Chest Radiology

104th Scientific Assembly and Annual Meeting
November 25-30 | McCormick Place, Chicago
Keep Bleeding Lung: Radiological Findings in Pulmonary Hemorrhage

All Day Room: NA Hardcopy Backboard

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TEACHING POINTS
1. To review pulmonary hemorrhage pathophysiology and its relation to imaging findings.
2. To explain the imaging patterns found in pulmonary hemorrhages from different etiologies which contribute to establish an accurate diagnosis.
3. To illustrate the benefits of performing 3D reconstruction and selective bronchial angiogram in the diagnosis and treatment of pulmonary hemorrhage of vascular etiology.
4. To emphasize the importance of an integral approach, including patient history in order to identify key associated findings.
5. To review pulmonary hemorrhage pitfalls and learn the key findings for differential diagnosis.

TABLE OF CONTENTS/OUTLINE
Introduction Pathophysiology Common imaging findings History Etiologies: Infectious Vascular Collagen and rheumatologic diseases Neoplastic Postsurgical complications Pharmacological and toxicological causes Bone marrow transplantation Miscellaneous Mimics and pitfalls Conclusions
Advanced Non-Small Cell Lung Cancer CT Characteristics in the Era of Molecular Medicine: Correlation with ALK and EGFR Molecular Phenotype

All Day Room: NA Hardcopy Backboard

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TEACHING POINTS
Significant technical advances in the past decade regarding ALK (anaplastic lymphoma kinase) rearrangement and EGFR (epidermal growth factor receptor) mutations in non-small cell lung cancer (NSCLC), particularly advanced adenocarcinomas, faces the radiologist with a new challenge: can be correlate tumors imaging characteristics and thus predict possible genomic rearrangements? The purpose of this exhibit is to: Review adenocarcinoma molecular features. Investigate epidemiological characteristics of patients with molecular mutations to be able to subdivide them into study groups. Stablish the differences in computed tomographic (CT) characteristics between patients with advanced lung adenocarcinoma ALK gene rearrangement and those who have EGFR mutations.

TABLE OF CONTENTS/OUTLINE
- Adenocarcinomas are characterized by distinct genomic changes. ALK+ EGFR+ NSCLC has distinct epidemiological and CT characteristics regarding gender, age population and tumor size, margins, central or peripheral location, lymph node metastasis, intrathoracic metastasis (lung, pleural or pericardial, or bone)and association with large pleural effusions. - Case reviews of 30 patients in our institution from January 2017 to April 2018. A triple blind analysis model was applied to discriminate clinical and CT characteristics between these types of mutation.
Pulmonary Hydatid Cysts - What Are CT Features Should We Know?

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1- Different types of pulmonary hydatid cysts according to content, site and complications . 2- Screening tests for pulmonary hydatid cysts . 3- CT features of complicated and uncomplicated pulmonary hydatid cysts .

TABLE OF CONTENTS/OUTLINE

TYPES : 1-According to the content - Type I: Simple Cyst. Type II: cyst with floating membranes -Type III: Cyst with daughter cyst (vesicles) . Type IV: tumor like cyst.- Type V: calcified cyst.- 2-According to site : Pulmonary -Extra pulmonary locations , include pleura ,diaphragm , heart ,mediastinum ,pericardium and chest wall 3-According to complications : -Uncomplicated . -Complicated . CT Features : Uncomplicated hydatid cysts appear as well-circumscribed fluid attenuation lesions with homogenous content and smooth. Complicated cysts : CT signs of rupture of hydatid cysts. Signs of contained rupture : Air crescent sign ,Inverse crescent sign and Air bubble sign Waterlily sign . Signs of cyst complete rupture : Cumbo sign , Whirl sign, Waterlily sign , Mass within a cavity sign ,Dry cyst sign. -Differential diagnosis -Treatment :medical or surgical
Hemoptysis A to Z: What the Radiologist Needs to Know

All Day Room: NA Digital Education Exhibit

Awards
Magna Cum Laude

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TEACHING POINTS
1. To review the pathophysiologic features and causes of hemoptysis
2. To discuss the considerations during hemoptysis CT interpretation
3. To illustrate the various CT findings which can cause hemoptysis

TABLE OF CONTENTS/OUTLINE
1. Definition, is it real hemoptysis?
2. Pathophysiologic mechanisms and causes of hemoptysis
3. Anatomy of bronchial and non-bronchial systemic artery - with corresponding angiography findings
4. Diagnosis of hemoptysis: the role of MDCT
   1) CT protocol and Image reformation for hemoptysis
   2) What the radiologist should consider on hemoptysis CT?
      a. identify the immediate source of hemoptysis
      b. evaluate effects of hemorrhage, is the air-way patent?
      c. find primary cause of the hemoptysis
      d. which systemic artery require embolization?
      e. caution with hidden malignancy with hematoma
      f. is there any problem in upper airway?
5. Image findings encountered on CT hemoptysis, based on case review
   1) Airway disease: bronchiectasis, neoplasm, fistula with aorta
   2) Pulmonary parenchymal disease: infection (TB, paragonimiasis), rheumatic/Immune disorder (SLE pneumonitis, DAH), hemorrhagic metastasis, hidden lung cancer, catamenial hemoptysis
   3) Pulmonary vascular disease: bronchial artery aneurysm
   4) Disorders of coagulation: hemophilia patient
   5) Others
Vascular Complications of Pulmonary Resection: A Pictorial Review

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TEACHING POINTS
Vascular complications secondary to pulmonary resection are relatively uncommon and often require contrast-enhanced chest CT to establish the diagnosis along with a high index of clinical suspicion. Although rare, these entities frequently necessitate urgent intervention to prevent significant associated morbidity. The purpose of this exhibit is to:1. Review the types of vascular complications which can occur after pulmonary resection2. Illustrate imaging features of vascular complications associated with lobar and sub-lobar pulmonary resection3. Highlight how dual-energy CT may be useful in diagnosing these conditions

TABLE OF CONTENTS/OUTLINE
**Imaging of Precision Therapy for Lung Cancer: Update in Genomic, Therapeutic, and Imaging Perspectives**

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**FDA** Discussions may include off-label uses.

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**TEACHING POINTS**

Precision therapy based on tumor genomics has become a standard for lung cancer care in the past decade. Recently, further advances and paradigm shifts have occurred in precision medicine approaches to lung cancer. The exhibit provides a cutting-edge review of the recent advances of precision lung cancer therapy that are essential for radiologists to remain up-to-date in the rapidly evolving world of cancer. Lessons from the tumor board at the tertiary cancer center will be presented to enhance practical teaching points.

**TABLE OF CONTENTS/OUTLINE**

Advances in precision therapy
- EGFR inhibitors: 3rd-generation TKI (osimertinib) in acquired resistance and first-line settings
- ALK inhibitors: Review of approved drugs (crizotinib, ceritinib, alectinib, brigatinib); Role in ROS-1 rearranged and MET exon 14 mutated tumors
- BRAF inhibitors: Dabrafenib and trametinib for NSCLC
- Immune-checkpoint inhibitors: Discussion of increasing clinical used and summary of novel agents and combinations

Biomarkers and genomics
- Clinical application of tumor genotyping using whole exome sequencing
- Liquid biopsy and plasma genotyping

Biomarkers for immunotherapy: PD-L1 and beyond

Update in imaging
- Beyond RECIST: tumor volumes and growth rate
- Radiomics/Radiogenomics in response evaluations
- Future directions in molecular/functional imaging
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TEACHING POINTS
Multi-disciplinary conferences (MDCs) play a crucial role in the accurate diagnosis of interstitial lung diseases (ILDs). The integration of clinical, radiologic, and pathologic perspectives can lead to a change in the initial pathologic diagnosis in 20-40% of cases. Overlapping features of ILDs can make these conferences uniquely confusing. In order to effectively participate, radiologists must have a strong understanding of the terminology and common findings of ILDs. This educational exhibit will review the common clinical, radiologic and pathologic findings one will encounter in these MDCs.

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1. Formal system by which cases are reviewed at our institution. 2. Basics of pathologic stains and histologic appearance of normal lung. 3. Common patterns seen in ILD (a. honeycombing, b. granulomas, c. diffuse alveolar hemorrhage, d. vasculitis). 4. Clinical, radiologic, and pathologic findings of major ILDs (a. usual interstitial pneumonitis, b. nonspecific interstitial pneumonitis, c. smoking-related ILDs, d. acute interstitial pneumonitis, e. organizing pneumonia) and more rare ILDs (a. follicular bronchiolitis, b. lymphocytic interstitial pneumonitis, c. pleuroparenchymal fibroelastosis). 5. Additional entities frequently discussed in MDC (a. hypersensitivity pneumonitis, b. collagen vascular diseases, c. pulmonary hypertension)

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

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TEACHING POINTS
The diagnosis of interstitial pneumonias (IP) relies on the integration of clinical, HRCT, and pathology information. This exhibit reviews a) the imaging, pathology, and clinical diagnosis of idiopathic IPs (IIPs), emphasizing usual IP (UIP) and new Fleischner Society diagnostic recommendations b) CT clues for alternative causes of fibrosing IPs and c) pitfalls and challenges in multidisciplinary diagnosis.

TABLE OF CONTENTS/OUTLINE
1. IIP classification: American Thoracic Society (ATS) a. Patterns: UIP (Fleischner CT categories for UIP); nonspecific IP; organizing pneumonia (OP); desquamative IP b. Alternative causes of fibrosing IPs: Clues -Dilated esophagus, pericardial/pleural effusions (connective tissue, autoimmune disease) -Pleural disease (asbestosis) -Dense liver (Amiodarone) -Atypical lung CT findings: Upper lobe (sarcoid, hypersensitivity pneumonitis (HP)); peribronchovascular (NSIP); nodularity (sarcoid); mosaic perfusion (HP); consolidation (OP) 2. Fibrosing IPs: Diagnostic pearls and pitfalls a. Multidisciplinary approach b. Pearls and pitfalls -Clinical: Delayed serologic conversion and UIP; patient age -Imaging: Honeycombing vs traction bronchiolectasis; emphysema vs traction bronchiolectasis; OP and fibrosis; cysts in DIP vs. honeycombing -Pathology: Granulomas (drug, sarcoid, HP); OP coexists with other diseases
Not Always Clear: Radiographic Clearance of the Mediastinum in the Emergency Department

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Despite increased use of CT in emergency departments across the country, radiography persists as the mainstay of initial screening for trauma and many of the medical emergency patients. Identification of acute findings can allow for appropriate immediate management and prevent delay in care. This poster will review important normal mediastinal anatomy, followed by both common and uncommon pathology seen in the emergency department that can be identified radiographically and expedite further evaluation and treatment.

TABLE OF CONTENTS/OUTLINE
In a quiz format, multiple cases will be presented that highlight mediastinal pathology seen radiographically in the adult emergency department, with cross sectional and/or fluoroscopic correlation. Anatomy, pathology, and radiographic technique will be emphasized. Cases will include multiple examples of: 1) Normal chest x-ray anatomy: mediastinal lines, stripes, and contours 2) Vascular pathology: aortic dissection, intramural hematoma, various vascular aneurysms (aorta, pulmonary artery, subclavian artery, CABG) 3) Mediastinal hematomas 4) Acute esophageal pathology including perforation 5) Lines and tubes: misplaced/malpositioned lines/tubes, as well as appropriately placed lines/tubes seen mimicking malpositioning due to variant anatomy.
Imaging Findings in Pulmonary Vasculitis: A Pattern-Based Approach

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TEACHING POINTS

1. Describe the classification of pulmonary vasculitides
2. Review thoracic manifestations using a pattern-based approach
3. Understand how the clinical presentation and pattern of imaging findings can guide diagnosis
4. Discuss the role of laboratory tests in the refinement of diagnosis

TABLE OF CONTENTS/OUTLINE

- Background
- Classification of pulmonary vasculitides using the Chapel Hill Consensus Conference 2012 system.
- Review of imaging manifestations on CT chest using a pattern-based approach (large vessel stenosis/aneurysm, nodules +/- cavitation, ground-glass opacity, migrating consolidation and septal lines, tree-in-bud opacity, airways, mediastinum and pleura).
- Relate imaging findings to clinical features and pathogenesis of disease
- Discuss the role of laboratory tests including the significance of a positive result, to include (serum eosinophils, cytoplasmic antineutrophil cytoplasmic antibody (C-ANCA), perinuclear-ANCA, atypical-ANCA, anti-glomerular basement membrane, serum proteinase 3 and myeloperoxidase ANCA enzyme-linked immunosorbent assay tests).
Esophageal Carcinoma: Do You Know...

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To review illustrative cases that clarify important concepts in the clinical staging of patients with esophageal carcinoma. To review cases that illustrate pitfalls and post-therapeutic complications in patients with esophageal carcinoma.

TABLE OF CONTENTS/OUTLINE
TNM initial clinical staging
1- TNM (T) Primary tumor and importance of satellite tumor/s.
2- TNM (N) Regional nodal disease and importance of regional nodal metastasis not adjacent to the primary malignancy.
3- TNM (M) Distant metastasis and importance of occult metastases at initial diagnosis.

Pitfalls and post-therapeutic complications during treatment and follow-up
1. Radiation-induced esophagitis.
2. Radiation-induced liver injury.
3. Development of metastasis after neoadjuvant therapy.
4. Dehiscence of the anastomosis and leak.
5. Fat necrosis of the omental flap.
6. Recurrent disease.

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Sonia L. Betancourt Cuellar, MD - 2018 Honored Educator
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Esophagitis: It Is Not only About Gastroesophageal Reflux Disease

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

The purpose of this exhibit is: 1. To review the technique of the esophagogram. 2. To learn the principal differential diagnosis of esophagitis using esophagogram.

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Upper Lobe Predominant Diseases

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS

To review pathophysiologic process of upper lobe predominant diseases. Review the radiological differential diagnosis of upper lobe predominant diseases. To highlight the different imaging characteristics of upper lobe predominant lung diseases.

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Pathophysiologic processes of upper lobe predominant diseases Differences in perfusion-ventilation ratio - In an erect individual the apical regions are relatively over ventilated and the bases over perfused. Difference in lymphatic clearance - Lymphatic clearance is decreased in the apices compared to the bases, lymphatic flow is driven both by perfusion and respiratory excursion. Regional differences in metabolism - Within the lung there are regional differences in O2 uptake and CO2 elimination, creating differences in pH. Mechanics - The difference in mechanical stress between upper and lower chest wall can predispose the relatively less mobile apical regions to several processes like ankylosing spondylitis Sample cases
Acquired and Congenital Pulmonary Artery Pathologies: Thinking Beyond the Embolism

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS
1) To discuss the appropriateness criteria for imaging patients with suspected pulmonary artery pathologies (PAP). 2) To illustrate common and uncommon imaging manifestations of PAP. 3) To highlight potential pitfalls and mimics in diagnosing PAP.

TABLE OF CONTENTS/OUTLINE
While chest radiography is the initial imaging investigation for patients with suspected PAP, multidetector computed tomography (MDCT) has become the gold standard for making a definitive diagnosis. There are numerous congenital and acquired abnormalities that can affect the pulmonary arteries. This exhibit will explore a variety of such common and uncommon conditions, including pulmonary artery hypoplasia, hereditary hemorrhagic telangiectasia (HHT), Hepatopulmonary syndrome, pulmonary arterial dissection and pulmonary artery sarcoma. Awareness of the radiologic manifestations of these different disease entities and their potential complications is key in ensuring a timely diagnosis. Relevant imaging findings, differential diagnoses, as well as mimics and potential pitfalls will be reviewed.
Non-Tumorous Diseases of the Sternum: At the Front Gate of the Anterior Chest Wall

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Abnormalities of the sternum are commonly seen in clinical practice and may be one of the important causes of anterior chest wall pain. However, the sternum is easily overlooked on chest CT. 2. A wide variety of congenital variants and pathologic abnormalities such as trauma, infection, degenerative and inflammatory conditions, metabolic disorder and postsurgical changes are commonly identified in the sternum and adjacent joints. 3. An understanding of the normal anatomy of this region including normal variants and familiarity of the appearances of diseases at imaging with various modalities as well as multiplanar views are critical to make accurate diagnoses that facilitate appropriate treatment.

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Shades of Gray: Pitfalls and Problem Solving for Subsolid Densities

All Day Room: NA Digital Education Exhibit

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Magna Cum Laude

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TEACHING POINTS
• Technical and interpretive pitfalls in evaluation of subsolid nodules • Differential considerations include range of adenocarcinoma spectrum lesions, and other benign and malignant etiologies • Appropriate application of management guidelines

TABLE OF CONTENTS/OUTLINE
Teaching Points

1. To understand the role of radiology in diagnosis and management of NTM-PD.
2. Awareness of predisposing factors of NTM-PD and to look for these on imaging.
3. Recognise the main imaging findings of NTM-PD.
4. Consider Non Tuberculous Mycobacterium in the list of differentials in a patient with imaging features similar to Tuberculosis or malignancy.

Table of Contents/Outline

1. Introduction • What is Non Tuberculous Mycobacterium Disease? • Risk factors • Clinical Features • Diagnosing NTM
2. Imaging classification of NTM-PD • Imaging findings of fibro-cavitatory NTM- PD • Imaging findings of bronchiectatic NTM- PD • Hypersensitivity Syndrome- Hot Tub Lung
3. Ancillary findings
4. Imaging prognostic factors
5. Learning Points/Summary
Breast Findings on Cross-Sectional Imaging: What the Body Radiologist Needs to Know

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

Unexpected findings within the breast are common on CT & MRI, and are often times either missed (edge of film errors), or inappropriately recommended for follow up breast imaging. Understanding which imaging findings are benign is important and can obviate need for dedicated breast imaging follow-up. We will review benign and malignant breast findings on cross sectional imaging, and present a case based review from the perspective of the body radiologist.

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Review of standard mammographic views and digital breast tomosynthesis, with cross-sectional imaging correlation Importance of viewing all prior imaging to determine significance of finding (new vs. stable) Benign breast findings on cross sectional imaging (coarse calcifications, smooth oval mass) and common breast masses on MRI which can be characterized as benign - fibroadenoma, cysts, fat containing lesions, fat necrosis Malignant breast findings on cross sectional imaging (spiculated mass, skin thickening, nipple retraction) and enhancement characteristics of malignant lesion Pitfalls (T2 hyperintense colloid carcinoma, lymphadenopathy, post-surgical change) Case based review of breast findings (can you characterize lesion as benign, or would you recommend follow up imaging?)
Computer-Aided Analysis of Progression of Idiopathic Pulmonary Fibrosis: Comparison of Pathological Findings

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Idiopathic pulmonary fibrosis (IPF) is a disease showing usual interstitial pneumonia (UIP) pattern on computed tomography (CT) (Fig.1). 2. Here, we explain the key features of UIP CT patterns (“Subpleural” and “Heterogeneity”), comparing pathological findings in cases with typical UIP, probable UIP, and indeterminate for UIP, CT patterns (Fig. 2-4). 3. In IPF, normal lung decreases gradually due to subpleural atelectatic fibrosis. Progression of CT findings, measured by a computer-aided system, helps us understand this atelectatic fibrosis. The normal lung reduces at a rate greater than the rate of fibrosis; since 80% of the lung is air, atelectasis leads to lung volume reduction. (Fig.2-4). 4. The differential diagnosis of IPF includes several kinds of secondary interstitial pneumonias, such as chronic hypersensitivity pneumonia, and pneumonia due to collagen vascular disease. Radiologists need to know that fibrosis and cellular infiltration cannot be distinguished by CT attenuation values alone (Fig.5).

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Fig.1, Common CT features in patients with IPF and the differences among typical UIP, probable UIP, and indeterminate for UIP CT patterns. Fig.2, 3, and 4, CT findings and their progression in the patients with IPF. Fig.5, Differential diagnosis of IPF.
CH114-ED-X

Unusual Imaging Manifestations of Pulmonary Histoplasmosis

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS
1. Review the epidemiologic and etiologic characteristics of histoplasmosis
2. Review the clinical manifestations of pulmonary histoplasmosis
3. Brief review of typical/usual imaging findings in pulmonary histoplasmosis
4. Illustration and description of unusual pulmonary manifestations of histoplasmosis

TABLE OF CONTENTS/OUTLINE
1. Introduction
2. Overview of the epidemiologic and etiologic characteristics of histoplasmosis
3. Examples of typical/usual pulmonary manifestation of pulmonary histoplasmosis
4. Illustration and description of unusual pulmonary manifestations of histoplasmosis such as disseminated disease in immunocompromised patients, consolidation and cavitation, mediastinal fibrosis, etc.
Application of Contrast-Enhanced Ultrasound in Guiding Percutaneous Pleural and Peripheral Lung Biopsies

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FDA Discussions may include off-label uses.

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TEACHING POINTS
(1) CT is the primary mode of image-guided pleural/lung biopsy, however contrast-enhanced ultrasound (CEUS) in selected cases demonstrates a number of advantages over CT. In particular, its real-time nature, excellent spatial resolution as well as lack of radiation exposure and nephrotoxic contrast make CEUS a prime modality for guiding interventional procedures. (2) Through 13 cases performed at our institution this exhibit will highlight the ability of CEUS to define the microvasculature and allow precise targeting of viable tissue, avoiding both necrotic elements and vascular structures. (3) CEUS guided biopsy (CUGB) can improve tissue sampling and help avoid complications in biopsy of thoracic wall, pleural and peripheral lung lesions.

