyuki Taguchi, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG; Consultant, JOB Corporation

RC421C Clinical Applications of Dual- and Multi-energy CT

Participants
Joel G. Fletcher, MD, Rochester, MN (*Presenter*) Grant, Siemens AG; Consultant, Medtronic plc; Consultant, Takeda Pharmaceutical Company Limited; Grant, Takeda Pharmaceutical Company Limited; ;

For information about this presentation, contact:

fletcher.joel@mayo.edu

LEARNING OBJECTIVES

1) Review different types of standard dual energy images (e.g., linearly blended mixed kV, virtual monoenergetic images, virtual non-contrast, virtual non-calcium, iodine maps) and understand how they can be reconstructed and utilized in an efficient, protocol-driven, heterogeneous radiology practice. 2) Understand multiple clinical scenarios where clinical benefit is obtained by using the ability of dual energy to enhance iodine signal or quantify iodine content. 3) Illustrate how to use dual energy information quickly in exam interpretation.

RC422

Anatomical MR Imaging for Radiotherapy Planning and Guidance

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S501ABC

MR PH RO

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

Participants
Kristy K. Brock, PhD, Houston, TX (*Moderator*) License agreement, RaySearch Laboratories AB; Grant support, RaySearch Laboratories AB; Research support, Mirada Medical Ltd; ;

Sub-Events

RC422A State of the Art in Anatomical MR Imaging

Participants
Aradhana M. Venkatesan, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

avenkatesan@mdanderson.org

LEARNING OBJECTIVES

1) Review opportunities and unmet needs for state of the art imaging techniques to inform radiotherapy strategies. 2) Summarize the current state of the art role for contemporary MRI in radiotherapy, with an emphasis on gynecologic and prostate cancer therapy. 3) Describe emerging solutions enabled by MR imaging guidance and their potential gains for patients.

RC422B Clinical Need for Anatomical MR Imaging in Radiation Therapy

Participants
Cynthia Menard, MD, Montreal, QC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Cynthia.Menard@umontreal.ca

LEARNING OBJECTIVES

1) Understand the various roles of MRI in radiotherapy practice. 2) Identify pitfalls in integrating MRI in radiotherapy planning. 3) Describe anatomical sites where the integration of MRI is established as standard-care.

RC422C Technical Challenges in the Integration of Anatomical MR Imaging into Radiotherapy

Participants
Carri Glide-Hurst, PHD, Detroit, MI (*Presenter*) Researcher, ViewRay, Inc; Research Consultant, Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Researcher, Modus Medical Devices Inc; Equipment support, Medspira, LLC; Equipment support, QFix

LEARNING OBJECTIVES

1) To understand the unique imaging challenges and benefits for incorporating MRI into radiation therapy treatment planning. 2) To describe the magnetic resonance simulation (MR-SIM) process to yield images that are more robust for radiation therapy planning. 3) To describe emerging technologies in MR-only treatment planning and MR-guided radiation therapy and opportunities for collaboration between imaging and radiation therapy colleagues.

RC423

Evolving Perspectives on Ultrasound Safety

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E353A

PH SQ US

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

FDA Discussions may include off-label uses.

Participants

J. Brian Fowlkes, PhD, Ann Arbor, MI (*Coordinator*) Equipment support, Koninklijke Philips NV; Equipment support, General Electric Company; Equipment support, Canon Medical Systems Corporation; Research collaboration, Sonetics Inc; Stockholder, HistoSonics, Inc; Founder, HistoSonics, Inc

For information about this presentation, contact:

fowlkes@umich.edu

LEARNING OBJECTIVES

1) Understand the physical principles related to ultrasound safety and the potential for biological effects of ultrasound. 2) Utilize ultrasound in a safe and effective manner in clinical practice. 3) Increase their knowledge and understanding of the regulatory environment associated with medical ultrasound.

Sub-Events

RC423A Ultrasound Safety: Understanding the Potential Bioeffects

Participants

J. Brian Fowlkes, PhD, Ann Arbor, MI (*Presenter*) Equipment support, Koninklijke Philips NV; Equipment support, General Electric Company; Equipment support, Canon Medical Systems Corporation; Research collaboration, Sonetics Inc; Stockholder, HistoSonics, Inc; Founder, HistoSonics, Inc

For information about this presentation, contact:

fowlkes@umich.edu

LEARNING OBJECTIVES

1) Understand the physics associated with the potential bioeffects of ultrasound. 2) Increase basic knowledge of the controls and operator feedback related to ultrasound safety. 3) Be sufficiently proficient to utilized on-screen displays related to ultrasound safety. 4) Identify additional resources for understanding the physical effects of ultrasound.