TABLE OF CONTENTS/OUTLINE
(1) Describe the technical aspects of how to perform CEUS. (2) Demonstrate the variability in findings between cross-sectional, B-mode ultrasound and CEUS of thoracic lesions. (3) Show the utility of CEUS in thoracic and pleural biopsy for avoidance of necrotic components and major vascular structures, improving histological yield and decreasing the risk of complications.
Pre and Post-Operative Imaging Findings of Chronic Thromboembolic Pulmonary Hypertension (CTEPH): What the Surgeon Needs to Know

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Understand the proposed pathophysiology of CTEPH. Detail the role of pre- and post-operative imaging with echocardiography, computed tomography pulmonary angiography (CTPA), ventilation perfusion (V/Q) scintigraphy, magnetic resonance angiography (MRA), and right heart catheterization. Describe the key imaging findings that the radiologist should convey to the clinician to best help guide therapy.

TABLE OF CONTENTS/OUTLINE
Chronic thromboembolic pulmonary hypertension (CTEPH) is a life-threatening condition characterized by elevated pulmonary vascular resistance eventually leading to right heart failure. CTEPH is a potentially surgically curable disease with imaging not only playing a critical role in the diagnosis but also in determining surgical candidacy by evaluating the presence of accessible disease. Therefore, knowledge of the imaging characteristics of CTEPH to aid in diagnosis and to choose appropriate patients for surgical management is crucial. This pictorial review is designed for residents, fellows, general radiologists, thoracic radiologists, interventional radiologists, and non-radiology participants. Outline: CTEPH Definition Pathophysiology Echo Findings V/Q Findings CTPA/MRA Findings Right Heart Catheterization Findings Post-treatment findings (medical management, endarterectomy, balloon angioplasty)
How to Optimize Scans of Triple-rule-out CT Angiography for Chest Pain Patients with Wide Coverage Detector

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1) To illustrate limitations of conventional triple-rule-out CT Angiography (TRO-CTA)
2) To illustrate advantages of wide-detector imaging in TRO-CTA
3) To demonstrate strategies of applying wide-detector imaging to optimize scans in TRO-CTA
Adenocarcinoma of the Lung: Spectrum of Disease with Radiological-Pathological Correlation, Diagnostic Management, and Prognostic Implications

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
The purpose of this exhibit is: 1) To set out the different tumour subtypes encompassed within the spectrum of 'lung adenocarcinoma' (pre-malignant and malignant). 2) To define their main histological and radiological features. 3) To describe the diagnostic work-up. 4) To briefly describe the importance of new molecular pathways.

TABLE OF CONTENTS/OUTLINE
We will describe: 1) The histological structure of the normal lung. 2) The pathological characteristics that define pre-invasive lesions and invasive adenocarcinomas. 3) The CT features of pre-invasive and invasive lesions and how they correlate with anatomopathological images. 4) The latest clinical guidelines regarding management of pulmonary nodules. 5) Key molecular pathways (such as EGFR pathway) and their implications in treatment and image follow-up.
Patterns of Malignant Dissemination in the Chest

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

Participants
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TEACHING POINTS
Understand the pathophysiology and imaging presentation of the various types of malignant dissemination in the chest Describe their imaging findings, differential diagnosis, and imaging pitfalls

TABLE OF CONTENTS/OUTLINE
Introduction Hematogenous Spread of Tumor Pathophysiology (microscopic versus macroscopic hematogenous spread) Imaging features (centrilobular, perilymphatic, random) Differential considerations/Imaging pitfalls Lymphangitic Spread of Tumor Pathophysiology Imaging features Differential considerations/Imaging pitfalls Endobronchial Spread of Tumor Pathophysiology Imaging features Differential considerations/Imaging pitfalls Local Spread of Tumor Pathophysiology Imaging features Differential considerations/Imaging pitfalls Metastatic Spread to the Heart and Mediastinum Pathophysiology Imaging features Differential considerations/Imaging pitfalls Metastatic Spread to the Chest Wall and Pleura Pathophysiology Imaging features Differential considerations/Imaging pitfalls Summary and Conclusions
Direct and Indirect Findings of Pulmonary Embolism on Pulmonary Magnetic Resonance Angiography: What to Look for and Where These Findings Will Be Located

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Review of the patient selection criteria and contraindications for pulmonary magnetic resonance angiography (MRA) for the primary diagnosis of pulmonary embolism (PE). 2. To review the Direct and Indirect Findings of PE on MRA 3. Learn the relative frequencies of the Direct and Indirect Findings of PE at MRA

TABLE OF CONTENTS/OUTLINE
1. Use of pulmonary MRA for the primary diagnosis of pulmonary embolism 2. Direct findings of pulmonary embolism on MRA Filling defect in the pulmonary arteries Arterial cutoff sign Double bronchus sign High T1 signal intensity clots Central dot sign Ghost vessel sign 3. Indirect findings of pulmonary embolism on MRA Perfusion defects Atelectasis The 'W-B-W' sign Blank slate sign Pulmonary infarction Pleural effusion Enhancing visceral pleural surfaces High signal adjacent draining pulmonary vein Enlarged pulmonary trunk, right heart strain and elevated central venous pressure 4. Conclusion The most commonly found direct finding of PE on pulmonary MRA is a filling defect within a pulmonary artery. The most common indirect finding of PE on pulmonary MRA is a perfusion defect. Knowledge of the other direct and indirect signs can be helpful in reaching a correct interpretation of these exams.
Imaging of Asthma and Asthma Related Conditions

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
• To recognize the imaging findings in asthma. • To recognize conditions that may complicate asthma. • Point out conditions that may present with asthma. • Increase awareness of newer treatments of asthma and the role of imaging.

TABLE OF CONTENTS/OUTLINE
Introduction Asthma: clinical characteristics Imaging of asthma Bronchial and bronchiolar involvement Parenchymal involvement Imaging of conditions that may complicate asthma ABPA Churg-Strauss Chronic eosinophilic pneumonia Bronchocentric granulomatosis Neuroendocrine tumor Neumothorax Review differential diagnosis of asthma clinical mimics Approach to imaging findings in asthma and how imaging plays a role in newer treatments Conclusion

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Pitfalls of Bone Suppression on Chest Radiograph: Anatomic Structures Falsely Suppressed

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Anatomic structures such as the bones or the pulmonary vessels often overlap pulmonary lesions, which causes the lesions to be overlooked in CXR interpretation. To prevent such oversights, BS images have been created using dedicated software to suppress the bone structures from CXRs in recent years. The purpose of this exhibit is:
1. To review the kinds of anatomic structures that are falsely suppressed on BS images
2. To review the anatomic features of structures that are falsely suppressed
3. To avoid pitfalls of BS image interpretation

TABLE OF CONTENTS/OUTLINE
1. List of structures that are falsely suppressed on BS imaging:
   a. Breast
   b. Pericardial fat pad
   c. Diaphragm
   d. Vessels overlapping ribs
   e. Vessels not overlapping ribs
   f. Representative cases of each falsely suppressed structure
2. Anatomic features of each falsely suppressed structure
3. Appendices:
   a. Lung cancer on BS imaging
   b. Vascular malformations on BS imaging
4. Summary of the pitfalls of BS imaging
Oncologic Imaging: Thoracic Vascular Emergencies

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. To describe usual and unusual thoracic vascular emergencies that may appear in the context of an oncologic patient. 2. To show the radiological findings on chest radiograph and multislice CT of these disorders. 3. To discuss the appropriateness of the imaging techniques and the clinical impact of these diseases.

TABLE OF CONTENTS/OUTLINE
Oncologic patients may show many complications at some time during the course of their illness caused by the effects of the tumour itself or secondary to treatment. The goal of this exhibit is to show the radiological appearance of thoracic vascular emergencies in the oncologic patient. The thoracic vascular emergencies in oncologic patients showed in this exhibit are as follows:
1. Pulmonary embolism: Diagnosis simultaneous to the neoplastic disease, incidental or symptomatic. 2. Superior vena cava syndrome. Most usually related to a primary lung tumour though other malignant causes may exist. 3. Massive haemoptysis: Frequently due to primary lung cancer. 4. Aortic disease: Thrombosis, dissection and aortobronchial or aortoesophageal fistulas. 5. Pulmonary veins thrombosis: It may be associated to systemic embolic disease. 6. Thrombosis after lung surgery: Thrombosis of the arterial or venous stump. 7. Central lines complications: Thrombosis, superior vena cava perforation, and catheter rupture and migration.
Micronodular Patterns on High-Resolution Chest CT

All Day Room: NA Digital Education Exhibit

Awards
Cum Laude

Participants
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TEACHING POINTS
1. Describe how to differentiate the 3 main micronodular patterns on chest CT. 2. List a differential diagnosis for centrilobular nodules and explain how clinical information can help to narrow the differential. 3. List the differential diagnosis for perilymphatic and random nodules.

TABLE OF CONTENTS/OUTLINE
1. Introduction to micronodular patterns
   a. Approach to distinguishing on CT
2. Centrilobular
   a. Tree-in-bud variant
   b. Inflammatory
      i. Aspiration
      ii. Respiratory bronchiolitis
      iii. Follicular bronchiolitis
      iv. Hypersensitivity pneumonitis
      v. Panbronchiolitis
   c. Infectious
      i. Viral pneumonia
      ii. Mycobacterial
3. Vascular causes
   a. Cholesterol granulomas in PHTN
   b. Pulmonary arteriolar aneurysms
   c. Talc granulomatosis
   d. Arterial or perilymphatic tumor
   e. Pulmonary capillary hemangiomatosis
4. Perilymphatic
   a. Sarcoidosis, silicosis
   b. Lymphangitic carcinomatosis
5. Random
   a. Miliary metastases
   b. Miliary tuberculosis, histoplasmosis
Cardiopulmonary Devices the Unknown, the Overlooked, and the Misplaced

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS
Radiologists routinely encounter unknown cardiopulmonary/thoracic devices. The purpose of this exhibit is to present a series of cases of common and uncommon cardiopulmonary/thoracic devices to familiarize radiologists with their appearance, function, and possible complications.

TABLE OF CONTENTS/OUTLINE
The cases will be presented in a quiz format. Key diagnostic points and appropriate device assessment will be highlighted in the discussion of each case. Uncommon devices such as: NuPulse, HeRO graft, CardioMEMS, Impella RP, Pericardial wraps, Vagal stimulators, EKOS catheters, Minnesota tube, ZIO, LINQ, etc. Cases will detail the appearance, function, and expected location of cardiopulmonary devices Device complications including malpositioning, fracture, embolization, abandoned components, and device associated artifacts Common cardiopulmonary device complications Pearls and pitfalls of assessing critical care cardiopulmonary support devices

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Sarcoidosis: Pitfalls in Diagnosis-A Case-Based Review

Awards
Certificate of Merit

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TEACHING POINTS
1. Sarcoidosis is a diagnosis of exclusion that requires careful correlation of imaging, clinical, laboratory, and pathological findings.
2. Always consider alternative differential diagnoses in the setting of potential sarcoidosis, particularly in cases that exhibit an atypical distribution, confluent lymphadenopathy, or when the clinical evaluation suggests a specific diagnosis.

TABLE OF CONTENTS/OUTLINE
1. Sarcoidosis: Background, typical and atypical imaging findings, differential diagnosis 2. Case based review of diseases that may mimic sarcoidosis with explanations and differentiating features that are helpful in making the alternative diagnosis a. Thyroid cancer metastases with focus on distribution of pulmonary nodules and shape of lymphadenopathy b. IgG4-related disease with asymmetric perilymphatic nodularity c. Berylliosis with differentiating clinical and imaging features from sarcoidosis d. Cluster 2 or chronic hypersensitivity pneumonitis with helpful ancillary findings in diagnosis e. Tuberculosis manifesting with asymmetric hilar and mediastinal lymphadenopathy 3. Conclusion and most helpful differentiating features in diagnosis

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Correlation Between the Genomic Abnormalities and CT Features of Lung Adenocarcinoma

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Understanding the recent knowledge on driver gene (DR) mutations of lung adenocarcinoma, its impact on therapiac strategies, and the correlation between CT features and DR mutations. Radiologists may contribute to appropriate patient management by pointing out the possibility of DR mutated status.

TABLE OF CONTENTS/OUTLINE
**Lungs N’ Silicosis: A Guide to Imaging for Common and Uncommon Manifestations**

All Day Room: NA Digital Education Exhibit

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**TEACHING POINTS**
To review the spectrum and the pathogenesis of silicosis  
To explore the association between silicosis and some diseases, including silicotuberculosis, emphasizing the radiological features  
To review its potential complications  
To get familiar with the differentials diagnosis, emphasizing pitfalls and diagnostic difficulties

**TABLE OF CONTENTS/OUTLINE**
Pathophysiology and spectrum of silicosis; Review of imaging findings (illustrative cases of acute/ classic / and accelerated silicosis); Association between silicosis and several related diseases (illustrative cases of tuberculosis; Erasmus syndrome; Caplan syndrome; interstitials diseases); Review the potential complications of silicosis (silicotuberculosis; progressive massive fibrosis; empyema; spontaneous pneumothorax); Sample cases of pitfalls, diagnostic difficulties and mimics; Summary and take home messages.
Esophageal Emergencies: As Another Important Cause of Acute Chest Pain

Awards
Identified for Radiographics

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TEACHING POINTS
1. As there is no serosa, the esophagus is vulnerable to injury, inflammation, infection or direct tumor extension. 2. A variety of esophageal pathology including esophagitis, foreign body impaction, traumatic injuries and neoplasm may progress to transmural perforation which may result in potentially life-threatening complications such as mediastinitis, pneumonia, lung abscess, empyema or fistula between the esophagus and adjacent structures. 3. CT is a useful adjunct to esophagography and direct visualization, helping evaluate nonspecific manifestations of acute esophageal conditions, delineate the location and extent of disease, assess complications and exclude alternative diagnoses. 4. Accurate diagnosis and early initiation of a timely management strategy (conservative, endoscopic, or surgical) are integral to successful outcomes.

TABLE OF CONTENTS/OUTLINE
1. Review normal anatomy of esophagus 2. Classification of esophageal emergencies according to management A. Surgical emergency - Esophageal perforation: uncontained B. GI emergency - Foreign bodies: complete obstruction, lodged sharp objects, corrosive batteries, Acquired tracheoesophageal fistula C. Medical management - Intramural dissection and hematoma, Mucosal tears, Esophagitis 3. Review characteristic CT findings in collaboration with other imaging and diagnostic modalities
CT Findings of Common and Uncommon Pulmonary Infections After Lung Transplantation

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To describe and make the radiologists familiar with the typical and atypical findings at computed tomography (CT) of common and uncommon pulmonary infections occurring after lung transplantation (LT); for each type of pulmonary infection (e.g., bacterial, viral), are evaluated the frequency, time of onset, and risk factors such as the role of the native pulmonary disease.

TABLE OF CONTENTS/OUTLINE
i) recall the most and less frequent pathogens causing pulmonary infections after lung transplant (LT); ii) review the typical and atypical CT findings of bacterial, viral, fungine, parasitic pulmonary infections occurring after LT; iii) describe the most common types of infection according to the post-surgical interval (i.e., <1 month: bacteria and fungi; >1 month: viruses, fungi and bacteria); iv) gain knowledge about the association between specific primary diseases (i.e., pulmonary disease that led to the transplant) and specific post-transplant infections (e.g., Burkholderia cepacia in patients affected by cystic fibrosis).
Take Me Hilar: Pulmonary Artery Diseases Affecting Blood Flow

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
In viewing this exhibit the learner will: 1) Review the hemodynamics and physiology of pulmonary artery flow as relevant to CT and MRI imaging. 2) Analyze typical CT or MRI appearances of intrinsic and extrinsic abnormalities of the pulmonary artery system with radiographic signs of affected blood flow. 3) Understand current 4-D flow visualization techniques in the characterization of the degree of pulmonary blood flow abnormality and relevance to management of pulmonary vascular abnormalities.

TABLE OF CONTENTS/OUTLINE
I) Review of Normal Pulmonary Arterial Physiology, Pressures, and Appearance
II) Pulmonary Artery Pathologies Impacting Blood flow (with focus on radiographic findings relevant to management): 1) Pulmonary Embolism 2) Pulmonary Hypertension 3) Congenital Malformation 4) Malignancy: Primary and Secondary 5) Pulmonary Artery Aneurysm 6) Inflammatory Conditions
III) Review of 4-d flow MRI and potential relevance to clinical management

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https://www.rsna.org/Honored-Educator-Award/ Elliot K. Fishman, MD - 2012 Honored Educator Elliot K. Fishman, MD - 2014 Honored Educator Elliot K. Fishman, MD - 2016 Honored Educator Elliot K. Fishman, MD - 2018 Honored Educator
The God of Small Thoracic Things: Review of Chest Anatomical Variants and Benign Pathologies Which Have Potential for Diagnostic Pitfalls

All Day Room: NA Digital Education Exhibit

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Karl Sayegh, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The goal of this educational exhibit is a review of (1) several chest anatomical variants and (2) some benign conditions which can be misinterpreted as significant pathology, such as neoplasia, tuberculosis, interstitial lung disease, fractures or serious cardiac and vascular disease. By the end of the presentation the learner should be able to distinguish 30 of such conditions from serious thoracic pathology.

TABLE OF CONTENTS/OUTLINE
**Imaging of Congenital and Acquired Thoracic Venous Anomalies: What the Radiologist Needs to Know**

All Day Room: NA Digital Education Exhibit

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**TEACHING POINTS**
Illustrate the proposed pathophysiology of congenital and acquired thoracic venous anomalies. Describe the unique imaging characteristics of venous anomalies with CXR, CTA, MRA, and DSA. Discuss practical tips for aiding in diagnosis and describing current diagnostic challenges.

**TABLE OF CONTENTS/OUTLINE**
This pictorial review is designed for trainees, general and thoracic radiologists, and non-radiology participants. The primary goals are to describe the imaging features of a variety of venous anomalies with correlation from our multicenter patient database. For each anomaly, epidemiology, pathophysiology, complications, and multimodal imaging features will be discussed Venous anomalies discussed: azygos lobe, interrupted IVC with azygos continuation, duplicated and left-sided SVC, total and partial anomalous pulmonary venous return, pulmonary arteriovenous malformation, pulmonary vein atresia, cor triatriatum sinistrum with anomalous insertion of the pulmonary veins, situs inversus totalis, Scimitar syndrome, Ivemark syndrome, SVC syndrome, and hepatopulmonary syndrome. Thoracic venous anomalies are often unexpectedly encountered and knowledge of their imaging features are crucial for the radiologist to evade diagnostic pitfalls and avoid unnecessary follow-up imaging.
The Changing Face of Lung Cancer Treatment—Expected Imaging Appearances Following Modern Non-Surgical Treatments: What the Radiologist Needs to Know

Awards
Cum Laude

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TEACHING POINTS
• Explore recent developments in lung cancer treatment including targeted systemic therapies and highly conformal / ablative radiotherapy
• Understand the expected imaging appearances following of modern / novel non-surgical therapies compared with traditional therapies
• Response assessment and monitoring of novel therapies - implications for treatment decisions and management at the multidisciplinary tumor board meeting
• Complications of modern systemic and targeted therapies

TABLE OF CONTENTS/OUTLINE
• Mechanism of action of targeted systemic therapies (cytostatic) compared with traditional chemotherapies (cytotoxic)
• Role of tumor biology in treatment response assessment: tolerated progression on molecular therapies; ‘pseudoprogression’ and ‘hyperprogression’ on immunotherapies; and the abscopal effect
• Complications of modern systemic therapies with imaging examples: ‘radiation recall’, organizing pneumonia, diffuse alveolar damage and hypophysitis
• Modern radiotherapy techniques - expected post treatment imaging findings with examples of early and late changes based on modality used (3D-CRT, IMRT, SABR, proton therapy)
• Multimodality imaging following radiotherapy - expected change vs. recurrence
• Algorithm to guide decision making at the multidisciplinary team meeting
The Many Faces of Pulmonary Sarcoidosis

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Epidemiology and pathophysiology of pulmonary sarcoidosis Natural history of pulmonary sarcoidosis Typical and atypical radiological features of pulmonary sarcoidosis Prognostication, disease monitoring and treatment response Complications of pulmonary sarcoidosis Differential diagnosis and mimics of pulmonary sarcoidosis Sarcoïd-like reaction in patients with malignancy or receiving chemotherapies

TABLE OF CONTENTS/OUTLINE
Introduction to pulmonary sarcoidosis including pathogenesis, epidemiology and clinical features Imaging examples of the different stages in the natural course of pulmonary sarcoidosis Typical radiological features of pulmonary sarcoidosis Atypical features with imaging examples e.g. pleural disease, airway involvement and fibrocystic disease The role of multimodality imaging (including CT, MRI and 18FDG PET-CT) in prognostication and disease monitoring Complications of pulmonary sarcoidosis e.g. pulmonary hypertension, mycetoma, myocardial involvement and increased risk of lung malignancy Differential diagnoses and mimics of pulmonary sarcoidosis - examples from our institution e.g. metastatic adenocarcinoma, tuberculosis and lymphoma mistaken for sarcoidosis Sarcoïd-like reaction - imaging examples from our institution with pathological correlation
Esophageal Cancer: Role of Imaging in Primary Staging and Assessment of Response to Neoadjuvant Therapy

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TEACHING POINTS
Review the role of imaging modalities, namely CT, PET and EUS, in the management of patients with esophageal cancer. Illustrate the importance of imaging in primary staging and evaluation of response to neoadjuvant therapy. Describe an algorithm for the therapeutic approach of patients, based on imaging.

TABLE OF CONTENTS/OUTLINE
Role of CT, PET and EUS in:
- Esophageal cancer staging
- Therapy response
- Recurrent disease
Algorithm for the therapeutic approach in esophageal cancer
Summary and key points
Primary tumors of the heart are an uncommon site for neoplasm, with primary neoplasms of the pericardium accounting for a small fraction of pericardial tumors. Tumor-like lesion of the pericardium can also be seen, often as an incidental finding, and must be differentiated from primary or secondary neoplasm. In this presentation, we will review radiologic and pathologic findings in a broad spectrum of primary tumors and tumor-like lesions of the pericardium.

TABLE OF CONTENTS/OUTLINE
A. Pericardial anatomy
B. Imaging modalities
C. Benign Non-Neoplastic Lesions: Pericardial cyst, lipoma, organized hematoma, hernia
D. Benign Neoplastic Lesions: Mature teratoma, thymoma, arteriovenous malformation
E. Malignant Neoplastic Lesions: Mesothelioma, solitary fibrous tumor, primary cardiac lymphoma, primary anaplastic/sarcomatoid carcinoma
F. Summary/Quiz
Mediastinal Mass Mania! Radiographic and Cross-Sectional Correlation of Common Mediastinal Neoplasms

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
There are numerous neoplastic pathologies that arise in the mediastinum. Many of these pathologies can be differentiated on imaging. In addition to diagnostic assistance, the imaging can help delineate relationship with other important mediastinal structures. After reviewing this presentation, the viewer will have a better grasp on critical mediastinal anatomy as it relates to mediastinal tumors, the differential diagnosis of mediastinal masses, and be familiar with the radiographic and cross sectional appearance of these lesions.

TABLE OF CONTENTS/OUTLINE
The cases will be presented in a quiz format with emphasis on differential diagnosis in each case. Normal anatomy and radiographic signs will be highlighted initially to assist with mediastinal compartment localization. Radiographic findings will be correlated with cross sectional imaging. Neoplastic pathologies that will be discussed include: anterior mediastinal masses (thymoma, thyroid malignancy, lymphoma, teratoma), metastasis, direct mediastinal invasion from lung tumors, esophageal cancer, neurogenic tumors, and tracheal squamous cell carcinoma.
Thoracic Manifestations of Vascular Malformation Disorders

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Briefly describe the classification of vascular malformations and which malformations are associated with the various syndromes.
2. Discuss the association of Klippel-Trenaunay syndrome with pulmonary embolism and pulmonary hypertension. 3. List the osseous and chest wall manifestations of vascular malformation syndromes.

TABLE OF CONTENTS/OUTLINE
1. Classification of Vascular Malformations
5. Proteus syndrome a. Cyst/bulla formation
6. Gorham disease a. Lymphatic malformations with resorption of bones

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Sanjeev Bhalla, MD - 2014 Honored Educator Sanjeev Bhalla, MD - 2016 Honored Educator
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Tissue Characterization by Thoracic MRI with Histopathologic Correlation

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. MR signal characteristics reflect histopathology
2. MRI can therefore provide information about the tissue composition of lesions that are indeterminate by CT, serving as a virtual biopsy

TABLE OF CONTENTS/OUTLINE
I. Title Slide
II. Background
   A. Basic MRI sequences used for tissue-typing
III. Tissue types with CT, MR, and histopathologic correlation
   A. Blood Products/Protein
      i. Thymic cyst
      ii. Endometrioma
   B. Microscopic fat
      i. Hamartoma
      ii. Thymic hyperplasia
         a. Chemical shift ratio (CSR)
         b. Signal intensity index (SII)
   C. Cartilage
      i. Chondroid hamartoma
   D. Fibrous tissue
      i. Solitary fibrous tumor of the pleura
      ii. Sarcoidosis
      iii. Fibrosing mediastinitis
   E. Smooth muscle
      i. Esophageal leiomyoma
      ii. Esophageal invasion by tumor
      F. Skeletal muscle
         i. Diaphragmatic hernia
         a. Companion case of diaphragmatic invasion
      G. Cellular versus acellular
         i. Tumor thrombus versus bland thrombus
IV. Conclusion
   A. MRI is a valuable tissue characterization tool and can serve as a virtual biopsy.
   B. Judicious use of Thoracic MRI has the potential to change clinical management and prevent unnecessary diagnostic intervention
V. References
TEACHING POINTS

The purpose of this exhibit is: 1. To explain various causes of hemoptysis. 2. To explain hemoptysis originating from various vessels, such as systemic artery, systemic vein, pulmonary artery, pulmonary vein, and aorta. 3. To show imaging findings of hemoptysis from various vessels due to various causes. 4. To explain therapeutic strategies of hemoptysis from various vessels due to various causes.

TABLE OF CONTENTS/OUTLINE

1. Explain hemoptysis from various vessels due to various causes. 2. Explain therapeutic strategies of hemoptysis from various vessels due to various causes. 3. Illustrative cases - Review of imaging findings and intervention of hemoptysis from various vessels due to various causes. 4. Discussion. 5. Directions and summary
Pictorial Review of Aortic Dissection After Endovascular Repair: What Radiologists Need to Know

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
The purpose of this exhibit is: 1. To know the indications of endovascular repair for aortic dissection (AD) and its related disease. 2. To know normal CT findings of AD and its related disease after endovascular repair. 3. To know CT findings of complications after endovascular repair. 4. To know clinical significances of various imaging findings after endovascular repair. 5. To know the therapeutic strategies of complications after endovascular repair.

TABLE OF CONTENTS/OUTLINE
1. Explanation of the indications of endovascular repair for AD and its related disease. 2. Explanation of normal CT findings of AD and its related disease after endovascular repair. 3. Explanation of CT findings of complications after endovascular repair. 4. Explanation of therapeutic strategies of complications after endovascular repair. 5. Illustrative cases - Presentation of normal CT findings of AD, including serial changes, after endovascular repair. - Presentation of CT findings and treatment of complications after endovascular repair. 6. Discussion 7. Directions and summary
Acute Pulmonary Embolism: The Role of the Radiologist from Diagnosis to Treatment

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Review diagnostic approach for Acute Pulmonary Embolism
2. Define the different severity grades of Acute Pulmonary Embolism
3. Discuss different treatment options based on the patient's presentation and history

TABLE OF CONTENTS/OUTLINE
1. Introduction
   a. Anatomy of the Pulmonary Arteries
   b. Pathophysiology of Pulmonary Embolism
2. Diagnosis
   a. CTA of the Chest
   b. V/Q Scan
   c. Direct Pulmonary Angiography and Pressure Measurements
   d. Echocardiography
   e. Role of Lower Extremity Doppler
3. Clinical Severity
   a. Massive PE
   b. Sub-Massive PE
   c. Right Ventricular Dysfunction
   d. Myocardial Necrosis
   e. Non-Massive PE
4. Treatment
   a. Multi-disciplinary Pulmonary Embolism Response Team (PERT)
   b. Interventional Radiology, Cardiothoracic Surgery, Pulmonology, Cardiology, Vascular Medicine
   c. Medical Therapy
   d. Interventional Radiology Therapy
   e. Prophylaxis with IVC Filter
   f. Mechanical Aspiration and Thrombectomy
   g. Catheter Directed Thrombolysis
5. Potential Complications
   a. Complications of PE
   b. Pulmonary Infarct
   c. Cardiovascular Dysfunction
   d. Chronic Thromboembolic Pulmonary Hypertension

Complications of PE Treatment
Ch146-ED-X

Mucormycosis of the Lung: Spectrum of Findings with Pathology Correlation and Evolution of Disease

All Day Room: NA Digital Education Exhibit

Awards
Identified for RadioGraphics

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TEACHING POINTS
After viewing this exhibit, the learner will: (1) Recognize patients who are at-risk for pulmonary mucor infection. (2) Be able to identify radiologic signs that are more specific for mucor through multiple examples. (3) Understand the radiologic morphology through presentation of correlative pathology slides. (4) Understand the rapidly progressive nature of the infection in select hosts. (5) Be able to suggest the diagnosis in patients with nonspecific radiologic signs and appropriate clinical history.

TABLE OF CONTENTS/OUTLINE
Tracheobronchial Tumors: Imaging Findings with Pathological Correlation

Awards
Certificate of Merit

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TEACHING POINTS
1. To know the wide variety of tracheobronchial tumors. 2. To show the MDCT, MRI, and FDG-PET CT findings of them. 3. To correlate them with the pathological findings. 4. To assess the usefulness of these current imaging modalities for the diagnoses.

TABLE OF CONTENTS/OUTLINE
1. Review the normal tracheobronchial anatomy. 2. Imaging findings with pathological correlation. The variable tumor growth patterns will be demonstrated by the reconstructed MDCT findings: polypoid or expanding growth, mold-like growth along the tracheobronchial lumen, tracheobronchial invasion by a parenchymal tumor, and bronchial invasion by mediastinal or hilar lymph node metastasis. Accompanied findings (obstructive pneumonia, atelectasis, mucoid impaction, pulmonary hemorrhage) will be also shown. The cases include 1. benign tumor: papilloma, hamartoma, leiomyoma, schwannoma, and intrapulmonary thymoma, 2. primary malignant tumor: mucoepidermoid carcinoma, squamous cell carcinoma, small cell carcinoma, MALToma, and adenocarcinoma, 3. secondary malignant tumor: endotracheal/endobronchial metastases from various extrapulmonary malignancies. 3. Summary. Tracheobronchial tumor presents various imaging findings that reflect the tumor growth pattern and other pathologic backgrounds. Combination of MDCT, MRI, and FDG-PET CT can show the details well and is useful for the diagnosis.
TEACHING POINTS

1. Chronic lung Allograft Dysfunction (CLAD) is suspected in lung transplant patients whenever there is a prolonged decrease transplant function or inability of a transplant to achieve its expected level of function. 2. When there is concern for CLAD (based on pulmonary function testing) patients will typically undergo bronchoscopy and CT. Imaging can play a key role in identifying the cause of transplant dysfunction. 3. CLAD is divided into restrictive and obstructive subtypes. Specific imaging findings can be seen in each subtype. 4. Obliterative bronchiolitis (OB) is one type of obstructive CLAD. On imaging mosaic attenuation, bronchiectasis, bronchial wall thickening and air-trapping can be seen. 5. Imaging findings of restrictive CLAD are those of pleural thickening and persistent airspace abnormality predominately occurring apically. Changes due to fibrosis such as bronchiectasis may also be seen.

TABLE OF CONTENTS/OUTLINE

Please Don’t Upstage These Lung Cancers! Mimics of Metastatic Disease in Lung Cancer Staging

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To discuss how the knowledge of a biopsy-proven lung cancer can create a bias in the radiologist to prematurely interpret abnormal imaging findings elsewhere in the body as malignant, leading to an erroneous diagnosis of stage IV disease in some patients. To review the potential mimics of metastatic disease that can be seen in the staging imaging of lung cancer patients and the imaging features that should raise suspicion that further work-up is needed to make a more definitive diagnosis. To explain the options for further lesion work-up, including cross-sectional imaging with lesion-specific protocols, alternative imaging modalities, and biopsy.

TABLE OF CONTENTS/OUTLINE
- Introduction
  1. Risk of Misclassification as Stage IV Disease
  2. Role of Radiology Report Language - Categories of Potential Mimics of Metastatic Disease
  2. Abdominal - Adrenal Adenoma - Benign Liver Lesions
  3. Musculoskeletal - Pars Interarticularis Defect - Paget's Disease - Increased Bone Marrow Hematopoietic Activity - Approaches to Differentiate True Metastatic Disease from Mimics
  1. Short Interval Follow-up CT
  2. Multiphasic Abdominal CT or MRI
  3. Spine/Musculoskeletal MRI
  4. Biopsy
Pulmonary Infections in Immunocompromised Patients: A Clinico-Radiological Approach

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
The aim of this exhibit is to: Improve understanding of the types of pulmonary infections that affect the different groups of immunosuppressed individuals, and recognise their characteristic imaging features. Highlight the role radiology plays in aiding clinicians to manage these complex patients by: Understanding how different infections respond to treatment and how this is reflected in imaging. Gaining a basic understanding of the other types of diagnostic tests that are used to differentiate causative infectious agents, and how these can help guide radiological differential diagnosis.

TABLE OF CONTENTS/OUTLINE
Define the clinical groups of immunosuppressed patients and how pulmonary infection affects them. Identify the types of infective agents to which they are susceptible, with review of characteristic imaging findings. Review other types of diagnostic tests such as microbiology, and update on newer specific serological markers, and their diagnostic pitfalls. Treatment of disease and the role of radiology to assess response. Case-based examples. Summary
STOP! Not All Masses are Malignant: A Review of CT Spectrum of Pulmonary Tuberculosis

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. To review the CT findings in a case of pulmonary tuberculosis. 2. To discuss unusual findings of pulmonary tuberculosis mimicking malignancy. 3. To illustrate the pathogenesis of pulmonary tuberculosis and correlate with various chest CT findings. 4. Correlate with histopathological studies like transbronchial lung biopsy, transbronchial lymph node biopsy and pleural fluid cytology. 5. Highlight the differentiating features between tubercular and malignant pulmonary masses and between tubercular and non-tubercular infective lung pathologies.

TABLE OF CONTENTS/OUTLINE
1. Pulmonary tuberculosis can involve lung parenchyma, airway, pleura, chest wall, mediastinum and pulmonary vasculature. 2. Spectrum of findings may vary from small centrilobular nodules to large lung masses. There can be cavity formation, aspergilloma, pleural effusion and mediastinal lymphadenopathy. 3. Unusual presentation of pulmonary tuberculosis mimicking malignancy should be radiologically differentiated. 4. There can be associated complications like bronchopulmonary fistula formation, pneumothorax and mediastinal abscess. 5. Primary and post-primary pulmonary tuberculosis is a resurfacing disease entity which should be carefully dealt with by the radiologists and they should be aware of the imaging findings.
Pulmonary Fungal Infection in Hematopoietic Stem Cell Transplant (HSCT) Recipients

Awards
Certificate of Merit

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TEACHING POINTS
To learn about the epidemiology and risk factors for opportunistic fungal infections in HSCT patients. To describe the imaging features of different types of fungal infection, review of the radiological signs, and discuss the differential possibilities. To correlate the imaging features of opportunistic fungal infection with the pathology. To familiarize radiologists with expected posttreatment imaging features.

TABLE OF CONTENTS/OUTLINE
Background and risk factors of fungal infection in hematologic malignancy (HM) and hematopoietic stem cell transplantation (HSCT) patients. Imaging features of different types of fungal infections with differential diagnosis, mimics, and pathology correlation. Structured systematic approach to establish the diagnosis based on the imaging features and clinical data. Management plan for fungal infection in HM/HSCT patient and the role of radiologists.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Sudhakar N. Pipavath, MD - 2013 Honored EducatorSudhakar N. Pipavath, MD - 2015 Honored EducatorGautham P. Reddy, MD - 2014 Honored EducatorJ. D. Godwin, MD - 2013 Honored Educator
CH154-ED-X

Chronic/Persistent/Migratory Airspace Disease: Causes and Radiographic Findings

All Day Room: NA Digital Education Exhibit

Awards
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TEACHING POINTS
• Review the causes and imaging findings of chronic/persistent/migratory air space opacification. • Review the pertinent anatomy of the lungs including the airways and airspace • Provide relevant differential diagnosis for each pathology based on imaging findings and ancillary and clinical information. • Describe the imaging/clinical features of each pathology that can narrow down the differential diagnosis.

TABLE OF CONTENTS/OUTLINE
1. Introduction
2. Overview of different materials that can fill the airspace and cause air space opacification (water, pus, blood, protein, cells, fat, gastric contents)
5. Conclusion
Review of Different Underlying Causes of Life-Threatening Hemoptysis

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Review of different underlying causes of life-threatening hemoptysis. Recognize bronchial arteries, their typical anatomy and pathology to quick diagnostic of hemoptysis.

TABLE OF CONTENTS/OUTLINE
Hemoptysis is symptomatic of a potentially life-threatening condition and warrants urgent and comprehensive evaluation of the lung parenchyma, airways, and thoracic vasculature. Multi-detector computed tomographic (CT) angiography is a very useful noninvasive tool for initial assessment of hemoptysis and study the variety of underlying causes, such as bronchiectasis, chronic bronchitis, lung malignancy, tuberculosis, and chronic fungal infection are some of the most common underlying causes of hemoptysis and are easily detected with CT. Despite of lots of causes, researchers suggest that bronchial arteries are the source of bleeding in 90% of cases of hemoptysis, so that reason it,s important to recognize their different appearance to promote a quick assessment and specific embolisation treatment.
Prediction of Postoperative Lung Function in Patients before Pneumonectomy: Dual-Energy CT with Lung Perfusion Blood Volume Comparison of Perfusion Scintigraphy

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TEACHING POINTS
Usefulness of predicting postoperative residual reserve using DECT before surgery Combination with morphological image Advantage and limitation of DECT New treatment strategy with functional image

TABLE OF CONTENTS/OUTLINE
Prediction of postoperative pulmonary function in patients undergoing pulmonary resection surgery was performed using Dual Energy CT (DECT) before surgery and its usefulness was evaluated. Our evaluation method is a comparison of Lung Perfusion Volume (Lung PBV) by pulmonary scintigraphy and DECT. The value obtained by Spirometry before surgery was calculated for each operation type (total lung extraction, lobectomy). Combining quantitative evaluation and morphological images from CT, and describing the new role. Conventionally, as a method for predicting postoperative residual lung function, a method using pulmonary blood flow scintigraphy was a golden standard. In recent years, Lung PBV is now available by analyzing with DECT. The predicted residual lung function by Lung PBV using DECT was found to be highly correlated in comparison with scintigraphy (r = 0.83 or more). The Bland-Altman method also confirmed high agreement. It is possible to predict residual lung function using DECT at the time of lung resection. Our method can be quantitatively evaluated and morphologically evaluated, so its usefulness is very high.
Dual-Energy CT for Pulmonary Artery Embolism: How "To Do It" potential Benefits and Pitfalls

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
To present how dual-energy CT imaging works. To review the indications, contraindications, potential benefits and limitations of dual-energy CT for pulmonary artery embolism. To summarize optimal parameter settings for dual-energy data acquisition and demonstrate postprocessing of dual-energy data. To demonstrate the interpretation of positive dual-energy findings and potential pitfalls in conjunction with dual-energy CT pulmonary angiography.

TABLE OF CONTENTS/OUTLINE
A. Pulmonary artery embolism: diagnostic workup; indications, contraindications, potential benefits and limitations of (dual-energy) CT
B. How does dual-energy CT work?
C. Optimal parameter settings for dual-energy CT pulmonary angiography in dependence of the scanner generation/type
D. Differences between various scan and contrast injection protocols
E. Image reconstruction and dual-energy postprocessing
F. Dual-energy specific parameters: iodine map, pulmonary blood volume
G. Dual-energy image analysis in conjunction with CT pulmonary angiography: imaging examples
H. Limitations of dual-energy CT pulmonary angiography: artifacts and pitfalls
Thoracic Manifestations of Neurological Disorders: A Comprehensive Pictorial Review

Awards
Cum Laude
Identified for RadioGraphics

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TEACHING POINTS
Systemic disorders with origins ranging from infective/inflammatory and congenital to metabolic and malignant diseases can affect both central nervous system and thoracic cavity. Finding abnormality in one system can establish the diagnosis & limit the differential diagnosis. Review the multimodality imaging features and pertinent information the radiologist can provide towards clinical management.

TABLE OF CONTENTS/OPTLINE
Radiologic Review of Lung Adenocarcinoma

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Review the pathophysiology of lung adenocarcinoma. Review the pathologic subtypes and radiologic appearances of lung adenocarcinoma. Discuss the important points of the updated 2017 Fleischner society guidelines. Discuss the recommendations of lung cancer screening.

TABLE OF CONTENTS/OUTLINE
Clinical and Imaging Overview of Aspergillosis

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
The teaching points/goals of the exhibit are: 1) To review the epidemiology and pathophysiology of Aspergillosis. 2) To illustrate the imaging findings of different forms of aspergillosis infection (Aspergilloma, ABPA, Invasive aspergillosis and obstructive bronchopulmonary aspergillosis) and highlight imaging features that help in the early suspicion of different forms of aspergillosis and especially confident diagnosis of angioinvasive aspergillosis. Discuss the role of Chest Radiography and/or CT in the characterization and follow-up of these lesions.

TABLE OF CONTENTS/OUTLINE
Aspergillosis is caused by a fungus ubiquitous in air and soil including environmental surfaces in hospitals. It has significant morbidity and mortality and is especially seen in patients undergoing organ transplants, receiving cancer chemotherapy, broad-spectrum antibiotics, alcohol or marijuana use, HIV disease and other disorders leading to immunosuppression. Chest radiography is commonly the initial examination performed in patients with respiratory symptoms and/or suspected respiratory disease. However, it has significant limitations. CT Scan has better sensitivity and specificity for the diagnosis of aspergillus infection. The imaging manifestations of the broad spectrum of aspergillus thoracic infection will be reviewed.