Active Handout:J. Brian Fowlkes

http://abstract.rsna.org/uploads/2019/17000402/Active RC423A.pdf

RC423B Ultrasound Safety: What the Clinician Should Know

Participants

Jacques S. Abramowicz, MD, Chicago, IL (*Presenter*) Author with royalties, Wolters Kluwer nv; Medical Advisory Board, Samsung Electronics Co, Ltd

For information about this presentation, contact:

jabramowicz@bsd.uchicago.edu

ABSTRACT

Ultrasound is, arguably, one of the most common diagnostic procedures in clinical obstetrics. Its use for over more than 60 years has not been associated with fetal scientifically-proven harmful effects. Ultrasound, however, is a form of energy with potential rise of temperature and mechanical effects in insonated tissues. Knowledge of end-users on bioeffects of ultrasound and how to keep it safe is grossly lacking, but slowly improving, thanks to the efforts of various professional organizations. When a clear medical indication exists and the scan is performed by a professional knowledgeable in ultrasound bioeffects and safety and with respect to the As Low As Reasonably Achievable (ALARA) principle, risks to the fetus are minimal, if at all present. Education of clinical end-users continue to be of major importance, particularly given the ever-increasing use of new ultrasound technologies, such as Doppler and three/four-dimensional ultrasound.

RC423C Ultrasound Safety: What You Should Know About Therapeutic Ultrasound

Participants

Kenneth Bader, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

baderk@uchicago.edu

LEARNING OBJECTIVES

1) An overview of the physical principles by which ultrasound can be utilized for therapeutic benefit will be reviewed. 2) Image guidance methods and metrics for evaluating treatment efficacy will be outlined. 3) An overview of potential off-target effects will be discussed in the context of As Low As Reasonably Achievable (ALARA) principle.

ABSTRACT

Ultrasound is known most ubiquitously as a diagnostic imaging modality. High-intensity insonation conditions can be utilized for therapeutic benefit, generally categorized as ablation or enhanced permeability.

Printed on: 10/29/20

RC424

Humans, River Dolphins, Rottweilers, and Radiology: Applications of Comparative Diagnostic Imaging to One Health

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S103AB

OT

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

FDA Discussions may include off-label uses.

Participants
Marina Ivancic, DVM, Brookfield, IL (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

marina.ivancic@czs.org

laurabancroftmd@gmail.com

LEARNING OBJECTIVES

1) Discuss the developing field of zoological radiology and how interpretation of diagnostic imaging across all taxa plays a role in One Health. 2) Understand the role of canine companion animals in translational research and how molecular imaging technology using PET impacts veterinary and human medicine. 3) Learn about the correlations and contradictions in radiology of small animals (cats, dogs) and humans.

ABSTRACT

The health of humans and the well-being of companion animals, zoological species, and free-ranging wildlife are intrinsically linked. Medical investigations integrating these disciplines have enormous potential for advancing our understanding across taxa, and diagnostic radiology can play a vital role in this transdisciplinary approach. Although veterinary radiology originated as a discipline in the 1960s, the field of zoological radiology is in its infancy. Diagnostic imaging of wild animals invariably creates exceptional logistical challenges in both image acquisition and interpretation, and the application of well-understood concepts from human and domestic animal radiology to work with zoo animals will be discussed. Canine companion animals are integral to society as pets and working animals, and they share environmental risk factors with humans, developing many of the same cancers. We will explore the potential of molecular imaging technologies using PET imaging to impact veterinary and human medicine with shared expertise and advanced technology. A discussion of similarities and dissimilarities in radiological findings in companion animal medicine vs. human medicine will also be explored.

Sub-Events

RC424A Zoological Radiology: A Field in Its Infancy-How Specialists in Diagnostic Imaging Can Help Zoo Animals and Wildlife

Participants
Marina Ivancic, DVM, Brookfield, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

marina.ivancic@czs.org

LEARNING OBJECTIVES

1) Describe the historical use of diagnostic imaging in zoological medicine. 2) Understand the current radiological applications and challenges in the management and care of wild/zoo animals. 3) Learn about the intersectionality of human, companion animal, and zoological animal imaging and its role in OneHealth.

RC424B Imaging Pets with PET: A Bridge from Bench to Bedside

Participants
Allison L. Zwingenberger, DVM, Davis, CA (*Presenter*) Board of Directors, COLTENE; Research Grant, Omniox Inc

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Understand the role of canine companion animals in the development of translational research. 2) Learn about examples of translational imaging projects accelerating veterinary and human clinical trials. 3) Discuss the use of PET in advancing translational research with companion animals, primarily dogs.

ABSTRACT

Canine companion animals are integrated into our society as pets and working animals. In sharing peoples' lives, they also share environmental risk factors and develop many of the same cancers. Veterinary researchers are partnering with cancer researchers in

the laboratory and in the clinic to find opportunities to accelerate translational research. Studying spontaneous tumors in immunocompetent hosts is a step toward understanding the challenges in translating treatments to people. Imaging is used to monitor biomarkers of disease, treatment, and response in these naturally occurring cancers which have earlier onset and an accelerated course due to animals' shorter lifespans. Conventional imaging modalities such as radiographs, ultrasound, CT, and MRI are being augmented by molecular imaging technologies using PET to advance our knowledge of companion animal cancer. We will explore the potential of PET imaging to impact veterinary and human medicine with shared expertise and advanced technology.