Honored Educators
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**Lung Subtraction Imaging by Single-Energy CT for Evaluation of Chronic Thromboembolic Pulmonary Hypertension (CTEPH) Before and After Balloon Pulmonary Angioplasty**

All Day Room: NA Digital Education Exhibit

### Participants

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### TEACHING POINTS

1) To review single-energy CT (SECT) findings of chronic thromboembolic pulmonary hypertension (CTEPH)  
2) To describe basic facts & principles of lung subtraction imaging (LSI) by SECT  
3) To illustrate various clinical evaluations of CTEPH before/after balloon pulmonary angioplasty (BPA) using the LSI by presenting clinical images

### TABLE OF CONTENTS/OUTLINE

1) SECT findings of CTEPH Pulmonary hypertension: pulmonary artery dilatation/right heart overload  
   CT pulmonary angiography (CTPA): collateral circulation/webs & bands, abrupt narrowing etc.  
   Pulmonary emphysema/mosaic attenuation etc.  
2) Basic facts & principles of LSI by SECT  
   Deformable registration  
   CTPA & pulmonary perfusion imaging like dual-energy CT (DECT): quantification by CT value/respiration & cardiac motion artifact/beam-hardening artifact by congested contrast media/false negative by systemic collateral circulation (vs. pulmonary perfusion scintigram)  
   Advantages vs. DECT: cheaper & easier implication/less FOV restriction (vs. dual-source CT)/better spatial resolution of CTPA by ultra-high-resolution CT  
   Limitations vs. DECT: misregistration/higher radiation dose  
3) Clinical evaluations of CTEPH before/after BPA using the LSI  
   CTPA/pulmonary perfusion image fusion: image-guided BPA  
   Post-BPA reperfusion evaluation: CT value quantification on pulmonary perfusion images
Interstitial Lung Disease of Inherited Origin: CT-Pathologic Correlation

TEACHING POINTS

- Review the spectrum of interstitial lung disease of inherited origin
- Correlate imaging findings with underlying histopathology
- Provide a structured framework for formulating a differential diagnosis

TABLE OF CONTENTS/OUTLINE

Inherited ILDs are those that result from the transmission of genetic mutations. These diseases may affect multiple organs or exclusively the lung. This exhibit will review and illustrate the high-resolution CT manifestations of various inherited ILDs correlating the CT findings with the underlying pathologic abnormalities. Recognition of the imaging morphology of these lesions and the underlying histopathologic changes allows the radiologist to present a focused differential diagnosis and help direct appropriate management. Types of Interstitial Lung Disease of Inherited Origin: 1. Dyskeratosis congenita 2. Neurofibromatosis, type I 3. Tuberous sclerosis / LAM 4. Microlithiasis 5. Birt-Hogg-Dubé syndrome 6. Hyper-IgE syndrome 7. Hermansky-Pudlak syndrome 8. Gaucher disease, type I 9. Niemann-Pick disease, type B 10. Lysinuric protein intolerance 11. Familial Adult-Onset Pulmonary Fibrosis a. Familial Pulmonary Fibrosis Associated with Telomerase Mutations 12. Familial Pulmonary Alveolar Microlithiasis
Pictorial Review of Malperfusion Caused by Aortic Dissection

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
The purpose of this exhibit is: 1. To know the mechanism of malperfusion caused by aortic dissection. 2. To know the various CT findings of malperfusion caused by aortic dissection. 3. To know the clinical significances of CT imaging findings of malperfusion caused by aortic dissection. 4. To know the therapeutic strategies of malperfusion caused by aortic dissection.

TABLE OF CONTENTS/OUTLINE
1. Explanation of the mechanism of malperfusion caused by aortic dissection. 2. Explanation of CT findings and clinical significances of malperfusion caused by aortic dissection. 3. Illustrative cases - Presentation of various CT findings of malperfusion caused by aortic dissection. - Presentation of CT findings of serial changes of malperfusion caused by aortic dissection. 4. Discussion 5. Directions and summary
Bronchiectasis in 2018: Classification, Imaging Findings, and Beyond

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
The purpose of this exhibit is: 1. Review the definition of Bronchiectasis and identify its causes 2. Discuss radiologic and non-radiologic classification schemes of Bronchiectasis 3. Examine the importance of Bronchiectasis in establishing other diagnosis 4. Review the role of radiography and cross-sectional imaging of Bronchiectasis

TABLE OF CONTENTS/OUTLINE
Definition - Reversible vs Irreversible - Sex/habitus differences Classification - Reid - Bhalla - BSI, FACED/E-FACED scores - BRICS - Zonal - CF/Non-CF - US Bronchiectasis research registry Physiology - Airway remodeling - Effect on lung, pulmonary arteries, bronchial arteries - Post-surgical, post-radiation, sequelae of lung injury Role of imaging - How to establish diagnosis - Follow-up - Complications - Modalities (CXR, CT, MRI, V/Q scan) As a clue to diagnosis - Pulmonary Hypertension - Lung transplant rejection, GvHD, chronic aspiration/GERD - Lung cancer (Recurrence, Primary) As a prognosticator - ARDS, hypersensitivity pneumonitis, COPD, pneumonia, ILD Aquired Causes - eg. Aspiration, infection, sarcoidosis, pleuroparenchymal fibroelastosis, post-pneumonectomy, ARDS, etc.. Congenital Causes - eg. Primary ciliary dyskinesia, tracheobronchomegaly, pulmonary artery absense, etc.. Mimics Treatment

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Approach to Various Fat Containing Lesions in Thoracic Imaging

Participants
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TEACHING POINTS
1. Fat containing lesions may involve any compartment of the thorax. While many fat-containing lesions of the chest are benign, they may represent pathologic or malignant conditions with clinical implications that affect patient management. 2. The differential diagnosis of fat-containing lesions varies according to anatomic location, presence of associated imaging features, and patient age and sex. Interval growth of the lesions and any morphological changes of the adjacent structures over time should be also evaluated. 3. Multiplanar CT is the mainstay to confirm intralesional fat. Fat suppression and in/out-of-phase GRE imaging can enhance accuracy of diagnosis and disease extent.

TABLE OF CONTENTS/OUTLINE
It’s Not All in Your Head: Thoracic Manifestations of Neurologic Diseases and Disorders

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
A variety of systemic diseases may affect both the nervous system and the thorax, while other diseases primarily affecting the thorax may manifest with neurological abnormalities. Correlations of signs, symptoms, and imaging findings in the neurological system with those in the thorax can help guide further diagnostic work-up and treatment. We will illustrate the imaging appearance of several systemic/neurological diseases with thoracic manifestations as well as discuss conditions in the thorax that can lead to neurologic symptoms.

TABLE OF CONTENTS/OUTLINE

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Do You Really Know CT Findings of Chronic Hypersensitive Pneumonia?

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To demonstrate the spectrum of CT findings of chronic hypersensitive pneumonia (CHP) To teach the pathologic backgrounds of various CT finding.

TABLE OF CONTENTS/OUTLINE
Pathologic finding: usual interstitial pneumonia (UIP), non-specific interstitial pneumonia (NSIP), preuloparanchymal fibroelastosis (PPFE), granuloma, and airway centered fibrosis. Cellular interstitial pneumonia (CIP) is superimposed if subacute on chronic HP happens. Corresponding CT findings: UIP; intralobular reticular opacities, honeycombing, perilobular abnormalities (Fig 1), intralobular heterogeneity NSIP; areas with ground-glass attenuation or reticular opacities along bronchus with traction bronchiectasis PPFE:Apical subpleural compact airspace consolidation with dilated airbronchiologram (Fig 2), apical subpleural cysts(Fig 3) Granuloma; centrilobular nodules (Fig 4) Air-way centered fibrosis; reticular shadow or ground-glass attenuation along bronchus (Fig5), centrilobular branching structures, air-trapping, mosaic attenuation CIP: areas with ground-glass attenuation Frequent upper lobe involvement is also important. If chronic inetestitial lung diseases show relatively upper lobe predominance, apical subpleural compact consolidation or cysts, centrilobular nodules, and air trapping CHP should be mentioned as one of differential diagnosis.
The How, Why, and What of Imaging and Quantification of Emphysema Prior to Lung Volume Reduction

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TEACHING POINTS
Our educational series will demonstrate the radiologist's role in emphysema imaging, providing a toolkit for recognizing and reporting salient aspects prior to surgical and bronchoscopic intervention. 1. Review key imaging modalities for evaluation of emphysema pre procedure, including Multi-Detector CT (MDCT) and lung perfusion imaging. 2. Provide an overview of the imaging features that are important to the Thoracic surgeon prior to Lung Voume Reduction Surgery (LVRS) and Endobronchial Valve (EBV) placement. 3. Demonstrate the use of a Quantitative Pulmonary CT analysis platform enabling adequate selection of patients for EBV.

TABLE OF CONTENTS/OUTLINE
Introduction Aim of imaging in Emphysema and criteria for LVRS and EBV patient selection Use of multimodality imaging with MDCT, Lung Perfusion imaging and Pulmonary Quantification software How to Report Chest CT: - Distribution of emphysema: Heterogeneous or homogeneous - Fissural integrity - Relative Contraindications to surgery: Bronchiectasis and Neoplasm Take Home Points: Complementary imaging modalities and lung analysis software play an important role in the work-up of patients with emphysema requiring surgical intervention. Anatomical information helps identify patients who will benefit from lung volume reduction and aids in endobronchial intervention planning.
Whole-Lung Dynamic Respiratory CT: Novel Respiratory Function Examination by Dynamic Wide Volume Scanning Using 320-Row ADCT

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TEACHING POINTS
To present the method of whole-lung dynamic respiratory CT using 320-row ADCT. To present the whole-lung respiratory motion of typical cases. To present the dynamic volume measurement for regional respiratory function analysis.

TABLE OF CONTENTS/OUTLINE
Methods: 1. Constant respiration cycle by sound guidance. 2. Dynamic volume scanning using 320-row ADCT. Two or more volumes of respiratory dynamic CT, with 1cm overlap. 3. Choice of an inspiratory peak phase and an expiratory peak phase of scanned dynamic data. 4. After coinciding the phase of two (or more) volumes, we connected them together and deleted the overlapped cross section for each phase data set. Dynamic volume measurements of lung: Functional residual capacity (FRC), tidal volume (TV), ROI (region of interest) area, or VOI (volume of interest), total lung density, regional lung density, and flow volume curve of regional parenchyma is obtained. Conclusions: We were able to create whole-lung dynamic respiratory data which combined two or more volumes. By using this method, it was possible to measure the lung functions. Flow volume curve of regional parenchyma is obtained from regional lung volume change. CT FEV1% was able to detect the decline of respiratory function of smokers. These regional function data were not obtained by the respiratory-function test thus far.
Interstitial Pneumonia Strongly Suspected of Being Associated with Connective Tissue Disease: Disease Concept, CT Findings, and Pathological Findings

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To understand and present the disease concept of interstitial pneumonia (IP) strongly suspected of being associated with connective tissue disease (CTD). To understand CT and pathological findings of diseases classified as IP with autoimmune features (IPAF). To understand CT and pathological findings of anti-synthetase syndrome (including anti-MDA-5 antibody) classified as IPAF.

TABLE OF CONTENTS/OUTLINE
Discussion of disease concepts and diagnostic criteria for undifferenciated connective tissue disease (UCTD), lung-dominant CTD (LDCTD), autoimmune-featured interstitial lung disease (AIF-ILD) before IPF is proposed. Discussion of disease concepts and of diagnostic criteria for IPAF. Evaluation of CT images of 16 patients with the major features of IPAF criteria and a comparison with pathological findings. (Table 1) 9 patients with non-specific interstitial pneumonia (NSIP) on CT images. - Major CT findings. 7 patients : 4 unclassifiable IP, 1 OP., 1 NSIP with OP overlap, and 1 LIP. 8 patients with surgical lung biopsy : 5 NSIP, 1 UIP, 1 OP, and 1 unclassifiable IP. 4. Anti-synthetase syndrome classified as IPAF. CT diagnosis in patients with 8 different antibodies. - Major CT findings.
The Salivary Gland Tumor Also Can Appear in the Lung: What the Radiologist Should Know

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To learn about different types of salivary gland tumors of the lung. To understand clinical and imaging features of different kinds of salivary gland-type lung tumors. To know the information what radiologists should provide for clinicians about salivary gland-type lung tumors.

TABLE OF CONTENTS/OUTLINE
1. Rare, accounting for fewer than 1% of all lung cancers, the incidence of individual SGT differs greatly between primary salivary gland tumors and pulmonary SGT, the vast majority of pulmonary SGT are malignant, whereas the opposite applies to tumors of the salivary glands. 2. Tend to occur in younger patients, to affect the central airways, to have a more indolent nature and presumably originate from the submucosal glands 3. The prognosis of 5- and 10-year survival rates of 65% and 53%, respectively, is much better than the prognosis for patients with the more common lung cancers. 4. According to the 2015 World Health Organization Classification of Lung Tumors, salivary gland-type tumors include - Adenoid cystic carcinomas (ACCs) - Mucoepidermoid carcinomas (MECs) - Epithelial-myoepithelial carcinomas (EMECs) - Pleomorphic adenoma Supplemented with acinic cell carcinoma (Fechner Tumor), carcinoma ex pleomorphic adenoma, mucous gland adenoma, oncocytoma, hyalinizing clear cell carcinoma and salivary duct-like carcinoma
Let Me Show You Real Radiological Findings of Drug Induced Lung Diseases

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. To show the spectrum of radiological findings of drug induced lung diseases (DILDs) 2. To teach how to diagnose severe DILDs, the risks of severe DILDs and how to prevent the onset of severe DILDs

TABLE OF CONTENTS/OUTLINE
1. Radiological findings: A. Common; bilateral non-segmental areas of airspace consolidation and/or ground-glass opacity (GGO) (Fig.1), diffuse peribronchovascular opacities (Fig. 2) B. Uncommon; cnterilobular nodules (Fig. 3), abnormalities which looks like cardiogenic pulmonary edema 2. Management of severe DILDs: A. How to diagnose severe DILDs: - Pathological diagnosis of severe DILDs is diffuse alveolar damage (DAD). -Because normal or pure GGO without tractionbronchiectasis (Fig.4) are common on CT in early exudative phase, it is very difficult to diagnose DAD at that period by CT. -However, they show rapidly progression. Thus repeated chest radiography can detect earlier DAD (Fig 5). B. Risks of severe DILDs : -preexistence of chronic interstitial pneumonia -relatively small amount of normal lung C. How to prevent the onset of severe DILDs; -To check the existence of chronic interstitial pneumonias and the extent of normal lung on CT before drug usage. This educational exhibit will demonstrate tips and clues for the diagnosis and management of DILD
Uncommon and Challenging Imaging Manifestations of Lung Adenocarcinoma

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
Lung adenocarcinoma (AD) is most confidently diagnosed on imaging as a part-solid or solid lesion, often with concomitant emphysema and unilateral lymphadenopathy. Variant forms of AD include cystic/bubbly, cavitary, pneumonia- or abscess-like forms, AD within a scar, indeterminate lesion in a non-smoker or a lesion changing morphology as a result of a treatment. Subtle imaging clues may aid in diagnosis. Indeterminate cases can be further assessed with 18F-FDG PET/CT or tissue diagnosis.

TABLE OF CONTENTS/OUTLINE
In this pictorial review, we discuss and illustrate spectrum of AD presenting as a lesion different from the common part-solid or solid forms, with an emphasis on the most helpful imaging findings in a non-treated lesion (subtle growth, increased density, development of spiculations/lobulations, wall morphology in cavitary/cystic lesion, etc.) and treatment-induced metamorphoses (cavitation, adjacent alveolitis, residual tumor within post-radiation field with disappearance of traction bronchiectasis/convex borders/PET uptake pattern, etc.). Highlights of important non-imaging characteristics, diagnostic dilemmas, brief differential diagnosis and key management (when applicable) are provided as well.
**Differential Diagnosis of Ground Glass Opacity (GGO) on HRCT: A Must for Thoracic Radiologist**

**All Day Room: NA Digital Education Exhibit**

**Participants**

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**TEACHING POINTS**

1. To study the pathophysiology and imaging of various diseases causing GGO
2. To study the role of HRCT chest in evaluation and differential diagnosis of GGO

**TABLE OF CONTENTS/OUTLINE**

GGO is increase in pulmonary attenuation without obscuration of pulmonary vascular markings on HRCT. It should not to be confused with consolidation, in which bronchovascular structures are obscured. It is a nonspecific finding & may be due to interstitial/alveolar diseases, fine fibrosis, or increased capillary blood volume & indicates active disease that is potentially reversible with treatment. False diagnoses of GGO stem from technical errors, respiratory/cardiac motion, poor inspiration/hypoventilation in dependent lungs. **Aims/Objectives** Introduction & pathogenesis of diseases causing GGO:

- Vascular: Edema, Haemorrhage, Pvd, Pul cap hemangiomatosis, vasculitis
- Infection (Bacterial, Viral, Fungal, Opportunistic)
- Inflammation: Smoking related- RB, RB-ILD, DIP, NSIP, COP, Acute exacerbation of UIP, Acute/chronic eosinophilic pneumonia, Hypersensitivity pneumonitis, ARDS/AIP, Collagen vascular diseases, Bronchiolitis, Drug toxicity
- Miscellaneous: Bronchoalveolar carcinoma, Alveolar proteinosis, Traumatic, & Syndromes

**Conclusion:** HRCT is very useful to evaluate GGO & help guide biopsy & evaluate effectiveness of therapy. It also helps to determine differential diagnosis.

**Honored Educators**

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Carlos S. Restrepo, MD - 2014 Honored Educator

Carlos S. Restrepo, MD - 2017 Honored Educator

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Beyond T.B.: Non-Infectious Granulomatous Diseases of the Chest

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit
Identified for RadioGraphics

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TEACHING POINTS
1. To review the imaging features of non-infectious granulomatous diseases of chest. 2. To approach these disease based on an imaging based algorithm.

TABLE OF CONTENTS/OUTLINE
1. Differentiation of the granulomas in 2 broad categories such as necrotizing and non-necrotizing granulomas. 2. To further divide these non-necrotic and necrotic granulomas based on the imaging appearance. 3. To review the pathological and immunological bases of granuloma formation. 4. To review imaging features of the non-infectious granulomatous chest diseases.

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Black Holes and Cavitations: Musings on Cavitating Lung Nodules

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

- Differential Diagnosis of a Cavitary Lung Nodule includes many different diseases. To remember the wide range of these a helpful mnemonic 'CAVITY' can be used.
- Recognition of common radiological findings in correlation with relevant clinical history and clinical findings can help us make the right diagnosis and recommend the correct management plan.
- Other conditions can mimic cavitary lesions on radiology; awareness of the pitfalls and common mimics will help timely diagnosis and avoid unnecessary further imaging and investigations.

TABLE OF CONTENTS/OUTLINE

1. INTRODUCTION
2. DEFINITION
3. RADIOLOGICAL FEATURES: a. morphology b. location c. number
4. IMPORTANT CLINICAL FEATURES
6. MIMICS OF CAVITATING LUNG NODULES
7. CONCLUSION
Beyond Chronic Pneumonia: A Review of the Non-Infectious Causes of Chronic Airspace Disease

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Review various causes of chronic airspace disease
2. Illustrate radiologic pattern of each of these diseases
3. Discuss how combining clinical manifestations, radiologic signs and laboratory findings can help in narrowing the differential diagnosis

TABLE OF CONTENTS/OUTLINE
Consolidation and ground glass opacities are common radiologic findings on chest imaging. These can be secondary to various causes including infection, inflammation or neoplasia, thereby making these signs highly non-specific. Persistent consolidation beyond one month after treatment brings forward the differential diagnoses for chronic airspace disease. In this review paper, we will focus primarily on non-infective causes of chronic airspace disease. • Inflammatory causes: chronic eosinophilic pneumonia, organizing pneumonia, alveolar sarcoidosis, granulomatosis with polyangitis (GPA), eosinophilic granulomatosis with polyangitis (EGPA/Churg-Strauss syndrome), pulmonary alveolar proteinosis (PAP), IgG4 disease, lipoid pneumonia, radiation pneumonitis, drug toxicity etc. • Neoplastic causes: Lung cancer particularly invasive adenocarcinoma (mucinous or nonmucinous) (previously bronchoalveolar carcinoma) and pulmonary lymphoma Persistent or non-resolving airspace disease should alert radiologist to differential diagnosis outside community-acquired pneumonia.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Mylene T. Truong, MD - 2015 Honored Educator Mylene T. Truong, MD - 2018 Honored Educator
"Breaking Bud:’ A New Twist to Tree-In-Bud Pattern in Bronchiolitis

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
- Revisit the normal anatomy of the secondary pulmonary lobule
- Define the term bronchiolitis and recognize the imaging appearance at chest radiography and high resolution CT (HRCT)
- Describe the classification into either cellular or constrictive types and discuss the wide spectrum of causes
- Make an appropriate differential diagnosis and depict the mimics of small airways diseases

TABLE OF CONTENTS/OUTLINE
- Normal anatomy
- Bronchiolitis as a radiologist challenge
- Pathologic classification of bronchiolitis
- Cellular bronchiolitis
- Constrictive bronchiolitis
- Semiology of small airway disease
- Direct signs
- Indirect signs
- Imaging technique considerations
- Mimics
- Conclusion
TEACHING POINTS

Suspect pulmonary vein stenosis in imaging. Know the major causes of pulmonary vein stenosis, show how pulmonary vein stenosis looks like in imaging.

TABLE OF CONTENTS/OUTLINE

Pulmonary vein obstruction is a rare entity and often difficult to diagnose since these veins are not evaluated on a regular basis when conducting analyses of chest imaging studies. Its timely diagnosis is relevant given that in advanced stages it has a poor prognosis. Currently, the most frequently encountered cause is that one secondary to radiofrequency ablation procedures performed to manage atrial fibrillation, but it can also occur due to pulmonary or mediastinal tumors, fibrosing mediastinitis, vein thrombosis, or congenital defects. Regardless of the etiology, an obstruction of the pulmonary veins can translate into variable congestion of the segment dependent on the pulmonary parenchyma. High-grade obstructions might reach zones of pulmonary edema, pulmonary infarction, and even massive hemoptysis. A review on relevant anatomy, main etiologies, and imaging findings of these pathologies will be provided in this educational exhibit.
HRCT Findings in Pulmonary Tuberculosis in Patients with HIV/AIDS

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To describe the findings in HRCT of pulmonary tuberculosis in patients diagnosed with HIV/AIDS, followed at our Hospital. The resurgence of tuberculosis has been attributed to HIV infection, increased poverty, immigration, and the low adherence to treatment. We studied HRCT findings in outpatients and hospitalized patients with HIV/AIDS with a diagnosis of pulmonary tuberculosis, these patients are more likely to develop tuberculosis in the course of the disease and are 20 times more likely to reactivate tuberculosis than the general population.