RC424C Clinical Veterinary Radiology in 2019: Similarities and Differences with the 'Human' Radiologists

Participants
Anthony Fischetti, DVM, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

anthony.fischetti@amcny.org

LEARNING OBJECTIVES

1) Compare diagnostic imaging modality choices for various emergency room presentations in people and small animal veterinary patients. 2) Describe common outcomes of diagnostic imaging diagnoses in small animal veterinary patients; discuss how these outcomes can be drastically different from outcomes in people.

ABSTRACT

Availability, cost, and patient size play the largest roles in determining the modality of choice for veterinary patients in the emergency room setting. Few veterinary hospitals, including emergency centers and large tertiary-care referral hospitals, have access to after-hours CT and MR. Radiographs remain the mainstay for initial diagnostics. As a result, tele-radiology consultation is the leading professional option for board-certified veterinary radiologists in recent job task analysis surveys. Veterinary ultrasound has exponentially increased in availability over the past 10 years, but operator skill remains a barrier. Owners are often burdened with the costs of veterinary expenses as insurance for small animal patients remains a budding enterprise. Finally, the size of a cat or small dog (common to city dwellers) makes radiology and ultrasound the preferred option for accurate and swift diagnoses in small animal patients.

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RC425

Quantitative Imaging: Statistical Analysis/Metrology Issues

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S502AB

BQ 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

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mmcnittgray@mednet.ucla.edu

LEARNING OBJECTIVES

1) Understand issues related to quantitative imaging (QI) with regard to initiating a research question, developing an appropriate study design, and employing the specific statistical methods required to evaluate the QI method. 2) Understand methods to assess technical performance such as assessing repeatability and reproducibility through test-retest studies as well as bias and linearity through phantom studies. 3) Understand objectives of algorithm comparison studies and study design principles including methods for testing hypotheses, estimating performance, and producing descriptive summaries for algorithm comparison.

Sub-Events

RC425A The Role of Metrology in Quantitative Imaging

Participants
Hyung J. Kim, PhD, Los Angeles, CA (*Presenter*) Research Consultant, MedQIA Imaging Core Laboratory

For information about this presentation, contact:

gracekim@mednet.ucla.edu

LEARNING OBJECTIVES

1) Understand the role of quantitative imaging (QI) and the measurement. 2) Apply a study design for developing, evaluation, and validating a measurement of QI in a targeted population. 3) Contribute a unified terminology for aggregating information toward bias and variation of QI markers.

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 providing a common dataset and a common set of metric of evaluation, QI driven biomarkers and measurements from radiomics can facilitate rigorous evaluation of algorithms and eventually can be used clinically. Metrology is the science of measurement, including all theoretical and practical aspect of measurement at any level of uncertainty. Statistical design and evaluation in metrology is for describing the uncertainty of measurement and deriving a clinically meaningful metric in quantitative imaging. Many applications of using QI biomarkers or radiomics have been reported in numerous scientific publications. Challenges are to obtain a universally consistent terminology or methods in reporting a variation of QI marker or radiomics under the various conditions of scanners, readers, and software. Understanding variation of 'measureland' (the quantity intended to be measured (VIM clause 2.3) in radiological imaging is critical to set a clinically meaningful benchmark of a QI or radiomics. To estimate a variation of measureland or smallest detectable changes (SDC) using a standard metric of variation, the study design is a critical basis for the each stage of development, evaluation, and validation of a QI biomarker or measurement from radiomics. Reporting an estimated measureland is an initial step for combining the knowledge across studies and centers as part of evaluation and validation by an independent party. We will discuss the procedure: initialing research question, study design, and corresponding statistical methods toward development, evaluation, and validation of a measurement of QI marker in a targeted population. Furthermore, we will discuss meta-analysis when we use the common terminology of QI biomarkers and measurements from radiomics.

RC425B Methods for Technical Performance Assessment: What to Assess and How

Participants
Nicholas Petrick, PhD, Silver Spring, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Nicholas.petrick@fda.hhs.gov

LEARNING OBJECTIVES

1) Understand how to assess bias and linearity through phantom studies (or studies with an established reference standard). 2) Understand how to assess repeatability and reproducibility through test-retest studies. 3) Understand how technical performance impacts the utility of a quantitative imaging biomarker or radiomic signature.

ABSTRACT

Developments in extracting biological information from medical images have given rise to a wide range of quantitative imaging (QI)

functions and the field of radiomics. Critical to these research areas are the establishment of accurate and reproducible QI functions and the establishment of appropriate and widely accepted assessment methods. In this section of the refresher course, we will update the audience on the latest recommendations for assessing QI technical performance. I will also present examples of applying the concepts discussed in this course to specific clinically-relevant QI functions.

RC425C Statistical Evaluation of Quantitative Imaging Algorithms

Participants
Gene Pennello, PhD, Silver Spring, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand principles, objectives, common study designs, and common agreement metrics in the statistical evaluation of quantitative imaging algorithms. 2) Perform descriptive analysis, hypothesis testing, and estimation of algorithm performance. 3) Apply statistical methods appropriate to particular data structures and interpret the results.

ABSTRACT

A quantitative imaging biomarker can be defined as a physical quantity for which a measurement can be extracted from medical image(s), e.g., pulmonary nodule volume from CT scan and fracture callus size (mm2) from plain radiograph. Algorithms for deriving these measurements may be evaluated for accuracy (agreement with true value of the measurand), imprecision (variability of repeated measurements) and clinical performance (association with current or future health state). Algorithms may also be compared for agreement with each other in a method comparison study. In this talk, I'll survey performance evaluations of quantitative imaging algorithms, including graphical representations, unscaled performance metrics that are in the units of measurement, and scaled performance metrics that standardize the evaluation to a unitless scale. I'll review recent advances in measurement assessment as well as traditional metrics. I'll also review study designs including those with repeated measurements, and statistical analysis of a performance metric that account for random sampling variability, algorithm measurement error, and missing data.

Active Handout:Gene Pennello

http://abstract.rsna.org/uploads/2019/19001553/Active RC425C.pdf

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RC427

Objection! Medicolegal Issues for Today's Radiologist

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E260

HP

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

Participants
Jonathan Mezrich, MD, Guilford, CT (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

Jonathan.Mezrich@yale.edu

LEARNING OBJECTIVES

1) Be aware of common medico-legal issues involved in radiology. 2) Be aware of potential legal/risk management issues involved in the use of Gadolinium. 3) Have an understanding of the role of defensive medicine and its history. 4) Understand the risks involved in data acquisition and the impact of continuously adding new imaging sequences on liability. 5) Understand the impact of lawsuits in emergency medicine and its impact on imaging.

Sub-Events

RC427A Defensive Medicine: Born Yesterday, Here Today-Will it Be Here Tomorrow?

Participants
Leonard Berlin, MD, Wilmette, IL (*Presenter*) Nothing to Disclose

RC427B Gadolinium: An Emerging Risk-management Threat?

Participants
H. Benjamin Harvey, MD, JD, Nahant, MA (*Presenter*) Nothing to Disclose

RC427C Risky Business: Lawsuits in Emergency Medicine and Their Effects on Imaging

Participants
Saurabh Jha, MD, Philadelphia, PA (*Presenter*) Speakers Bureau, Canon Medical Systems Corporation

RC427D Sometimes Less is More: Data Acquisition and Its Impact on Liability

Participants
Jonathan Mezrich, MD, Guilford, CT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Jonathan.Mezrich@yale.edu

LEARNING OBJECTIVES

1) Better understand the liability risks inherent in data acquisition and the impact of continuously adding new imaging sequences. 2) Be cognizant of several potential solutions radiology might implement to address these issues.

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RC429

MRI Safety Course (Gadolinium and Pacemakers) (Interactive Session) (The In-Person Session is Supported in part by an Unrestricted Educational Grant from Bayer)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E350

MR SQ

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

FDA Discussions may include off-label uses.

Sub-Events

RC429A MRI in Patients with Pacemakers/Cardiac Devices

Participants
Robert J. Russo, MD, PhD, La Jolla, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Differentiate an MRI-conditional pacing system from a non-MRI-conditional system. 2) Assess the risks associated with MRI for patients with non-MRI-conditional pacemakers and defibrillators. 3) Integrate the performance of clinically indicated MRI in patients with pacemakers and defibrillators into the practice of radiology, cardiology, neurology, neurosurgery, and orthopedics. 4) Understand the current 2017 Heart Rhythm Society (HRS) Guidelines for performing MRI with an implanted cardiac device, as well as the Centers for Medicare and Medicaid Services (CMS) Decision Memo for Magnetic Resonance Imaging (MRI) (CAG-00399R4). 5) Utilize the current research results and clinical guidelines regarding MRI in patients with pacemakers and defibrillators for the establishment of a cardiology-radiology collaboration with the purpose of improving patient access to MRI.

RC429B Gadolinium Deposition: What Do I Tell Patients, Referring Physicians, Other Radiologists, and Attorneys?

Participants
Emanuel Kanal, MD, Pittsburgh, PA (*Presenter*) Consultant, Medtronic plc; Consultant, Bracco Group; Consultant, General Electric Company;

For information about this presentation, contact:

ekanal@pitt.edu

LEARNING OBJECTIVES

1) Provide an overview of the history of the long term safety effects of gadolinium based contrast agents regarding both nephrogenic systemic fibrosis (NSF) as well as gadolinium retention, and specify similarities as well as significant clinical differences between these two concerns. 2) Explain mechanisms how gadolinium based contrast agents, which do not cross the blood brain barrier, is believed today to be successfully transported from the vascular lumen to the parenchyma of the brain. 3) List similarities as well as differences among the various types of gadolinium based contrast agents relative to gadolinium retention/deposition as well as NSF. 4) Describe how the FDA's response to gadolinium retention concerns differs from that the European regulatory agencies. 5) Identify what we definitively know today - and what we still don't know - about the safety of retained gadolinium in the brain.