TABLE OF CONTENTS/OUTLINE
Tuberculosis can occur at any stage of HIV infection. Regarding pulmonary lesions, their aspects accompany the clinical presentation and its relation to the initial immunological condition. It was verified that in the initial phase of infection, with a CD4+ 200 cells / μL lymphocyte count, the findings resemble to those of immunocompetent individuals with central lobular nodules, branched centrilobular opacities with budding tree appearance, airspace consolidation, thickening of bronchial walls, with or without cavitation in the upper lobes. With worsening immunodepression CD4+ lymphocytes <200 cells / μL, the tomographic findings are altered, being the most varied with predominant involvement of lower segments, miliary dissemination, intrathoracic adenopathies and pleural effusion.
State-Of-The-Art Imaging in Chronic Thromboembolic Pulmonary Disease

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TEACHING POINTS
Pulmonary hypertension (PH) is defined as mean pulmonary arterial pressure (PAPm) >=25 mmHg at rest Digital subtraction angiography with right heart catheterization is the gold standard for diagnosis, providing morphological and hemodynamic information with added possibility of treatment Ventilation-perfusion lung scintigraphy (V/Q scan) remains the first line imaging modality for CTEPH, mismatched segmental or larger perfusion defects with a V/Q scan indicate a high probability of CTEPH Computed tomography pulmonary angiography (CTPA) has become the method of choice for imaging the pulmonary vasculature to rule-out pulmonary embolism (PE) with high specificity and sensitivity Dual-energy computed tomography (DECT) pulmonary angiography builds perfusion maps allowing for qualitative and quantitative analysis contributing to the visualization of peripheral perfusion defects, potentially depicting chronic from acute PE, but its full potential is yet to come

TABLE OF CONTENTS/OUTLINE
Introduction Overview of chronic pulmonary embolism and pulmonary hypertension: pathophysiology and classification Imaging techniques and clinical usages: Digital subtraction pulmonary angiography CT findings Dual Energy CT (basis, protocols and applications) V/Q scan Conclusions
To the Rescue: An Overview of Hemodialysis Reliable Outflow (HeRO) Graft Imaging

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
The purpose of this exhibit is to: 1) Provide a complete overview of the relevant imaging associated with HeRO Grafts for resident physicians and those unfamiliar with the device. 2) Review the indications, advantages, and drawbacks of HeRO Graft placement. 3) Review the utility of pre-procedural CT planning of HeRO Graft placement. 4) Review the venous anatomy associated with graft placement.

TABLE OF CONTENTS/OUTLINE
1) Background to the HeRO Graft: a. Hemodialysis, arteriovenous (AV) fistulas, and AV grafts overview b. End stage dialysis access (ESDA) and failure of AV fistulas/grafts overview c. Complications of tunneled dialysis catheters and lower extremity AV grafts d. Indications for HeRO Graft placement e. What is a HeRO catheter and normal appearance of implanted HeRO catheter on imaging
2) Pre-procedural testing for HeRO catheter placement: a. Review of venous anatomy b. Indications for CT angiogram/venogram (CTA/CTV) c. CTV evaluation including 3D processing
3) Example cases of patients who underwent pre-procedural planning for HeRO Graft placement
Ultra-High-Resolution CT Contributes to Reduce Radiation Dose in High-Contrast Regions

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
High resolution images of MDCT are generally reconstructed using enhancement kernels. However, Ultra-High-Resolution CT (U-HRCT) can obtain the same maximum resolution as MDCT without using enhancement kernels. Therefore, if U-HRCT has the same spatial resolution as MDCT, U-HRCT is more advantageous for noise reduction than that. This exhibit shows the possibility of radiation dose reduction in U-HRCT imaging in the high contrast regions.
CT Appearances of Emphysema in Never Smokers with Interstitial Lung Disease

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Understand that emphysema can occur in patients who have never smoked. 2. Be aware of the increasing reports of emphysema occurring in patients with interstitial lung disease who have never smoked. 3. Learn the frequency and patterns of emphysema in never-smokers with interstitial lung disease.

TABLE OF CONTENTS/OUTLINE
Pulmonary Metastasis? Where Are You From?

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1) Review pulmonary anatomy as relevant to metastasis 
2) Investigate how flow dynamics relate to development of metastasis
3) Demonstrate the morphology of pulmonary metastases using histopathologic correlation with the primary tumors

TABLE OF CONTENTS/OUTLINE
1. Pulmonary anatomy as related to metastasis
2. Tumor morphology, helpful findings, and histopathological correlation: illustrative cases in quiz format. Cavitory nodules: squamous cell carcinoma of the head and neck, adenocarcinoma of the gastrointestinal tract or breast, sarcoma Hemorrhagic nodules: choriocarcinoma, angiosarcoma Shaggy nodules: adenocarcinoma from the gastrointestinal tract Calcified nodules: sarcoma, papillary carcinoma of the thyroid, mucinous adenocarcinoma, colon cancer
Nail It! Lesions of the Chest with Novel, Pathognomonic T1 and T2 Weighted Imaging Findings That Allow Specific Diagnosis

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

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TEACHING POINTS
1. To learn novel signal intensity patterns of thoracic diseases for quick and precise disease diagnosis.
2. To learn the pathological underpinnings for these unique signal intensity patterns.

TABLE OF CONTENTS/OUTLINE
1. Review how tissue T1 and T2 signal intensity is related to microscopic pathological changes and summarize typical appearances on T1WI and T2WI.
2. Illustrate mainly lesions with T1 hyperintensity and T2 hypointensity and some other T1/T2 intensity combinations from our database. Cases include:
   - Pulmonary Amyloidosis
   - Bronchial atresia
   - Granulomatosis with polyangiitis
   - Hamartoma
   - Leiomyoma
   - Lipoid pneumonia
   - Tuberculoma
   - Pleural Chylothorax
   - Solitary Fibrous Tumor
   - Hemorrhage
   - Mediastinal Bronchogenic cyst
   - Extramedullary hematopoiesis
   - Duplication cyst of the esophagus
   - Pericardial cyst
   - Thymic hyperplasia
Features and Complications of Pleuroparenchymal Fibroelastosis in Interstitial Lung Disease

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Understand the CT features of PPFE
2. Understand the aetiological factors linked to PPFE
3. Learn the effects PPFE has on lung function
4. Learn the complications associated with PPFE
5. Understand the effects PPFE has on mortality

TABLE OF CONTENTS/OUTLINE
1. Description of PPFE
2. Imaging characteristics - idiopathic and known cause
3. Pathological appearances of PPFE
4. Prevalance of PPFE in ILD
5. Imaging characteristics of PPFE in ILD - CT signs
6. Complications of PPFE - pneumothorax, infections, bronchiectasis
7. Effects of PPFE on lung function in ILD
8. Effects of PPFE on mortality in ILD - specific reference to IPF and CHP


**Soup mL**

**Pneumocystis Jirovecii Pneumonia in Non-HIV Immunocompromised Patients: Chest High-Resolution Computed Tomography (HRCT) Findings and Differential Diagnosis**

**All Day Room: NA Digital Education Exhibit**

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**TEACHING POINTS**
- Pneumocystis jirovecii is a fungus transmitted from host to host via inhalation, causing lung infection (Pneumocystis jirovecii pneumonia, PJP). PJP is a main problem in immunocompromised hosts, particularly in case of T-cell deficiency (i.e., patients undergoing chemotherapy for solid and haematological malignancies, haematopoietic stem cell transplantation or solid organ recipients, and those undergoing long-term corticosteroid therapy). HRCT plays a major role in both supporting clinicians in the diagnosis of PJP and assessing the severity of infection and its prognosis.
- Extensive ground-glass opacity (GGO) is the main HRCT feature. GGO is usually symmetric, predominant in the perihilar regions and the apices, with peripheral sparing. Consolidation, nodules, crazy-paving pattern and cysts may represent ancillary findings.
- Many acute infectious (viral, fungal, and bacterial pneumonia) and non-infectious conditions (e.g., pulmonary oedema, diffuse alveolar damage, diffuse alveolar haemorrhage, and drug toxicity) can mimic HRCT features of PJP, presenting with areas of GGO and consolidation, in variable proportion.

**TABLE OF CONTENTS/OUTLINE**
1. Clinical overview
2. Common and less frequent HRCT features of PJP
3. HRCT differential diagnosis
   3a. Infectious diseases
   3b. Non-infectious conditions
4. Conclusion
Evaluation of Noise Reduction Techniques in Chest CT

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
To review existing noise reduction techniques for low-dose chest CT, including image and projection space denoising, iterative reconstruction, and temporal denoising. To discuss the strengths and limitations of individual noise reduction techniques.

TABLE OF CONTENTS/OUTLINE
Materials and methods: Chest phantom: Lungman N1(standard type and fat type) CT scanner: Aquilion Precision Scan parameter: 45mAs and 15mAs Noise reduction techniques: Hybrid iterative reconstruction: AIDR3D, enhanced AIDR3D Iterative reconstruction: FIRST Image space denoising: safe CT Temporal denoising: PhyZiodynamics. Results and conclusions: Iterative reconstruction was most effective NR technique. It can achieve better noise reduction while maintaining spatial resolution and can reduce some artifacts such as beam hardening. Hybrid iterative reconstruction achieve noise reduction in image space, and artifact reduction by iteration between image and projection space denoising. Image space denoising is the process of filtering the reconstructed images. It could not reduce artifacts. In Z-direction, slice thickness was enlarged. Temporal denoising is the technique for 4D dynamic data. NR effect was about 50%. It is desirable to understand the advantages and disadvantages of each techniques and make effective use of them.
Correlation Between Lung Perfusion Blood Volume (Lung PBV) and Mosaic Perfusion on CT Images in Patients with Chronic Thromboembolic Pulmonary Hypertension (CTEPH) Before and After Balloon Pulmonary Angioplasty (BPA)

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
The major teaching points of this exhibit are: 1. Knowledge of lung PBV image and mosaic perfusion on CT image in patients with CTEPH before and after BPA 2. Understanding the mechanism and clinical meaning of lung PBV CT imaging 3. Knowledge of clinical feasibility of correlation with lung PBV and mosaic perfusion on CT imaging findings in patients with CTEPH before and after BPA 4. Knowledge of the meaning of the differences between lung PBV and mosaic perfusion on CT image findings in patients with CTEPH before and after BPA

TABLE OF CONTENTS/OUTLINE
TEACHING POINTS

1. Review the CT acquisition parameters and discuss both past and current CT reconstruction algorithms.
2. Review dose reduction and noise reduction of model-based iterative reconstruction (MBIR).
3. Compare the diagnostic quality of acute cardiovascular diseases using MBIR reconstruction algorithms.

TABLE OF CONTENTS/OUTLINE

A. Physics Overview
   a. CT image acquisition and reconstruction parameters
      i. kVP and mAS
      ii. Pitch
      iii. Slice thickness
   b. CT reconstruction algorithms:
      i. Filtered back projection
      ii. Iterative reconstruction
      iii. Model-based iterative reconstruction (MBIR)
B. Advantages of model-based iterative reconstruction
   a. Dose reduction
      i. Current peer-reviewed research
      ii. Our institution's experience, when compared to non-model-based iterative reconstruction second opinion outside examinations
   b. Improved spatial resolution and signal to noise ratio
C. MBIR and acute thoracic diseases
   a. Single examinations comparisons of MBIR relative to typical iterative reconstruction algorithms
      i. Pulmonary embolism on unenhanced CT
      ii. Acute aortic syndromes
      iii. Left ventricular infarction
      iv. Left ventricular thrombus
      v. Tumor/infection
D. Conclusion
   a. Dose reduction
   b. Preservation of diagnostic value
Imaging of Chronic Obstructive Pulmonary Disease (COPD) Using Hyperpolarized Xenon (HPX) MRI, Ventilation and Perfusion Single Photon Emission Computed Tomography (V/Q-SPECT), and Volumetric High-Resolution Thin-Section CT (vHRCT)

All Day Room: NA Digital Education Exhibit

TEACHING POINTS

Chronic obstructive pulmonary disease (COPD) is currently the fourth leading cause of death worldwide. Further increases in its incidence have been predicted. There are now a number of potential therapeutic options including interventions such as lung volume reduction surgery and endobronchial valves. The therapies chosen depend upon functional and structural imaging. Hyperpolarised Xenon-129 MRI may have a number of advantages in imaging patients with COPD. In this exhibit, we will present the different scan sequences available when using HPX MRI including a novel time-series HPX MRI technique that enables dynamic rapid imaging enabling the detection of gas flow in the lungs, and dissolved phase imaging enabling lobar gas flow transfer to be measured. We will discuss the possible advantages of HPX MRI in COPD subjects in comparison to V/Q SPECT, and vHRCT.

TABLE OF CONTENTS/OUTLINE

I. Background and literature review of previous HPX MRI techniques, II. Introduction of the novel time-series HPX-MRI in COPD patients and dissolved phase imaging, III. Quantitative comparison of HPX MRI, V/Q SPECT, and vHRCT measurements in COPD subjects.
The Reverse Halo Sign: What It Means and What Causes It

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
The reverse halo sign is a lung finding on CT in which there is a consolidation with central ground glass. It was once considered to be highly specific for a diagnosis of cryptogenic organizing pneumonia. There are now many recognized causes of the reverse halo sign, or atoll sign. The purpose of this exhibit is to: review the imaging features of the reverse halo sign and what this finding corresponds to on a microscopic level; review the various diseases that result in the reverse halo sign; review clinical features and other imaging findings in addition to the reverse halo sign that may narrow the differential diagnosis.

TABLE OF CONTENTS/OUTLINE
Examples of the reverse halo sign with pathologic correlates. Diseases that cause the reverse halo sign Organizing pneumonia Pulmonary Infarct (due to pulmonary embolus or percutaneous ablation) Post-radiation therapy Invasive fungal pneumonia (aspergillosis and mucormycosis) Necrotizing Vasculitis - granulomatosis with polyangiitis and eosinophilic granulomatosis with polyangiitis Primary lung adenocarcinoma Lymphoma Resolving bacterial pneumonia Lipoid pneumonitis
Transdiaphragmatic Pathologies: Anatomical Background, Pathologies and Spread of Disease on Cross Sectional Imaging with Pathological Correlation

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Demonstrate the anatomical details of the diaphragm. 2. List the diaphragmatic openings through which trans-diaphragmatic spread can occur. 3. Review the spectrum of common and uncommon trans-diaphragmatic disease processes. 4. Describe typical and atypical imaging features of these diseases with pathologic correlation. 5. Illustrate a pattern recognition approach to help reach a specific diagnosis.

TABLE OF CONTENTS/OUTLINE
1. Anatomical background - Diaphragmatic openings; contents and potential trans-diaphragmatic spread.
2. Pathological background; Spectrum of various pathological entities involving the diaphragm including: diaphragmatic diseases (e.g. eventration, paralysis, congenital hernia, hiatus hernia, diaphragmatic rupture and neoplastic masses), diseases involving the lower lung lobes (pneumonia, collapse, lung abscess, bronchiectasis and bronchogenic carcinoma), diseases involving the pleura (pleural effusion, empyema, calcified pleural plaques and pleural neoplastic lesions), sub-diaphragmatic pathologies (subphrenic abscess and others hepatic, splenic or gastric lesions).
3. Management: Current surgical and non-surgical management options of these pathological entities.

Honored Educators
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Modern Technical Adaptations for High Resolution CT (HRCT) Imaging of the Lungs

All Day Room: NA Digital Education Exhibit

Participants
Konstantinos Stefanidis, MD, PhD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS
• Current generation scanners offer a multitude of innovations which can be utilised to improve HRCT imaging • Radiologists should be aware of imaging improvements that can be achieved with imaging acquisition and post-processing

TABLE OF CONTENTS/OUTLINE
• Differences between traditional non-contiguous and volumetric HRCT • Advances in volumetric HRCT acquisition • Impact of slice thickness on z-axis resolution • Impact of gemstone detectors (higher resolution modes), wide area detector imaging, ultra-high pitch imaging on image quality • Impact of iterative reconstruction on image quality o Improved noise o Impact on image quality of interstitial lung disease o Higher resolution HRCT with model-based imaging? o Adaptations for obesity and metal artefacts • Choice of variable filtered back projection and iterative kernels for reconstruction • Impact of low-dose acquisition • Pitfalls of extreme dose ranges: photon starvation and excessive dose • Multiphasic imaging • Dynamic airway imaging, shuttle modes • Impact of intravenous contrast on diagnostic HRCT • Multiplanar imaging for diffuse interstitial disease • Characterisation of bronchiectasis, micronodular disease and fibrosis • Minimum and maximum intensity • Quantitative imaging • Neural network/Machine learning

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Novel Cardiopulmonary Devices, Purpose, and Imaging Appearances

All Day Room: NA Digital Education Exhibit

Participants
Raza Mushtaq, MD, Tucson, AZ (Presenter) Nothing to Disclose
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Berndt P. Schmit, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS

- Rapid technological advances have led to new cardio-pulmonary implantable materials and devices recently entering clinical practice. These include monitoring and treatment of cardiac failure, arrhythmias, pulmonary hypertension, COPD, among others.
- Familiarity with their use, indications and appearance is invaluable to ensure adequate position, function, prevention of complications and misinterpretation. At the completion of the article, readers will be able to:
  1) Identify recently introduced cardiopulmonary devices
  2) Describe clinical indications and function
  3) Recognize their imaging appearance and proper position

TABLE OF CONTENTS/OUTLINE

Introduction Cardiac conduction devices Cardiac assistance devices Valve replacement and repair devices Shunt occluding devices Monitoring cardiopulmonary devices Therapy delivering pulmonary devices Conclusion
Understanding the Air Trapping and Causes from HRCT

All Day Room: NA Digital Education Exhibit

Participants
Sandra M. Pinzon Ramirez, MD, Mexico City, Mexico (Presenter) Nothing to Disclose
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TEACHING POINTS
High resolution computed tomography (HRCT) is a useful tool used to evaluate air trapping in patients with various obstructive and airway diseases. HRCT is used during a forced inspiratory and expiratory maneuver to demonstrate dynamic changes in pulmonary attenuation. Air trapping is seen as a decreased attenuation of pulmonary parenchyma, especially manifested as a less than normal increase in attenuation during expiratory acquisition. Lung attenuation changes can be evaluated qualitatively or quantitatively by using time-attenuation curves measured for specific regions of lung. The differential diagnosis of diseases that show evidence of air trapping on expiratory HRCT scans including emphysema, bronchiolitis obliterans, asthma, Swyer-James syndrome, bronchiectasis, and cystic fibrosis.

TABLE OF CONTENTS/OUTLINE
How Does the Immunological Status of the Patient Alter the Face of Pulmonary Tuberculosis?

All Day Room: NA Digital Education Exhibit

Participants
Laima Tamkeviciute, MD, Kaunas, Lithuania (Presenter) Nothing to Disclose
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TEACHING POINTS
• Patient’s immunological status can alter clinical and radiological presentation of pulmonary tuberculosis (TB).
• Imaging appearance of TB is usually typical in general population. 
• Patients with different comorbidities causing immunodeficiency can have different radiologic manifestation.
• Imaging appearance of TB may overlap with nontuberculous mycobacterial and other infections in immunosuppressed patients.

TABLE OF CONTENTS/OUTLINE
1. Risk factors of tuberculosis. 2. Imaging features of TB in general population. 3. Imaging features of TB in children. 4. Imaging features of TB in immunocompromised patients: • HIV; • Immunodeficiency due to solid organ transplantation; • Chronic metabolic diseases (such as diabetes); • Other. 5. Differential diagnosis of TB with nontuberculous and other infections.
Update on Imaging of Non-Aortic Thoracic Vessel Tumors

All Day Room: NA Digital Education Exhibit

Awards
Cum Laude

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Prabhakar Rajiah, MD, FRCR, Dallas, TX (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS
Describe common imaging findings and differential diagnosis of tumors related to SVC, Intrathoracic IVC, pulmonary venous and pulmonary arterial tumors. Learn role of various imaging techniques for non-aortic thoracic vessel tumors. Learn about clinical implications of non-aortic thoracic vessel tumors

TABLE OF CONTENTS/OUTLINE

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Manifestations of Mediastinal Hemangiomas: Spectrum of CT Findings with Pathological correlation and Their Significance

All Day Room: NA Digital Education Exhibit

Participants
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Suhny Abbara, MD, Dallas, TX (Abstract Co-Author) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
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TEACHING POINTS
1. Review mediastinal hemangiomas for their spectrum of clinical manifestations, CT findings and their pathological basis.
2. Develop the comprehensive diagnosis and differential diagnosis of mediastinal hemangiomas.
3. Role of CT in pre-operative management.