ABSTRACT

2006 was accompanied by the discovery of a relationship between the intravenous administration of at least some gadolinium based contrast agents (GBCA) and the development of nephrogenic systemic fibrosis (NSF) in patients with significant renal disease. Roughly 8 years later GBCAs were found to deposit or leave a very small amount of their administered intravenous dose in the brain as well as other tissues/organs of its recipients that can be found months or even year following its initial administration. This time, however, this finding was present even in those with normal renal function, although it did seem more pronounced in patients with renal disease. In the more than 5 years that have passed since this discovery was first publicized, there is much that we have learned - and a great deal that we still have not determined - about gadolinium retention. Still being investigated are such issues as similarities versus differences between individual GBCAs with respect to gadolinium retention and potential high risk patients or populations for gadolinium retention. Perhaps the single main question that remains, however, is whether there is any significant clinical consequence or harm as a result of such deposition, and if that potential consequence is the same in type and incidence for all GBCA.This presentation will attempt to provide a succinct summary of the more salient issues and facts that we know regarding retained gadolinium, and will at the same time stress what we still do NOT confidently know or understand regarding the safety of gadolinium retention in humans today.

RC429C Establishing an Efficient Workflow for MRI Safety

Participants
Bradley N. Delman, MD, New York, NY (*Presenter*) Consultant, Bayer AG Speaker, Bayer AG

For information about this presentation, contact:

bradley.delman@mountsinai.org

LEARNING OBJECTIVES

1) Assess current MRI environment in critical aspects of safety. 2) Understand key structures of MRI safety oversight, including current consensus models for management. 3) Define potential risks in MRI suites to patients, personnel and visitors. 4) Explain considerations in special populations. 5) Establish a reliable method of response in emergent situations. 6) Identify resources for optimizing the safety program.

RC429D **Q&A**

Participants
Robert J. Russo, MD, PhD, La Jolla, CA (*Presenter*) Nothing to Disclose
Emanuel Kanal, MD, Pittsburgh, PA (*Presenter*) Consultant, Medtronic plc; Consultant, Bracco Group; Consultant, General Electric Company;
Bradley N. Delman, MD, New York, NY (*Presenter*) Consultant, Bayer AG Speaker, Bayer AG

For information about this presentation, contact:

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RC431

The New Standard of Care of Large Vessel Stroke is Endovascular: Is Your Radiology Practice Ready?

Tuesday, Dec. 3 4:30PM - 6:00PM Room: N229

ER NR IR

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

Participants

Joshua A. Hirsch, MD, Boston, MA (*Moderator*) Consultant, Medtronic plc; Data Safety Monitoring Board, Johnson & Johnson; Committee member, Relievant Medsystems, Inc; Consultant, Whale Imaging Inc;

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 intra-arterial 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 highlighing 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 Neuroimaging, Artificial Intelligence, and Triage in the Age of Thrombectomy

Participants
Ramon G. Gonzalez, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the physiological changes that occur in acute stroke patients with large vessel occlusions. 2) Identify the most important variables needed to select ischemic stroke patients for endovascular thrombectomy and the most reliable neuroimaging methods to identify these key variables. 3) Review the data that has shown that there is high variability in the growth of the ischemic core that makes possible the endovascular treatment of large vessel occlusion patients up to 24 hours after stroke onset. 4) Appreciate the large proportion of patients that are slow progressors (slow infarct growth) that may be transported for successful endovascular thrombectomy.

RC431B This is How I Do It: Practical Tips for Opening the Occlusion

Participants
Allan L. Brook, MD, Bronx , NY (*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 Health Policy and Reimbursement RE: Stroke

Participants
Joshua A. Hirsch, MD, Boston, MA (*Presenter*) Consultant, Medtronic plc; Data Safety Monitoring Board, Johnson & Johnson; Committee member, Relievant Medsystems, Inc; Consultant, Whale Imaging Inc;

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 ~+/- 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 ~50% reduction in mortality and a ~3-fold increase in good outcomes, despite a ~50% decrease in the number of procedures. A recent prospective observational trial at the MGH using stentrievers 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 AIDS 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.

RC431D **Q&A**

RC432

Imaging Utilization, Clinical Decision Support, and Appropriateness

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S503AB

LM

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

Participants
Yoshimi Anzai, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose

Sub-Events

RC432A Imaging Utilization: Past, Present, and Future

Participants
David C. Levin, MD, Philadelphia, PA (*Presenter*) Consultant, HealthHelp, LLC Board Member, Outpatient Imaging Affiliates, LLC

LEARNING OBJECTIVES

1) Understand the overall trends in imaging during the last 12 years. 2) Understand the trends in utilization of each of the major imaging modalities over the last 12 years. 3) Assess the various factors that might cause imaging use to increase or decrease in the coming years.