TABLE OF CONTENTS/OUTLINE
Review serum tumor marker and clinical history of mediastinal hemangioma.
Step by step evaluation of mediastinal hemangioma with CT:
- Non-contrast CT
- Contrast CT: pulmonary artery and aortic phases
Review the spectrum of expected radiological findings (radiographs, CT and MRI) of mediastinal hemangiomas using case based approach, but are not limited to:
- Mass with obviously heterogeneous density: phlebolith, fatty component
- Arterial supply and draining veins: Enhancement pattern: no enhancement or slight enhancement or nodular or streak enhancement
- Pampiniform growth pattern with fuzzy margin, mass effect
- Mass-cardiovascular interface, mass-pulmonary interface
- Normal serum tumor markers
Role of MRI in diagnosis of mediastinal hemangiomas
Role of Dual energy/Spectral CT for evaluating mediastinal hemangiomas
Comprehensive diagnosis by correlating Imaging features with pathological findings
Management: Surgery or follow-up

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Suhny Abbara, MD - 2014 Honored Educator
Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
Teaching Points:

Teaching Points: Dense, calcified mediastinal lymph nodes are commonly encountered when interpreting images of the thorax. A large proportion of these lymph nodes can be ascribed to prior granulomatous disease. Mediastinal lymph node calcification may be a harbinger of occupational exposure. Lymph node calcification is also reported in certain metastatic lymphadenopathy and may be the first sign of disease in the chest. Furthermore, certain systemic disorders are associated with lymph node calcification. This poster will review the benign and malignant conditions that can manifest with calcified mediastinal lymph nodes and emphasize distinguishing features.

TABLE OF CONTENTS/OUTLINE

Infectious - Endemic fungi Tuberculosis Inhalational/occupational lung disease - Coal worker's pneumoconiosis Silicosis Aluminosis Chronic beryllium diseaseMalignant - Osteosarcoma Mucinous adenocarcinoma of the digestive tract Serous adenocarcinoma of the ovary Treated lymphomaSystemic - Amyloidosis Sarcoidosis

Honored Educators

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Early Stage Lung Cancer Therapy: What Every Radiologist Should Know

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

Participants
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Justin E. Mackey, MD, Darby, PA (Abstract Co-Author) Nothing to Disclose
Oleg Teytelboym, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

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TEACHING POINTS

With the implementation of low-dose computed tomography as a screening tool, early detection of lung cancer in asymptomatic patients has substantially increased. Early-stage non-small cell lung cancer (NSCLC) is (historically) best treated by surgical resection, however patients with associated advanced emphysema are often precluded from surgery due to severe pulmonary disease. For inoperable patients or those who refuse lobectomy, new options for treatment have emerged in recent years with promising results. This educational exhibit will review and illustrate state-of-the-art treatment options for early stage NSCLC, including surgery, interventional radiology ablation, radiation and emerging/research techniques.

TABLE OF CONTENTS/OUTLINE


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Imaging of the Post-Operative Chest and Complications

Participants
Merissa Harris, MD, Dallas, TX (Presenter) Nothing to Disclose
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TEACHING POINTS
Discuss surgical indications, imaging modalities and expected post-operative anatomic changes seen following various surgeries of the lung, pleura and chest wall. Describe imaging findings of early and late post-operative complications, with distinction on those common and uncommon using case examples. Emphasize the role of diagnostic imaging to facilitate prompt diagnosis and management of complications.

TABLE OF CONTENTS/OUTLINE
Common surgical procedures and indications
- Wedge resection
- Segmentectomy
- Lobectomy
- Pneumonectomy
- Chest wall resection

Expected early and late post-operative appearance
- Volume loss, residual air and fluid
- Displacement of fissures, mediastinal shifting, diaphragm elevation, hyperinflation
- Architectural distortion and fibrosis (late)

Early and late post-operative period complications
- (common and uncommon)
  - Early Atelectasis
  - Infection
  - Hemorrhage
  - Edema
  - Air leak, anastomotic dehiscence
  - Bronchopleural fistula
  - Long torsion, infarction
  - Late Bronchial Stenosis
  - Bronchopleural Fistula
  - Esophagopleural fistula
  - Gossypiboma
  - Tumor Recurrence
  - Pulmonary Artery stump thrombus

Management of mentioned complications.

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The objectives are the discuss the role of dual-energy CT (DECT) in the thorax. Emphasis will be placed on unique qualities of DECT and how these can be applied in thoracic imaging. DECT’s diagnostic performance will be outlined for various pathologies, as evidenced in recent literature.

TABLE OF CONTENTS/OUTLINE
**Awards**

Certificate of Merit

**Participants**

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**TEACHING POINTS**

Knowledge of the 8th edition of TNM staging as it applies to the spectrum of lung adenocarcinoma is important in accurate staging and determining patient management. New pathologic entities adenocarcinoma in situ (AIS) and minimally invasive adenocarcinoma (MIA) have been incorporated into the T descriptor. Lung adenocarcinomas can manifest as mixed attenuation lesions on CT with both solid and ground-glass components. At pathology, the solid component usually corresponds to the invasive part, and the ground-glass component corresponds to the lepidic growth along alveolar structures without stromal, vascular, or pleural invasion. The complex topic of classifying lung cancers with multiple sites of involvement is addressed in TNM 8th edition. Lung adenocarcinomas can present as a dominant mass with intrapulmonary metastases in the same lobe (T3), same lung non-tumor lobe (T4) or contralateral lung (M1a). TNM 8th edition also addresses multifocal pulmonary adenocarcinoma with ground-glass/lepidic features and diffuse pneumonic-type lung adenocarcinoma.

**TABLE OF CONTENTS/OUTLINE**

Table of Contents T descriptor Tis (AIS) Tmi (MIA) T1a/T1b/T1c Solid component determines tumor size. T3 separate nodule(s) in tumor lobe T4 separate nodule(s) in ipsilateral non-tumor lobe M1a separate nodule(s) in contralateral lung Multifocal Diffuse pneumonic-type.

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Life After Tuberculosis. Typical and Atypical Thoracic TB Sequelae and Long-Term Complications

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

The purpose of this exhibit is to:
• Review the pathophysiology of primary pulmonary tuberculosis and reactivation
• Point out typical and atypical thoracic tuberculosis sequelae, their radiological features and clinical significance
• Review common and uncommon long-term thoracic complications that may be seen in patients with history of tuberculosis
Common Variable Immune Deficiency (CVID) is the most common symptomatic congenital immunodeficiency which may remain undiagnosed until adulthood. It is one of the most common immune deficiency syndromes, and the radiologists must be aware of the usual imaging manifestations. Granulomatous and lymphocytic interstitial lung disease (GL-ILD) is a rare complication of CVID. The radiologist should be cognizant of imaging manifestations of GL-ILD due to its impact on both prognosis and treatment.

TABLE OF CONTENTS/OUTLINE

We will include a richly illustrated review of: 1. Thoracic manifestations of CVID include: bronchial wall abnormalities, air-trapping, infections and scarring. Bronchiectasis is common in CVID, and a poor prognostic indicator. 2. Describe findings of granulomatous and lymphocytic interstitial lung disease (GL-ILD)
Bronchiolocentric interstitial pneumonia (BIP) is a type of interstitial lung pneumonia, described from the observation of cases with inflammation and/or fibrosis clearly centered in the airways. This condition may be idiopathic or associated with hypersensitivity pneumonitis, connective tissue diseases and chronic aspiration. The histologic appearance corresponds to a centrilobular inflammatory process with small airway fibrosis and inflammation that radiates into the interstitium of the distal acinus in a patchy fashion. Granulomas are not identified. Hypersensitivity pneumonitis is a prototype for bronchiolocentric chronic interstitial lung disease, however has a distinctive histology. The usual tomographic pattern demonstrates lesions predominating in the lower two thirds of the lungs, with peribroncovascular predominance. Areas of ground glass opacification and traction bronchiolectasis may also be identified. In contrast to hypersensitivity pneumonitis, BIP has a poor prognosis, what makes the correct diagnosis of utmost importance for the patient follow-up.

**TABLE OF CONTENTS/OUTLINE**

- Basic concepts about the pathophysiology of BIP.
- Illustration of several cases of BIP from our service, categorized accordingly to their etiologies.
- Correlation of the biopsy and tomographic findings, including photomicrographs.
- Take-home messages.
Evaluation of Cystic Pericardial Masses: Not for the Faint of Heart

All Day Room: NA Digital Education Exhibit

Participants
Ana S. Mitchell, MD, Kingsburg, CA (Presenter) Nothing to Disclose
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TEACHING POINTS
Cystic lesions abutting the pericardium must be scrutinized on CT or MRI to make a definitive diagnosis of pericardial cyst as these can share imaging features with other mediastinal lesions. Multimodality imaging features including size, enhancement characteristics, and location can help the radiologist suggest a different diagnosis when necessary. Surgical resection is reserved only for symptomatic pericardial cysts, but the possibility of alternative diagnoses may alter management and may warrant surgical resection.

TABLE OF CONTENTS/OUTLINE
Discuss the salient imaging features on cross-sectional imaging that enable a definite diagnosis of pericardial cyst. Identify key distinguishing imaging features that warrant a differential diagnosis thereby potentially changing management. Review the differential diagnosis of pericardial cyst mimics through a case series. Congenital and acquired processes that can mimic a pericardial cyst include: pericardial diverticula, bronchogenic cysts, esophageal duplication cysts, thymic cysts, diaphragmatic pleural cysts, neuroenteric cysts, hemangioma, mesothelioma, echinococcal cysts, lymphangioma, teratoma, and metastatic disease. Identify multimodality imaging features that can aid in the diagnosis of a pericardial cyst mimic.
Constrictive Bronchiolitis: Spectrum of HRCT Features and Differential Diagnosis

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
After viewing this exhibit, the viewer should be able to: - recognize the imaging features of constrictive bronchiolitis, with emphasis on high resolution computed tomography; - discuss the main constrictive bronchiolitis etiologies and their clinical settings.

TABLE OF CONTENTS/OUTLINE
1. Definition and pathology of constrictive bronchiolitis. 2. Anatomy and HRCT appearances of normal small airways. 3. Abnormal small airways HRCT features: a. direct signs; b. indirect signs. 4. Main differential diagnosis of constrictive bronchiolitis, with sample cases: a. postinfectious constrictive bronchiolitis and Swyer-James-McLeod syndrome; b. autoimmune diseases (eg. rheumatoid arthritis, inflammatory bowel disease); c. exposure to inhalational toxins; d. drug reaction; d. diffuse idiopathic neuroendocrine cell hyperplasia; e. bronchiolitis obliterans syndrome associated with bone marrow and lung transplantation; f. idiopathic.
Epipericardial Fat Necrosis: The Often Forgotten Culprit on Chest CT and CTA Scans Ordered in the Emergency Department

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
Epi-pericardial (EP) fat necrosis is an uncommon cause of chest pain that can be readily diagnosed on CT Demonstrate the classic imaging findings of EP fat necrosis Review literature for incidence, typical presenting symptoms and efficacy of treatment

TABLE OF CONTENTS/OUTLINE
Chest Pain Anatomy review of the epicardium and pericardium Differentiating pericarditis from EP fat necrosis Review of Home Institution Cases Review of 36 ED cases of EP fat necrosis from 2012 - 2018 Demographics, predisposing factors Typical signs and symptoms at presentation, location within the chest Associated CT findings Management Literature Review Recent meta-analysis in 2016 (AJR 207; Oct 2016: 773 - 777) Prevalence Presenting symptoms, associated conditions Imaging findings on CT Treatment Conservative, pain relief Other diagnostic considerations causing non-cardiac chest pain
Imaging in Lung Transplantation: a Practical Guide for Radiologists

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

Acknowledge the normal anatomy and the surgical technique
Review the main indications and contraindications of lung transplant
Illustrate preoperative imaging of the donor and recipient
Discuss imaging and pathological implications of postoperative complications

TABLE OF CONTENTS/OUTLINE

Brief main indications of lung transplant in our institution
Preoperative Imaging of the Recipient
Relevant Anatomy
Airways
Airspaces
Interstitium
2. Relevant anatomical variations
3. Indications of specific surgery techniques
4. Exclusion criteria
Postoperative Imaging
Primary Graft Dysfunction (X-Ray evaluation)
Immediate postoperative complications
Airway complications - Bronchial Stenosis x Bronchial dehiscenses
Infectious Complications
Immunological Complications (Practical pathological review)
Neoplasms
Iatrogenic Complications (including drugs toxicity and recurrence of primary disease
Vascular complications ( Anastomosis + Pulmonary Thromboembolism)
Xenon Ventilation CT for Various Pulmonary Diseases

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS
To understand how to perform Xenon ventilation CT. To understand how to analyze and interpret Xenon ventilation CT. To learn typical findings of Xenon ventilation CT with clinical case presentations.

TABLE OF CONTENTS/OUTLINE
· Basic principles of Xenon ventilation CT using dual energy CT.
· Protocol of Xenon ventilation CT including ventilation method and scan timing.
· Data analysis and basic index of Xenon ventilation CT (Xenon ventilation map and mean Xenon enhancement values).
· Correlation with pulmonary function tests and ventilation scintigraphy.
· Xenon CT findings of pulmonary diseases such as COPD, interstitial pneumonia, CPFE, asthma, and bronchiolitis obliterans.
Advanced Imaging of Non-Tumoral Chest Diseases

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit
Identified for RadioGraphics

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TEACHING POINTS
1. To identify the diagnostic clues of several benign conditions of the chest, being some of them potential pitfalls for malignant diseases. 2. To analyze the diagnostic impact of advanced imaging modalities for differentiating them, giving a roadmap for its application on the daily clinical basis.

TABLE OF CONTENTS/OUTLINE

Honored Educators
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The Esophagus 2.0: The Missing Spot for Chest Radiologist

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. To illustrate the manifestations of benign and malignant esophageal diseases with advanced imaging techniques
2. To provide a practical clinical approach in the use of advanced imaging techniques in the assessment of the esophagus
3. To illustrate how advanced imaging techniques can be used to diagnose esophageal diseases

TABLE OF CONTENTS/OUTLINE

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Multimodality Imaging of the Extrapleural Space: A Primer for the Radiologist

All Day Room: NA Digital Education Exhibit

Awards
Cum Laude

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TEACHING POINTS
1. To understand the cross-sectional anatomy of the extrapleural space (EPS)
2. To understand the role of various imaging modalities in evaluating the EPS and how different modalities can be used for problem solving
3. To review the various pathologies affecting the EPS and their varied appearance on different imaging modalities
4. To identify and recognize the pitfalls of interpreting pathologies that affect the EPS

TABLE OF CONTENTS/OUTLINE
1. Introduction to the EPS a. Anatomy and histologic correlation b. Appearance on xray, ultrasound, and CT
Micro CT and Histopathological Image Registration Based on Deep-Learning Assisted Image Registration

All Day Room: NA Digital Education Exhibit

FDA *Discussions may include off-label uses.*

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TEACHING POINTS
To understand deep-learning assisted image registration
To understand how chest micro CT and histopathological HE-stained images are registered
To understand micro structure observation on micro-focus X-ray CT images

TABLE OF CONTENTS/OUTLINE
Examples of micro CT and HE images of lung cancer cases
Review of micro CT and HE images
Examples of 3D reconstruction of micro CT images
Image registration based on deep learning
Review of image registration methods
Understand how image registration is achieved by combining deep-neural network
Understand how deep neural network can compute deformation field
Understand how global image deformation information is found by scalable deep neural network
Demonstration
Demonstration of micro CT and HE volumes with 3D volume rendering
Demonstration of co-registered images of micro CT and HE images
Demonstration how to use co-registered image for understanding micro structure of lung anatomy and lung cancer
Discussion
Deep neural network based registration
Comparison with conventional methods
Application of co-registered images for detailed diagnosis of lung cancer
Imaging Approach to Immunoglobulin G4-Related Lung Disease

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Immunoglobulin G4 related sclerosing disease (IgG4-sd): diagnostic criteria and differential diagnoses Radiological types of pulmonary involvement Illustrated review of the literature with case discussions from our institution

TABLE OF CONTENTS/OUTLINE
Definition and a brief history of IgG4-related sclerosing disease, a relative recently recognized disease entity Diagnosis criteria Relevance in the pathological recognition of pulmonary involvement Differential diagnosis Types of radiological findings of IgG4-related pulmonary disease, correlating with original cases A brief review on treatment and prognosis
Staging the Gray Areas: Recognizing Defined Situations and Proposals for Undefined Scenarios in Lung Cancer Staging

All Day Room: NA Digital Education Exhibit

Awards
Cum Laude

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Ioannis Vlahos, MRCP, FRCR, London, United Kingdom (Abstract Co-Author) Research Consultant, Siemens AG Research Consultant, General Electric Company

TEACHING POINTS
The 8th edition of the NSCLC staging system advances our stratification and prognostication of patients with lung cancer. This exhibit explores radiological scenarios which: - are defined but require knowledge of some of the less widely-known subtleties of staging, often in ancillary staging manuals or - remain undefined and/or troublesome to assign to a T, N or M category We aim to stimulate discussion and calls for uniformity, proposing approaches to staging in the currently undefined situations.

TABLE OF CONTENTS/OUTLINE
• Variability in T size measurements of greater impact with more size-stratification of T staging o Interobserver size variability (Subsolid lesions, spiculation, atelectasis, peri-cystic lesions etc.) o Radiology vs pathology size • Primary site of disease is poorly defined o Multiple lesions o Assigning N status in multifocal subsolid lesions • Tumor traversing fissures • Contiguous mass/nodal disease • Differentiating incidental nodules vs satellite nodules (determining T3 disease) • Indeterminate visceral pleural invasion • Applying the IASLC nodal classification to CT o Boundaries in differentiating N2 from N3 disease o Superior mediastinal nodes o Peripheral N1 disease v second nodule T3 disease? • Undefined nodal metastatic sites - e.g. axillary, cervical and abdominal • Lymphangitis carcinomatosa

Honored Educators
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Clinical Aspects Relating to Acute Pulmonary Embolism Imaging

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS

This exhibit provides a review of the current best practice and on-going dilemmas in clinical aspects surrounding radiological pulmonary embolism diagnosis.

TABLE OF CONTENTS/OUTLINE

- Factors affecting clinical rationalization for diagnostic CT imaging of pulmonary embolism are examined including:
  - use of clinical decision rules (Wells, modified Wells, Geneva, simplified Geneva, PERC)
  - use of D-dimer (including age-adjusted D-dimer)
  - considerations regarding clinical context (e.g. inpatient vs outpatient)
- The clinical impact of CT pulmonary angiography findings are considered, including:
  - radiological factors influencing clinical decisions to thrombolyse
  - the concept of overdiagnosis
  - management of subsegmental emboli or incidental, asymptomatic peripheral emboli
- Lastly, determinants of which patients require imaging follow up and when are highlighted, considering outcomes such as:
  - Recurrent or non-resolving pulmonary embolus
  - Development of chronic thromboembolic pulmonary hypertension

Honored Educators

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Nonthrombotic Pulmonary Embolism (NPE): A Pictorial Roadmap

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

- NPE may be an infrequent condition and diagnostic challenge due to low specificity of clinical symptoms and imaging signs. Awareness of imaging features of nonthrombotic pulmonary embolism facilitates correct diagnosis and must be recognized by radiologists. These conditions have important and potentially life-threatening complication. Imaging may play a key role in diagnosis, management and outcomes in this setting. It is also important to emphasize that an isolated radiographic finding for such diseases should be interpreted in correlation with patients clinical findings.

TABLE OF CONTENTS/OUTLINE

Illustrate and discuss the main NPE imaging features by presenting cases with images and brief discussion. Embolism caused by: air, fat, septic focus, methacrylate, amniotic fluid, foreign bodies such as silicone, pacemaker wire, microscopic and macroscopic tumoral embolism. Take-home messages. References.
Imaging Spectrum of Tuberculosis on CT Chest

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. To evaluate the broad spectrum of presentation of Tuberculosis on CT Chest
2. To understand the impact of diagnostic imaging on clinical management of Tuberculosis

TABLE OF CONTENTS/OUTLINE
1. Introduction
2. Pathophysiology of Pulmonary Tuberculosis and its complications
3. Imaging Spectrum on CT chest
4. Treatment aspects
Pulmonary Cryptococcosis: Computed Tomography (CT) Findings in Immunocompetent and Immunocompromised Patients

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. To review of the epidemiology, clinical features, and diagnostic approach of Pulmonary Cryptococcosis.
2. To assess the imaging findings of pulmonary cryptococcosis. 2.1 To compare Pulmonary Cryptococcosis imaging findings in the immunocompetent and immunocompromised patients.

TABLE OF CONTENTS/OUTLINE
Basic concepts and the clinical/epidemiological aspects of immunocompetent and immunocompromised patients. Illustration of several cases of PC, highlighting the radiological features most related to the immune status of the patient. The most common ones are: solitary or multiple solid pulmonary nodules, cavitary nodules, consolidations, ground-glass opacities, pleural effusion. Take-home message. References.
Imaging of Complicated Pneumonia in the Pediatric Population

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
1. Complications of pneumonia include pleural effusion, empyema, lung abscess, and necrotizing pneumonia.
2. Complicated pneumonia has key imaging features on radiographs, ultrasound, and computed tomography.
3. Chest ultrasound is a useful tool and lacks ionizing radiation.

TABLE OF CONTENTS/OUTLINE
1. Pathophysiology of complicated pneumonia
2. Pulmonary complications
   a. Acute/subacute: lung abscess, necrotizing pneumonia, bronchopulmonary fistula, pneumatocele
   b. Chronic: bronchiectasis, bronchiolitis obliterans, reactive airways disease
3. Extrapulmonary complications - simple pleural effusion, empyema, pericardial effusion, mediastinal abscess
4. Imaging
   a. Radiographs
      i. Dense consolidation with associated effusion
      ii. Abscess - rounded collection with air-fluid level
      iii. Empyema - lentiform-shaped pleural collection
      iv. Necrotizing pneumonia - collections of gas in a pattern atypical of air bronchograms
   b. US
      i. Chest ultrasound scanning technique
      ii. Pneumonia - consolidation with sonographic air bronchograms
      iii. Necrotizing pneumonia - hypoechoic, heterogenous lung parenchyma
      iv. Empyema - hypoechoic, complex pleural collection
      v. CT
         i. Poorly enhancing lung parenchyma
         ii. Cystic, air-filled collections within the lungs
         iii. Enhancing pleura
         iv. Pleural collections
Differential Diagnosis of Thoracic Lymphadenopathy

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TEACHING POINTS
Lymphadenopathy is a common finding in many thoracic diseases and may be caused by a variety of infectious, inflammatory and neoplastic conditions. The aim of this study is to show patterns of thoracic lymphadenopathy found in many benign and malignant diseases, emphasizing its characteristics, anatomic location and signs that may help to narrow the differential diagnosis, as hyper or hypoattenuation.