RC432B Variations in Medicare Imaging: A Data-driven Approach

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

For information about this presentation, contact:

rosena23@nyumc.org

LEARNING OBJECTIVES

1) Understand the importance from a policy perspective of recognizing sources of variation in imaging utilization. 2) Explore a spectrum of sources of variation in imaging utilization. 3) Describe associations between variation in utilization of imaging and other categories of healthcare services.

RC432C Clinical Decision Support for Radiology Order Entry: Challenges and Opportunities

Participants
Charles E. Kahn JR, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ckahn@upenn.edu

LEARNING OBJECTIVES

1) Describe the requirements of the Protecting Access to Medicare Act (PAMA). 2) Define some of the challenges of clinical decision support (CDS) for radiology order entry. 3) Explore early results using order-entry CDS. 4) Identify opportunities to use imaging CDS to improve clinical practice.

RC432D Harmonizing the Drivers of High Value Care: Professionalism, Performance Improvement and Policy

Participants
Pamela T. Johnson, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the barriers to value-based quality improvement. 2) Recognize the importance of cross-specialty collaboration for effective performance improvement initiatives. 3) Understand the power of cross-institutional collaboration to efficiently advance performance improvement. 4) Recognize the importance of disseminating value-based quality improvement through publication and presentations at national meetings, with emphasis on safety outcomes data.

ABSTRACT

This session reviews strategies to effectively increase radiology value on a national scale, based on our experience with the High Value Practice Academic Alliance, a national consortium of >90 academic medical centers.

RC450

US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S403A

NR US HN OI

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

Participants
Jill E. Langer, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Kathryn A. Robinson, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Sheila Sheth, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the sonographic characteristics of thyroid nodules that are suspicious for malignancy. 2) Discuss the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. 3) Describe the indications for new genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. 4) Review how to pall ACR TI-RADS. 5) Describe the technique of US-guided biopsy of thyroid nodules and cervical lymph nodes in patients who have undergone thyroidectomy for thyroid cancer. 6) Discuss the rationale and method of performance of US-guided ethanol ablation of malignant cervical adenopathy in post thyroidectomy patients.

ABSTRACT

This presentation will consist of a three individual presentations. The first will review the sonographic characteristics of thyroid nodules that are suggestive of malignancy. Recommendations for selecting which thyroid nodules require ultrasound-guided biopsies based on ACR TI-RADS guidelines will be discussed. The second presentation will review the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. Additionally this presentation describes the indications for genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. The last presentation will provide a detailed description of the technique for performing ultrasound guided biopsy of thyroid nodules and cervical lymph nodes. Various methods will be discussed and required equipment outlined. Possible complications, though rare, will be described. A comparison of the typical sonographic features of normal versus abnormal lymph nodes will be presented in an effort to identify those patients in whom sonographic follow up can be used instead of biopsy. A discussion of the possible advantages of adding thyroglobulin assay to cytologic evaluation will be provided. The rationale for and technique of performing ultrasound guided ethanol ablation of malignant cervical lymph nodes in patients with thyroid cancer will be undertaken.

RC452

Nerve Ultrasound Based on a Regional Approach: Ankle and Foot (Hands-on)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: E264

MK NR US

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

Participants
Carlo Martinoli, MD, Genova, Italy (*Presenter*) Speaker, Koninklijke Philips NV; Speaker, Canon Medical Systems Corporation; Speaker, Novonordisk Pharmaceuticals; Speaker, Pfizer Inc; Speaker, Novartis AG; Speaker, Swedish Orphan Biovitrum AB
Jon A. Jacobson, MD, Ann Arbor, MI (*Presenter*) Research Consultant, BioClinica, Inc; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier
Kenneth S. Lee, MD, Madison, WI (*Presenter*) Grant, General Electric Company; Grant, National Basketball Association; Grant, Johnson & Johnson; Research support, SuperSonic Imagine; Royalties, Reed Elsevier
Marnix T. van Holsbeeck, MD, Detroit, MI (*Presenter*) Stockholder, Koninklijke Philips NV; Stockholder, General Electric Company; Stockholder, MedEd3D;
Joseph H. Introcaso, MD, Neenah, WI (*Presenter*) Nothing to Disclose
Viviane Khoury, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Marina Kislyakova, MD, Moscow, Russian Federation (*Presenter*) Nothing to Disclose
Ximena L. Wortsman, MD, Santiago, Chile (*Presenter*) Speakers Bureau, AbbVie Inc; Royalties, Springer Nature
Federico Zaottini, Genova, Italy (*Presenter*) Nothing to Disclose
Ghiyath Habra, MD, Troy, MI (*Presenter*) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose
David P. Fessell, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Girish Gandikota, MBBS , Ann Arbor, MI (*Presenter*) Nothing to Disclose
Lodewijk J. van Holsbeeck, MD, Lansing, MI (*Presenter*) Nothing to Disclose
Andrea Klauser, MD, Reith bei Seefeld, Austria (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Familiarize course participants with the ultrasound appearance of nerves and the scanning techniques used to image them about the ankle and foot. 2) Emphasize the ultrasound anatomy of the tibial, medial and lateral plantar, sural, deep and superficial peroneal nerves and their divisional branches at their common sites of entrapment. 3) Learn the technique to image some minor nerves in their course throughout the distal lower extremity, such as the medial, intermediate and lateral dorsal cutaneous, the medial and inferior calcaneal. 4) Outline the range of clinical conditions where ultrasound is appropriate as the primary imaging modality for nerve assessment.