TABLE OF CONTENTS/OUTLINE
Many infections may present with thoracic lymphadenopathy, but when demonstrating necrotic components should raise the possibility of granulomatous diseases as tuberculosis and fungal infection. Sarcoidosis is a relatively frequent cause of lymphadenopathy in young adults, and can be distinguished from other diseases when lymph nodes are found multiple and symmetrical, especially in the hilar regions. The presence of calcifications, depending of its characteristics (grossly, eggshell or icing sugar) may help to narrow the differential diagnosis. Others conditions that may show thoracic lymphadenopathy are silicosis, drug reactions, amyloidosis, heart failure, Castleman's disease, chronic obstructive pulmonary disease and malignant diseases including lymphoproliferative diseases and metastases.
Multimodality Imaging of Tracheobronchial Tumours with Clinical-Pathological Correlation

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TEACHING POINTS
1. Understanding of the key appearances of benign and malignant endobronchial tumours on multimodality imaging using MDCT, PET-CT, and MRI.
2. Imaging, endoscopic, and histological correlation of cases to highlight characteristic imaging with discriminating features that guide clinical management.
3. Depiction of important imaging features to aid pre-surgical planning.

TABLE OF CONTENTS/OUTLINE
Depiction of tracheobronchial tumours using multiple imaging modalities of MDCT, MRI, and PET-CT combined with endoscopic direct visualisation with histopathological correlation. The tumours include: lipoma, hamartoma, tracheopathia osteochondroplastica, carcinoid (typical and atypical), adenocarcinoma of the lung, squamous dysplasia, squamous cell carcinoma, recurrent laryngeal papillomatosis with associated squamous cell carcinoma, metastases, adenoid cystic carcinoma.
Primary pulmonary tuberculosis appears consecutively with the initial Mycobacterium tuberculosis infection. CT and X-ray usually show a small calcified nodule or adenopathies disorders. In immunosuppressed patients, primary tuberculosis may be progressive. The degree of parenchymal involvement varies widely and can be demonstrated as a small infiltration to an extensive cavitary process on imaging findings. Another common manifestation, better evaluated by CT, is pleural effusion that occurs due to the penetration of the bacilli into pleural space. Haematogenous dissemination can be often asymptomatic. This occurs when the bacilli pass from the lung injury or lymph nodes to the vessels and randomly spread (miliary pattern).

TABLE OF CONTENTS/OUTLINE
Tuberculosis: Still an epidemic disease; Pathophysiology: from Ghon lesion to disseminated tuberculosis; Imaging protocols: Chest MDCT and HRCT; Different Imaging Findings: Lungs infiltration, consolidation, cavitation, nodular opacities, tuberculoma formation; miliary patern; Pleural effusions; Lymphadenopathy; Tracheal and bronchial involvement
Apical Pleural Thickening: From Scar Tissue to Pleuroparenchymal Fibroelastosis (PPFE): A Rare Entity revisited

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
Teaching points: • Explaining the pathology behind PPFE • Provide an overview on epidemiology and pathogenesis • Outline of the relevant clinical issues • Description of the key imaging features • Pitfalls (not every apical thickening is just an apical fibrosis) • Discussion of top differential diagnosis (hypersensitivity pneumonitis, ankylosing spondylitis, pneumoconiosis) • Pictorial review of cases from two tertiary care centers

TABLE OF CONTENTS/OUTLINE
Table of Contents / Outline: • Introduction to the rare entity of PPFE • Explanation of the central role of radiology in the diagnosis • Pictorial review of the classic imaging findings of pure PPFE, PPFE combined with other interstitials and the top differentials • Report our experience with the diagnosis and treatment options in cases of PPFE
Evaluation and Management of Subsolid Nodules (SSNs): From Lung Cancer Screening to Everyday Clinical Practice

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS
• To evaluate the features of subsolid nodules (SSNs) in terms of prevalence, growth rate, predictors of malignancy and prognosis.
• To describe the updated management of SSNs, distinguishing between lung cancer screening setting and daily clinical practice.

TABLE OF CONTENTS/OUTLINE
SSNs (which include ground-glass and part-solid nodules) show several morphological features, those correlate to their biological behaviour and can be used as predictors of malignancy and prognosis. Criteria for the evaluation and management of SSNs are still in becoming. In recent years, with the establishment of lung cancer screening programs, a large amount of data about SSNs have been collected, allowing a better definition of their features and behaviour over time. After showing prevalence and malignancy rate, we will analyse growth rate and predictors of malignancy. Possible differential diagnoses will also be discussed, as well as the topic of multiple SSNs. Special attention will be paid to the variability of classification and measurement of SSNs. In the second part the updated management of SSNs will be described, focusing on two different clinical settings: the lung cancer screening, discussing the ACR-LungRADS, and the routine clinical practice, describing the Fleischner Society Guidelines for the management of incidental pulmonary nodules.
Unusual Lung Masses: Learning Across Two Continents

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

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TEACHING POINTS
The purpose of this exhibit is: To create awareness about rare lung neoplasms Demonstrate clinical, imaging and pathological findings in these tumours Demonstrate pertinent features in imaging which help in differentiating these tumours from the common lung malignancy i.e. bronchogenic carcinoma Close working between two continents helps in better learning of rare and unusual tumours

TABLE OF CONTENTS/OUTLINE
A. Imaging algorithm for evaluation of pulmonary masses B. Clinical presentation, imaging and histopathological findings of unusual lung masses C. Illustration of typical cases Mesencymal tumours Benign metastasising leiomyoma Solitary fibrous tumour Inflammatory myofibroblastic tumour Lymphoreticular tumours Low grade small B-cell lymphoma Salivary gland type lung carcinoma Sarcomatoid carcinoma of lung Neuroendocrine tumours Tumours with combined epithelial and mesenchymal component Pleuropulmonary blastoma Vascular tumours Epithelial hemangioendothelioma Hemangiopericytoma Epithelial tumour Pulmonary papillomatosis
Revising the Updated Multidisciplinary Approach to the Diagnosis of Idiopathic Pulmonary Fibrosis According to Fleischner White Paper: Case-Based Approach

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TEACHING POINTS
1. To know the multidisciplinary assessment of patients with suspected usual interstitial pneumonia. 2. To describe the updated diagnostic categories of UIP based on CT patterns. 3. To explain the role of the working multidisciplinary diagnosis of IPF in different clinical scenarios.

TABLE OF CONTENTS/OUTLINE
1. Introduction. 2. Review of the major recent changes in the diagnosis approach of IPF. a. Clinical assessments to exclude other forms of ILD. b. CT features for making a diagnosis of UIP. Diagnostic criteria of UIP: i. Typical UIP CT pattern. ii. Probable UIP CT pattern. iii. CT pattern indeterminate for UIP. iv. CT features most consistent with non-IPF diagnosis. 3. Indications of biopsy: surgical or transbronchial cryobiopsy. a. Histopathological criteria for UIP in IPF (UIP-IPF). 4. Case-based approach illustrating the working multidisciplinary diagnosis in different clinical and radiological scenarios. 5. Conclusions.
Thoracic Involvement in Collagen Vascular Disorders: A Pictorial Essay

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TEACHING POINTS
To review and illustrate general patterns of chest involvement in collagen vascular disorders. To review and illustrate imaging hallmarks related to specific diseases, from the commonest features to the rare variations. To manage a rational diagnostic approach based on imaging findings and clinical correlation. To recognize superimposed or mimicker conditions such as infection, drug toxicity and occupational exposure.

TABLE OF CONTENTS/OUTLINE
A variety of collagen vascular disorders such as systemic lupus erythematosus, rheumatoid arthritis, systemic sclerosis, dermatopolymyositis and Sjogren syndrome frequently affect thoracic structures, which is an important cause of mortality in this group. Imaging patterns of lung parenchyma involvement, as well as mediastinal findings, may have great diagnostic value, especially when clinical setting is challenging due to concomitant conditions such as infection, drug toxicity or occupational exposure. Besides, some findings such as honeycombing and pulmonary trunk enlargement work as biomarkers for worse prognosis.
Diagnosis of Hypersensitivity Pneumonitis: Where Do We Stand Currently and Future Directions?

All Day Room: NA Digital Education Exhibit

**Awards**

**Certificate of Merit**

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**TEACHING POINTS**

To review the concept and shortcomings of the current classification of Hypersensitivity pneumonitis (HP) To review a cluster-based classification of HP into active and chronic notwithstanding that some overlap exists between the two To illustrate the HRCT findings of non-fibrotic (inflammatory) and fibrotic HP with typical and atypical findings To highlight the importance of multidisciplinary discussion in diagnosing HP with correlation of imaging, histo-pathological, clinical and pertinent laboratory findings

**TABLE OF CONTENTS/OUTLINE**

Background of HP Pathophysiology and causes with illustrations Current and proposed classification of HP based on scientific evidence Tabulation of imaging and pathology differences between fibrotic and non-fibrotic HP with illustrations of imaging findings Complications of HP with illustrative examples Flow chart showing a diagnostic algorithm in a multidisciplinary setting for diagnosis of HP with varying degree of confidence
Pulmonary calcifications can occur in a wide number of conditions, both common and rare, such as manifestations of previous infectious processes, neoplasms, metabolic disorders, occupational disorders or interstitial lung diseases. Pathophysiologic states predisposing to pulmonary calcification and ossification include hypercalcemia, a local alkaline environment, enhanced alkaline phosphatase activity, active angiogenesis and mitogenic effects of growth factors. We have two different types of lung calcifications based on the mechanism that determines them, dystrophic and metastatic calcifications. The metastatic calcifications are further divided into benign and malignant causes.

TABLE OF CONTENTS/OUTLINE

CT is indicated when radiographic findings are equivocal or for the detection of small calcifications. Many diseases demonstrate typical HRCT features. Varicella pneumonia (chickenpox) is characterized by tiny, widespread, micronodular calcifications through both lungs. Metastatic pulmonary calcification most commonly seen in chronic renal failure. Metastatic pulmonary calcification can manifest by diffuse calcium deposition in the lung.
ED020

CME Learning Checkpoint Exhibit ED020 (CT-Guided Fiducial Placement for Preoperative Localization of Small Pulmonary Nodules: How We Do It)

All Day Room: CME Learning Checkpoint Community

AMA PRA Category 1 Credit™: .50

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DESCRIPTION
Earn .50 AMA PRA Category Credit™ for each completed CME Learning Checkpoint quiz. To participate: 1. Study the hard copy poster on display in the Learning Center. 2. Scan the corresponding QR code using your mobile device to launch the quiz app. 3. Answer all five questions. 4. Claim CME credit via My Agenda on Meeting Central (Meeting.RSNA.org). You can log back in at any time until 12:30 PM, Friday, November 30, to finish the quiz. Need a QR code reader? There’s one in the RSNA 2018 app.
ED003-SU

Chest Sunday Case of the Day

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

AMA PRA Category 1 Credit ™: .50

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TEACHING POINTS
1) To analyze interesting chest cases. 2) To understand appropriate differential diagnosis. 3) To understand the clinical significance of the diagnosis presented.
SSA05
Chest (Emphysema/COPD)
Sunday, Nov. 25 10:45AM - 10:55AM Room: E451A

Participants
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Sub-Events
SSA05-01 High-Resolution Chest CT Imaging of the Lung: Impact of High Matrix Reconstruction and Photon-Counting-Detector CT
Sunday, Nov. 25 10:45AM - 10:55AM Room: E451A

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PURPOSE
To evaluate the impact of 1024 matrix size and photon-counting-detectors (PCDs) relative to 512 matrix size and energy-integrating-detectors (EIDs) for chest CT.

METHOD AND MATERIALS
22 adult patients undergoing clinically indicated chest CT received dose-matched PCD CT after written informed consent. 1.5 mm images were reconstructed at a 1 mm overlap with our routine clinical kernel (B46) at both 512 and 1024 matrix sizes for EID scans. For PCD, B46 and an additional sharp kernel (Q65, not available for EID) was reconstructed at a 1024 matrix. Two chest radiologists compared only the right lung of B46/EID/1024; B46/PCD/1024 and Q65/PCD/1024 images in a side-by-side fashion to the routine clinical B46/EID/512 images, noting the highest level bronchus clearly identified in each lobe. The 3rd and 4th order bronchi were specifically evaluated and any lung nodules were compared to the B46/EID/512 images using a 5 point Likert scale (+2 = improved detection confidence, +1=preferred but no confidence change, 0 = similar, -1=worse but no confidence change, -2=worse with decreased confidence). Statistical analysis was performed using a Wilcoxon signed rank test with a p <0.05 considered significant.

RESULTS
Compared to B46/EID/512, readers detected higher order bronchi using Q65/PCD/1024 images for every lung lobe (p<0.002). For B46/EID/1024 reconstruction, higher order bronchi were only significantly better seen in the right middle lobe (p=0.007). Readers were able to better identify bronchial walls of the 3rd and 4th order bronchi better using Q65/PCD/1024 (mean Likert-scores of 1.1 and 1.5), which was significantly higher compared to B46/EID/1024 or B46/PCD/1024 (mean difference 0.8; p<0.0001). Of 49 non-calcified pulmonary nodules (8 part solid, 41 solid), Q65/PCD/1024 had a slightly but significantly higher mean visualization score of 0.8 compared to 0 for B46/EID/1024 and 0.2 for B46/PCD/1024 (p<0.0002).

CONCLUSION
Lung PCD-CT with 1024 matrix using a sharp Q65 kernel increase visualization of higher order bronchi and bronchial walls without compromising nodule detection. Softer kernels and further work are needed to examine the internal density characteristics of nodules at PCD-CT.

CLINICAL RELEVANCE/APPLICATION
PCD-CT with 1024 matrix improves visualization of medium and small bronchi compared to current routine chest CT, creating an opportunity for radiologists to better characterize lung pathology.
SSA05-02  Normalized Emphysema Score Progression: An Improved CT Biomarker for Mortality

Sunday, Nov. 25 10:55AM - 11:05AM Room: E451A

Participants
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PURPOSE
Normalized emphysema score (normES) is a protocol-robust and validated CT biomarker for mortality. We aimed to improve mortality prediction by modelling its change over time.

METHOD AND MATERIALS
CT scans from all 1810 deceased participants from the National Lung Screening Trial were selected. Of these, 445 died from lung cancer. A random selection of 4190 surviving participants were sampled with replacement up to 24432 to approximate the full cohort. The normES was obtained by computing the emphysema scores after resampling, normalization, and bullae cluster analysis. The reference models contained solely the baseline (T0) normES. To investigate if progression of emphysema provides additional information, normES from the first (T1) and second annual screening rounds (T2) and normES progression (normESprog) were added to the base model. normESprog was calculated by subtracting the T0 log(normES) from the T1 or T2 log(normES) and dividing by the time in between. Proportional hazard models predicting all-cause and lung cancer mortality were compared by calculating the continuous net reclassification improvement (NRI) for each year of follow-up.

RESULTS
The analysis of T0 and T1 data was performed on 22695 samples; 3547 lacked T0 or T1 scans, or had corrupted data. NRI improvement for all-cause and lung cancer mortality prediction compared to the base models were 4.5% (95%CI: -7.3 to 8.4%) and 4.1% (95%CI: -9.3 to 14.6%) 3 years after baseline, 6.1% (95%CI: -5.3 to 9.4%) and 0.1% (95%CI: -7.1 to 12.2%) after 5 years, and 6.1% (95%CI: -6.2 to 8.7%) and -0.4% (95%CI: -5.6 to 11.3%) after 7 years, respectively. When modelling the T0 to T2 interval, another 2603 samples were excluded. For all-cause mortality, the 3, 5, and 7 year time points showed respective NRI improvements of -0.5% (95%CI: -6.7 to 8.0%), 10.8% (95%CI: 5.5% to 17.2%), and 12.2% (95%CI: 7.1% to 15.6%). Improvements in lung cancer mortality prediction were -6.1% (95%CI: -24.0 to 12.6%), 19.6% (95%CI: 10.6 to 29.2%), and 24.1% (95%CI: 15.4% to 31.7%), respectively. All hazard models had a logrank test p<.001.

CONCLUSION
Two normES measurements are better than one at predicting mortality over longer periods of time. The time between normES measurements should be sufficiently distant to account for the slow progression of emphysema.

CLINICAL RELEVANCE/APPLICATION
Normalized emphysema score progression is an automatic emphysema quantification method which can better predict the long-term mortality than a single baseline measurement.

SSA05-03  Comparison of Two Independent Visual Assessment Protocols for the Detection of Emphysema in the National Lung Screening Trial Cohort

Sunday, Nov. 25 11:05AM - 11:15AM Room: E451A

Participants
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PURPOSE
To investigate the variability in assessing the presence of emphysema in a lung cancer screening population using low-dose CT scans and compare this to rates of spirometry-detected airflow obstruction.

METHOD AND MATERIALS
Baseline low-dose CT scans from 6,352 NLST participants enrolled in the CT arm who also underwent spirometry were evaluated. Emphysema was visually assessed in NLST as present or absent. In our study, two readers visually assessed CT scans using a modified NETT protocol that divided the lung into upper, middle, and basal zones and graded emphysema as none (0%), trace (1-25%), mild (25-50%), moderate (50-75%), or severe (75%). In this protocol, a subject was scored as positive if any region was scored trace or greater. Results were compared to emphysema and spirometry data from the Pittsburgh Lung Screening Study (PLuSS).
RESULTS
Among the 6,352 subjects, emphysema was identified in 55.4% (3518/6352) of subjects in NLST and 40.4% (2566/6352) of subjects using our protocol (agreement Kappa=0.4990). Emphysema severity in the current study was reported as none, trace, mild, moderate, and severe in 59.6%, 27.4%, 7.0%, 4.1%, and 1.9% of the subjects, respectively. Inter-reader agreement for the presence of emphysema between the two readers in our study in 200 CT scans was moderate to substantial (K=0.6073). Using the McNemar test statistic, there was a statistically significant difference between our visual assessment of emphysema and the NLST assessment of emphysema (p < 0.001). Spirometry-detected airflow obstruction was reported in 32.0% of the NLST subjects. In PluSS (n=3638), emphysema and airflow obstruction were identified in 42.5% and 42.7% of the subjects, respectively.

CONCLUSION
Our study revealed a significant disagreement in emphysema assessment between two independent visual interpretations of low-dose CT scans. The discrepancy between emphysema and airflow obstruction (55.4% versus 32.0%) in the NLST-ACRIN subcohort appears to be from overestimation of emphysema. Our visual emphysema assessment of NLST CT scans is more consistent with rates of spirometry-detected airflow obstruction and with previously published rates of emphysema in lung cancer screening populations.

CLINICAL RELEVANCE/APPLICATION
Since emphysema is recognized as a significant risk factor for lung cancer, our study demonstrates the need to standardize and improve emphysema assessment in low-dose lung cancer screening CT scans.

SSA05-04 Visual Presence of Emphysema Predicts Progression of Emphysema and Air Trapping in Cigarette Smokers

Sunday, Nov. 25 11:15AM - 11:25AM Room: E451A

Participants
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PURPOSE
Visual categorization of emphysema on CT has been shown to correlate with symptomatic impairment and with mortality. However, the relationship between presence of emphysema and subsequent progression of disease has not previously been evaluated.

METHOD AND MATERIALS
We studied 4126 subjects enrolled in the COPDGene study, who had visual CT scores at baseline, and quantitative inspiratory and expiratory CT at baseline and at 5 years. Trained research analysts performed visual classification of parenchymal emphysema on baseline volumetric CT scans of these subjects using the Fleischner Society classification system. Each scan was independently evaluated by two analysts; discordances between analysts were adjudicated by a thoracic radiologist. Statistical analysis used a linear mixed model, adjusted for age, height, gender, race, smoking status, scanner make, and reconstruction algorithm, with dependent variables being inspiratory lung density at 15th percentile (adjusted for lung volume) as a measure of emphysema, and % of lung voxels < -856 HU on expiratory CT (LAA-856) as a measure of air trapping. Analysis was stratified by presence or absence of COPD at baseline.

RESULTS
In subjects with COPD, those with parenchymal emphysema at baseline showed a lung density decline of 4.7 g/l (95% CI 3.9, 5.4, p<0.0001), compared with 1.4 g/l (0.5, 2.4, p=0.003) for those without emphysema. For subjects without COPD, corresponding values were 4.0 (3.2, 4.9, p=0.0001) and 0.8 (0.25, 1.4, p=0.005). In subjects with COPD, those with baseline emphysema showed increase of 3.8% (2.9, 4.6, p<0.0001) in LAA-856, compared with 0.5% (-0.6, 1.5, n.s.) for those without. For subjects without COPD, those with emphysema had an increase in LAA-856 of 1.7% (1.1, 2.4, p<0.0001), while those without emphysema had a slight decrease of 0.5% (0.1, 0.9, p=0.01).

CONCLUSION
The presence of parenchymal emphysema at baseline is associated with a higher rate of progression in emphysema and air trapping at 5 year follow-up, in cigarette smoking subjects with and without COPD.