ABSTRACT

In recent years, ultrasound of the musculoskeletal and peripheral nervous systems is becoming an increasingly imaging tool with an expanding evidence base to support its use. However, the operator dependent nature and level of technical expertise required to perform an adequate ultrasound assessment means that appropriate training is required. For this purpose, the present course will demonstrate the basic principles of musculoskeletal ultrasound with a special focus on nerves of the proximal lower extremity (hip to knee). The standardized techniques of performing an adequate ultrasound study of the tibial, medial and lateral plantar, sural, deep and superficial peroneal, medial, intermediate and lateral dorsal cutaneous, medial and inferior calcanear nerves and their divisional branches will be illustrated. The hands-on workshops will provide the opportunity to interactively discuss the role of ultrasound in this field with expert instructors. Participants will be encouraged to directly scan model patients. A careful ultrasound approach with thorough understanding of soft-tissue planes and extensive familiarity with anatomy are prerequisites for obtaining reliable information regarding the affected structure and the site and nature of the disease process affecting it.

RC453

Structured Reporting: How Can We Make it Better?

Tuesday, Dec. 3 4:30PM - 6:00PM Room: N228

IN

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

Participants
Olga R. Brook, MD, Boston, MA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

obrook@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To learn benefits of disease-specific vs simple structured reporting in debate format. 2) To learn value of structured reporting for machine learning. 3) To learn about added value of specific disease-specific structured reports in neuroradiology and thoracic imaging.

Sub-Events

RC453A Contextual Structured Reporting in Neuroradiology

Participants
Mark D. Mamlouk, MD, Dublin, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mark.d.mamlouk@kp.org

LEARNING OBJECTIVES

1) Define what contextual reporting is and demonstrate how to create disease-specific templates. 2) Explain the advantages of contextual reporting over conventional structured reporting through the use of neuroradiology imaging examples and contextual templates.

RC453B Added Value of Disease-specific Structured Reporting in Thoracic Radiology

Participants
Jonathan H. Chung, MD, Chicago, IL (*Presenter*) Royalties, Reed Elsevier; Consultant, Boehringer Ingelheim GmbH; Speakers Bureau, Boehringer Ingelheim GmbH; Consultant, F. Hoffmann-La Roche Ltd; Speakers Bureau, F. Hoffmann-La Roche Ltd; Consultant, Veracyte, Inc;

LEARNING OBJECTIVES

1) Understand that structured reports encourage positive radiologist behavior. 2) Recognize how structured, disease specific templates can aid in quality improvement. 3) Understand how structured, disease specific templates can help our clinical colleagues.

RC453C The Importance of Structured Reporting for Machine Learning

Participants
Wieland H. Sommer, MD, Munich, Germany (*Presenter*) Founder, Smart Reporting GmbH

LEARNING OBJECTIVES

1) To understand the challenges for integrating machine learning algorithms into a radiological reporting workflow. 2) To understand the importance of analyzable data for training of machine learning algorithms.

RC453D Debate: Simple Structured versus Disease-specific Structured Reporting-Simple Structured is Better

Participants
Marta E. Heilbrun, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

marta.heilbrun@emory.edu

LEARNING OBJECTIVES

1) Explain why simple reporting templates facilitate workflow and efficiency. 2) Understand solutions also provide to disease specific or tailored reporting.

RC453E Debate: Simple Structured versus Disease-specific Structured Reporting-Disease-specific is Better

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 learn about benefits of disease-specific structured reporting and its implementation.

ABSTRACT

Disease-specific structured reporting is the next step in the evolution of radiology reporting. Simple structured reporting (organ level, paragraph style) is great solution for normal or near normal studies. However, when dealing with a specific disease entity, a tailored report serves better needs of referral physicians, as it provides all pertinent negative and positive findings needed to make a clinical decision.

Printed on: 10/29/20

RC454

Platforms and Infrastructures for Accelerated Discoveries in Machine Learning and Radiomics

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S403B

AI IN

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

Participants
Katherine P. Andriole, PhD, Chestnut Hill, MA (*Moderator*) Research funded, NVIDIA Corporation; Research funded, General Electric Company; Research funded, Nuance Communications, Inc; ; ; ;

For information about this presentation, contact:

kandirole@bwh.harvard.edu

LEARNING OBJECTIVES

1) Understand the challenges involved in creating machine learning and radiomics experiments with standard clinical systems. 2) Review some of the tools that can bridge the gap between existing clinical systems and translational research in medical imaging. 3) Provide use case examples using open source tools.

ABSTRACT

Machine Learning and Radiomics promise to revolutionize the field of Radiology by allowing more quantification of medical images exposing previously "hidden" information within the imaging data. More recently, the combination machine learning techniques such as deep learning with radiomics, open new opportunities for researchers in this space. However, standard clinical systems are not suited for machine learning and radiomics experiments posing a significant challenge for individuals together started. The purpose of this session is to review existing and custom developed infrastructures and platforms to bridge this gap.

Sub-Events

RC454A Overview of the R&D Process Pipeline for Machine Learning in Radiology

Participants
Katherine P. Andriole, PhD, Chestnut Hill, MA (*Presenter*) Research funded, NVIDIA Corporation; Research funded, General Electric Company; Research funded, Nuance Communications, Inc; ; ; ;

For information about this presentation, contact:

kanriole@bwh.harvard.edu

RC454B Infrastructure and Software Platforms for Model Development, Training, Validation, and Clinical Integration

Participants
Neil Tenenholtz, PhD, Boston, MA (*Presenter*) Employee, Microsoft Corporation

For information about this presentation, contact:

ntenenholtz@partners.org

LEARNING OBJECTIVES

1) Identify cohorts for model development leveraging radiology reports and imaging metadata. 2) Rapidly annotate reports and imaging data on which machine learning models can be trained. 3) Build a pipeline for acquiring imaging data from a PACS for model development. 4) Train machine learning models on imaging data. 5) Validate machine learning models in the clinical workflow.

RC454C Machine Learning and Radiomics in Practice: Tools and Case Example

Participants
Daniel L. Rubin, MD, Stanford, CA (*Presenter*) Consultant, F. Hoffmann-La Roche Ltd

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 tools, platforms, infrastructures, standards, and machine learning methods that can leverage medical images to better understand disease and enable decision support. 3) To see example use cases of radiomics and machine learning methods for accelerating research and improving clinical practice.

RCA35

Virtual Reality (VR) Improves Analysis of Complex Brain and Skull Base Tumors (Hands-on)

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S401AB

IN NR

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

FDA Discussions may include off-label uses.

Participants
Vinodh A. Kumar, MD, Houston, TX (*Presenter*) Nothing to Disclose
Maria Gule-Monroe, MD, Houston, TX (*Presenter*) Nothing to Disclose
Jill V. Hunter, MD, Houston, TX (*Presenter*) Author with royalties, Wolters Kluwer nv
Morgan Kuligowski, Los Angeles, CA (*Presenter*) Nothing to Disclose
Halyna Pokhylevych, MD, Houston, TX (*Presenter*) Nothing to Disclose
Donald F. Schomer, MD, Fountain Hills, AZ (*Presenter*) ; Stockholder, Sinopsys Surgical, Inc
Komal B. Shah, MD, Houston, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Identify how VR improves pre-operative planning of difficult brain and skull base tumors. 2) Appraise VR's ability to delineate important peritumoral arteries and veins. 3) Identify how VR can help localize peritumoral white matter tracts when DTI fails. 4) Assess how VR can be used as part of patient centered care and education.

ABSTRACT

This hands-on workshop will demonstrate an advanced brain atlas which fuses with a patient's MR brain imaging. Attendees will be able to navigate a patient's brain with 3D goggles using Virtual Reality (VR) technology and the embedded brain atlas. The atlas has extensive data related to brain anatomy, vasculature and function. It can map white matter fiber tracts when conventional DTI cannot be generated as a result of tumor or vasogenic edema. The anatomical structures in the atlas can be deformed to account for tumor mass effect. Given its 3D capability, this tool has been used for pre-operative neurosurgical and radiation planning for the treatment of gliomas and skull base tumors. Intraoperatively, the atlas has been sucessfully fused to neuronavigation systems to aid in real time surgical guidance. The technology also supports patient and family centered care, through the generation of videos related to the patient's brain tumor assisting patient education.

Printed on: 10/29/20

RCC35

Getting Stuff Done: A Mindful Approach to Personal Productivity

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S103CD

IN

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

FDA Discussions may include off-label uses.

Participants
Puneet Bhargava, MD, Shoreline, WA (*Moderator*) Editor, Reed Elsevier
Matthew B. Morgan, MD, Sandy, UT (*Presenter*) Consultant, Reed Elsevier
Puneet Bhargava, MD, Shoreline, WA (*Presenter*) Editor, Reed Elsevier

For information about this presentation, contact:

bhargp@uw.edu

LEARNING OBJECTIVES

1) Introduce the concept of 'Getting Things Done.' Learn the concepts of Inbox Zero and other email management techniques. 2) Using tools such as note-taking applications, citation and password managers. 3) Using self-inquiry techniques, review how to make meaningful and powerful changes in how we engage with technology.

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