CLINICAL RELEVANCE/APPLICATION
The presence of visible emphysema on CT in cigarette smokers is an important predictor of subsequent progression.

SSA05-05 3D Oxygen-Enhanced MRI at 3T System versus Thin-Section CT: Quantitative Capability for Pulmonary Functional Loss Assessment and Clinical Stage Classification in Smokers

Sunday, Nov. 25 11:25AM - 11:35AM Room: E451A

Participants
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RESULTS
evaluate the performance. The area under the receiver operating characteristic curve (AUC) was used to
tried to affect the upper lobes more than the lower lobes, and 3) using only the bottom 50% of the lung as a control. Deep
mild, moderate, or severe. To evaluate the effect of potential labeling error caused by per case rating system, three different
The dataset consists of 860 cases of LDCT scans from a lung screening program. Emphysema was identified on each scan as none,
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PURPOSE
To prospectively and directly compare the quantitative capability for pulmonary functional loss assessment and clinical stage
classification between 3D oxygen-enhanced MR imaging (O2-enhanced MRI) and thin-section CT in smokers.
METHOD AND MATERIALS
Twenty consecutive smokers (12 men and 8 women; age range 56-85 years) underwent 3D O2-enhanced MRI, thin-section CT and
pulmonary function test (FEV1/FVC%, %FEVI1% and %DLCO/VA). All smokers were classified into four stages ('Without COPD', 'Mild
COPD', 'Moderate COPD', 'Severe or very severe COPD') according to the GOLD guideline. For 3D O2-enhanced MRI in each smoker,
3D Fast Field Echo sequence with variable flip angles was performed with and without 100% oxygen inhalation at a 3T MR system. 

RESULTS
ΔT1 and LAA% were significantly correlated with FEV1/FVC% (ΔT1: r=-0.70, p=0.0006; LAA%; r=-0.75, p=0.0002), %FEV1 (ΔT1: 
r=-0.84, p<0.0001; LAA%; r=-0.67, p=0.0013) and %DLCO/VA (ΔT1: r=-0.69, p=0.0009; LAA%; r=-0.63, p=0.0029). ΔT1 had
significant difference between 'Severe or very severe COPD' group and others (p<0.05), although LAA% had significant difference
between 'Severe or very severe COPD' and 'Without COPD' (p<0.05) or 'Mild COPD' (p<0.05) groups. Discrimination accuracies of
ΔT1 (73.7 [14/19] %) was significantly higher than that of LAA% (42.1 [8/19] %, p=0.03).
CONCLUSION
3D O2-enhanced MRI has a better capability for pulmonary functional loss assessment and clinical stage classification in smokers
than quantitative CT.

CLINICAL RELEVANCE/APPLICATION
3D O2-enhanced MRI has a better capability for pulmonary functional loss assessment and clinical stage classification in smokers
than quantitative CT.
Per slice prediction for the entire lung region, the top 50%, and the bottom 50% produced an AUC of 0.76 (SE: 0.01), 0.77 (0.01), and 0.74 (0.01), respectively. Per case prediction produced an AUC of 0.84 (0.03), 0.83 (0.03), and 0.80 (0.03). The higher AUCs for per case prediction demonstrates that aggregating the predictions on slices help reduce the effect of labeling errors. The AUCs for the bottom 50% are lower, but still on par, which is likely due to the fact emphysema does not completely spare the bottom lobes.

CONCLUSION
We have demonstrated the potential of transfer learning to predict the presence of emphysema on LDCT scans. Fine-tuning work is currently on-going, and given the high performance already achieved with transfer learning, fine-tuning is likely to achieve even higher performance.

CLINICAL RELEVANCE/APPLICATION
LDCT provides an opportunity to identify other pathologies that may otherwise go undiagnosed. Having a suite of algorithms that automatically searches for multiple incidental findings has the potential to increase efficiency and prevent missing important findings.

A Convolutional Neural Network Approach to Imaging-Based Pulmonary Measurements in COPD Patients
Sunday, Nov. 25 12:05PM - 12:15PM Room: E451A

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Awards
Student Travel Stipend Award
PURPOSE

Chronic obstructive pulmonary disease (COPD) affects over 16 million Americans and 251 million people worldwide. Multiple patterns of pathology exist, and imaging measurements are increasingly important for identifying COPD subtypes and prognosis. We hypothesized that a convolutional neural network (CNN) could predict volumetric measurements relating to pulmonary function, based on a subset of chest CT images.

METHOD AND MATERIALS

With HIPAA compliance and IRB approval, we retrospectively identified inspiratory CT scans for 160 COPD patients from our institution enrolled in the COPDGene multicenter study. We used a CNN based on VGG19 to develop regression-based inference predictions of total lung capacity (TLC), functional residual capacity (FRC), and percentage of emphysema. Measurement of these parameters was obtained previously as part of the larger COPDGene dataset, and has been discussed by other groups. A subset of 10 equally spaced axial chest images were selected from the full chest CT and used to train the network, with assessment by five fold cross validation. Correlations between CNN and ground truth are given as R2, and bias was assessed with Bland-Altman plot analysis.

RESULTS

CNN predicted measurements of TLC were correlated with those from the COPDGene dataset with an R2 value of 0.86 (slope 1.10), and mean difference of 0.14L ± 0.57L. FRC was correlated with an R2 value of 0.84 (slope 1.26), and mean difference of -0.06L ± 0.56L. Percent emphysema was correlated at an R2 value of 0.82 (slope 1.04), and mean difference of 0.15% ± 3.34%.

CONCLUSION

Here we show the ability of a CNN to produce well correlated predictions of pulmonary volume measurements, inferred from a subset of chest CT images. Refinement of this CNN can expand it to additional structures or volumes, and may allow automation of quantitative pulmonary function measurements and volumes to streamline disease monitoring.

CLINICAL RELEVANCE/APPLICATION

We present a convolutional neural network capable of making well-correlated, inference-based, predictions of pulmonary volume measurements in COPD patients, based on a subset of 10 chest CT slices.
**Association Between Asynchrony and Stenoses in Apparently Normal Coronary Arteries**

**Participants**
- Ukihide Tateishi, MD, PhD, Tokyo, Japan (Moderator) Nothing to Disclose
- Phillip J. Koo, MD, Phoenix, AZ (Moderator) Advisory Board, Bayer AG; Advisory Board, Johnson & Johnson; ; ; ;

**Sub-Events**

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

**Participants**
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**PURPOSE**

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

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

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

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- Ritu Verma, New Delhi, India (Presenter) Nothing to Disclose
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PURPOSE
To evaluate the therapeutic benefit with revascularization and optimal medical treatment (OMT) in patients diagnosed with hibernating myocardium on myocardial perfusion imaging (MPI) using F-18 FDG cardiac PET

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**SSA16-05** Provider Utilization Trends for Elective Myocardial Perfusion Imaging

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

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

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

**RESULTS**
Elective standard (STD) MPI (both planar imaging and SPECT) utilization peaked in 2006 at 74 studies per 1,000 beneficiaries and then progressively decreased to 45 by 2016 (-36%). In 2004, cardiologists’ share of elective STD MPI had been 79%, and this steadily increased in subsequent years to 87% in 2016. Cardiologists perform elective STD MPI mostly in private offices where
utilization peaked in 2008 at 50 studies per 1,000 and then declined to 22 in 2016 (-56%). In HOPDs, utilization by cardiologists has increased over the period of the study from 7 studies to 15 (+120%). Utilization in private offices and HOPDs by radiologists has declined from 13 in 2004 to 6 in 2016 (-58%). Elective PET MPI, less frequently used at 3 studies per 1,000 in 2016, maintained an overall net upward trend since 2005, and most of this growth reflected increasing use by cardiologists (90% share in 2016).

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

CLINICAL RELEVANCE/APPLICATION
Cardiologists maintain an increasing share in utilization of elective standard and PET MPI.

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

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

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

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

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

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

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

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

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

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PURPOSE
The diagnosis of medium to large-vessel vasculitis and the assessment of its activity and extent remain challenging. We assess the clinical utility of FDG PET CT in patients with suspected medium and large vessel vasculitis to evaluate the pattern and extent of vessel involvement.
Rheumatoid arthritis (RA) has long been associated with increased risk for atherosclerosis. 18F-sodium fluoride (NaF) is a PET tracer that detects calcium deposition in the early stages of atherosclerotic plaque formation. We aimed to assess whether NaF-PET/CT can sensitively discriminate aorta calcification between RA patients and normal subjects.

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
Pegah Jahangiri, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
PURPOSE
The purpose of this study was to determine the relationship between the degree of pulmonary parenchymal inflammation measured from FDG-PET/CT with the degree of emphysema and also with PFT indices in chronic obstructive pulmonary disease (COPD) patients based on image segmentation and partial volume correction.

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

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

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

CLINICAL RELEVANCE/APPLICATION
Measurement of pulmonary FDG uptake on PET/CT may therefore be useful in the diagnostic and response assessment of patients with COPD.
RCC11

Case Review: Lung-RADS - Bring Your Own Device (Hands-on)

Sunday, Nov. 25 11:00AM - 12:30PM Room: S402AB

CH 01

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

Participants

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LEARNING OBJECTIVES

1) Describe patient risk factors for lung cancer and current requirements for patients to be eligible for lung cancer screening based on the coverage decision outlined by the Centers for Medicare and Medicaid Services. 2) Explain the rational for each category used in Lung-RADS. 3) Apply Lung-RADS to case examples and recommend appropriate follow up.

ABSTRACT

Participants will review cases on their own devices and answer questions. The cases will then be reviewed by the presenters. Note: this activity is best done on a laptop or tablet. Although phones will work, their small size limits optimal image view. Lung-RADS was established in 2014 as a means to standardized reporting and management in high-risk patients undergoing screening for lung cancer with low dose CT. This workshop will begin with an approximately 20 minute review of the National Lung Screening Trial (NLST) and other supporting evidence for the efficacy of screening, recommendations for screening as per the U.S. Preventative Services Task Force and the coverage decision by the Centers for Medicare and Medicaid Services. Additionally, concepts regarding the structure and rational for Lung-RADS will be highlighted. After a didactic portion, participants will review cases independently on their own devices. Faculty support will be available throughout the room to answer individual questions. Following this, cases will be reviewed by the presenters in order to highlight key concepts in the use of Lung-RADS. This session will focus on the application of Lung-RADS including: recognizing important imaging features and applying findings to assign the correct Lung-RADS category. Attendees will be given tips and tools to help with use of Lung-RADS and requirements for establishments of a lung cancer screening program.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Ella A. Kazerooni, MD - 2014 Honored Educator
**PURPOSE**
Quantitative CT analysis of COPD patients has an important role in the classification of the subtype of COPD, assessing the disease severity and longitudinal changes, and therapeutic responses. Especially, airway analysis is essential for patients with small airway diseases; however, it is predisposed to the effect of image quality including special resolution and noise, and intra- and inter-observer variability. Ultra high-resolution CT (UHRC) with a small detector size of 0.25mm in 3-dimension has recently developed, and is available for a clinical use. Thus, the purpose of our study was to evaluate the utility of UHRC in the quantitative evaluation of simulated chronic obstructive pulmonary disease (COPD) lesions using a phantom.

**METHOD AND MATERIALS**
CT images of a COPD-simulated phantom (COPD Gene 2 Phantom) were obtained by a 320-detector raw CT using 3 types of detector size (normal, NR, 0.5 x 0.5 x 0.5mm; high-resolution, HR, 0.25 x 0.25 x 0.5mm; super-high-resolution, SHR, 0.25 x 0.25 x 0.25mm). One emphysema lesion (CT value, -935HU) and 8 types of non-emphysematous lesions (bronchial wall, 0.4-1.5mm) were analyzed using a commercially available workstation. We compared relative errors of wall thickness (WT) and wall area percent (WA%) among three modes (NR, HR, and SHR) using a multi-group comparison. A corrected P-value (0.167) was considered as statistically significant.

**RESULTS**
There was no significant difference in the measurement of CT value among three modes. Relative error in the measurement of WT (1.82 - 40.0%) and WA% (0.21 - 23.9%) at SHR were significantly smaller than those at NR (WT, 6.53 - 150%; WA%, 0.79 - 67.6%). There was significantly smaller in relative errors in the measurement of WT and WA% at SHR (3-7%, 6-9%) compared with those of HR (5-15.8%, 6-14.2%) in only diagonally-arranged bronchus.

**CONCLUSION**
UHRC seems to increase the accuracy in the quantitative airway wall analysis for non-emphysematous COPD lesions, especially in diagonally-running bronchus.

**CLINICAL RELEVANCE/APPLICATION**
Accurate airway wall analysis using UHRC might lead to early detection or appropriate management of small airway diseases with accurate grading of disease severity.
PURPOSE

Elucidate the role of the radiologist’s report in planning CT for ENB and highlight the "CT bronchus sign" in predicting positive diagnostic samples.

METHOD AND MATERIALS

Retrospective analysis of 100 patients who underwent non-contrast CT prior to ENB over a 2 year period at a large tertiary centre for thoracic surgery. Data was acquired pertaining to site and appearance of the pulmonary lesion(s) of concern, presence/absence of an adjacent airway (CT bronchus sign), proximity to the nearest airway of those lesions without an adjacent bronchus and any change in size of the lesion(s) compared with the most recent cross sectional imaging. We assessed the adequacy of the histological sample and the rate of post-procedural chest radiography and complications.

RESULTS

100 patients who underwent planning CT studies for ENB were identified (46 male; 54 female; mean age 67.7; range 34 - 86). Of 104 target lesions (mean size 2.7 cm; range 0.6 - 10.7 cm) the CT bronchus sign was positive in 82.7 %. Lesions without an adjacent airway were on average 13 mm from the adjacent airway (range 6 mm - 23 mm). 80.0 % of lesions were solid, the remainder subsolid, cavitating or atelectatic lobe. Compared with the most recent previous CT 4.8 % of lesions had decreased in size. In one case the lesion had resolved. 98 % of patients underwent ENB without additional intra-procedural imaging. 88 tissue and cytological samples were obtained, of which 88.6 % were diagnostically adequate. 44.9% had malignant histology, with 51.3 % benign and 3.8 % indeterminate. 93.3 % of lesions with a positive CT bronchus sign resulted in a diagnostically adequate sample, compared with 61.5 % of lesions without an adjacent airway. 97.0 % of patients had a post-procedural chest radiograph. Post-procedural pneumothoraces occurred in 8.4 %.

CONCLUSION

ENB is an emerging diagnostic tool with the potential to sample peripheral lesions with increased accuracy and lower complication rate. Our institutional experience is that 93.3 % of lesions with a positive ‘CT bronchus sign’ resulted in diagnostic samples. The role of the radiologist in aiding the pre-procedural work up is in identifying the ‘CT bronchus sign’ as well as any significant change in the lesion that might alter management.

CLINICAL RELEVANCE/APPLICATION

This review provides the radiologist with a toolkit for reporting pre-procedural CT for ENB to aid the bronchoscopist in acquiring a positive diagnosis.

EGFR Exon19 and Exon21 Mutations Prediction by CT-Based Radiomics Features in Lung Adenocarcinom

PURPOSE

In this study, we try to identify a set of computed tomography(CT)-based radiomic features to predict epidermal growth factor receptor(EGFR) mutation status between EGFR exon 19 deletion(Ex19) and EGFR exon 21 L858R mutation (Ex21) in an Asian cohort of patients with lung adenocarcinoma.

METHOD AND MATERIALS

This study investigated 130 patients with lung adenocarcinoma harboring Ex19 (n=56) and Ex21 (n=74). Total of 2300 radiomic features are extracted from original and filtered (Exponential, Laplacian of Gaussia, Logarithm, Gabor, Wavelet) 1.5mm CT images with annotation by two radiologists and one oncologist. These features are divided into four classes, including histogram, volumetric, morphologic, texture features. To identify the set of features which gives the best prediction on EGFR mutation status out of 2300 features, we used Random Forest (RF) algorithm to extract the importance of features and run backward elimination feature selection on the ordered feature list based on the importance. To generalize the result, ensemble technique is used to identify the final feature set. The capability to classify Ex19 and Ex21 of the selected feature set is evaluated by Lasso, Ridge, RF, SVC and KNN models.

RESULTS

Seven features are selected as the set to predict EGFR mutation. It has reached best classification result (AUC 0.743±0.061) on KNN model and reached results of AUC 0.715, 0.736, 0.710 respectively from Lasso, Random Forest, Ridge, SVC models with standard deviation 0.121, 0.061, 0.091, 0.110.

CONCLUSION

We selected a set of radiomics features to predict EGFR mutation type. All of the features are from Wavelet and Gabor filtered image. It has shown the potential connection between EGFR mutation type and high-order deep features in CT image.
**CH2250-SD-SUA4**

Using Deep Learning to Predict Emphysema in Early Lung Cancer Screening Low-Dose CT Scan

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**PURPOSE**

The patients who are recommended for annual lung cancer screening are at a higher risk for other cardiopulmonary diseases. Therefore, it would be beneficial to use the low-dose CT scans (LDCT) to identify other conditions. This work aims to demonstrate the feasibility of using deep learning method to predict findings, specifically emphysema.

**METHOD AND MATERIALS**

The dataset consists of 860 cases of LDCT scans from a lung screening program. Emphysema was identified on each scan as none, mild, moderate, or severe. To evaluate the effect of potential labeling error caused by per case rating system, three different approaches were taken: 1) using the entire lung region, 2) using only the top 50% of the lung since emphysema due to smoking tends to affect the upper lobes more than the lower lobes, and 3) using only the bottom 50% of the lung as a control. Deep learning consisted of feature extraction using a pre-trained VGG-19 network followed by a support vector machine binary classifier that predicted the presence of emphysema (none vs. moderate and severe). The predictions were first performed on a per slice basis and averaged to acquire per case prediction. The area under the receiver operating characteristic curve (AUC) was used to evaluate the performance.

**RESULTS**

Per slice prediction for the entire lung region, the top 50%, and the bottom 50% produced an AUC of 0.76 (SE: 0.01), 0.77 (0.01), and 0.74 (0.01), respectively. Per case prediction produced an AUC of 0.84 (0.03), 0.83 (0.03), and 0.80 (0.03). The higher AUCs for per case prediction demonstrates that aggregating the predictions on slices help reduce the effect of labeling errors. The AUCs for the bottom 50% are lower, but still on par, which is likely due to the fact emphysema does not completely spare the bottom lobes.

**CONCLUSION**

We have demonstrated the potential of transfer learning to predict the presence of emphysema on LDCT scans. Fine-tuning work is currently on-going, and given the high performance already achieved with transfer learning, fine-tuning is likely to achieve even higher performance.

**CLINICAL RELEVANCE/APPLICATION**

LDCT provides an opportunity to identify other pathologies that may otherwise go undiagnosed. Having a suite of algorithms that automatically searches for multiple incidental findings has the potential to increase efficiency and prevent missing important findings.

**CH237-ED-SUA5**

Tracheal Abnormalities on CT: A Pictorial Review

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- Fernando R. Gutierrez, MD, Saint Louis, MO (Abstract Co-Author) Spouse, Stockholder, UnitedHealth Group
- Sanjeev Bhatta, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
- Santiago E. Rossi, MD, Buenos Aires City, Argentina (Abstract Co-Author) Advisory Board, Boehringer Ingelheim GmbH; Speaker, Boehringer Ingelheim GmbH; Royalties, Springer Nature

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**TEACHING POINTS**

- To recognize the different types of congenital and acquired tracheal abnormalities, their clinical characteristics and epidemiology.
- Describe the imaging findings associated with the different tracheal abnormalities.
- Review the key elements in regard to the imaging diagnosis of the individual tracheal abnormalities, the findings on computed tomography and the key element for differential diagnosis
- Propose an approach to the differential diagnosis of the tracheal abnormalities

**TABLE OF CONTENTS/OUTLINE**

Introduction
General aspects of the tracheal abnormalities
Shared clinical and imaging characteristics
Individual approach to the tracheal abnormalities
- Increased diameter:
  - Mounier Kuhn Syndrome
  - Tracheal diverticulum
- Decreased diameter:
  - Focal:
  - Granulomatosis with polyangiitis (subglottic)
  - Diffuse:
  - Tracheomalacia
Hybrid (CT and MR) 3D Printing Models in Chest Tumors: How I Do It Step-By-Step

TABLE OF CONTENTS/OUTLINE

During the exhibit, the following learning points will be discussed and illustrated with real cases and pre-surgical models. The initial results of our clinical essay about the application of hybrid 3D printing in lung cancer will also be available: 1. 3D printing: definition and basic concepts 2. Current background in 3D pre-surgical 3D printing in chest neoplasms 3. CT acquisition and post-processing 4. MR acquisition and post-processing 5. Rigid and non-rigid algorithms for hybrid imaging 6. Mesh archive post-processing: Improving the printing 7. Practical cases database with surgical correlation 8. Clinical and surgical potential impact: Our results 9. Conclusion

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Awards

Certificate of Merit

Participants

Jordi Broncano, MD, Cordoba, Spain (Presenter) Nothing to Disclose
Antonio Alvarez-Kindelan, Cordoba, Spain (Abstract Co-Author) Nothing to Disclose
Javier Alarcon Rodriguez, MD, Madrid, Spain (Abstract Co-Author) Nothing to Disclose
Antonio Luna, MD, PhD, Jaen, Spain (Abstract Co-Author) Consultant, Bracco Group; Speaker, General Electric Company; Speaker, Canon Medical Systems Corporation; Royalties, Springer Nature

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TEACHING POINTS

1. To review the principles of 3D printing, technical aspects, materials and printing procedures, segmentation tools and fusion algorithms for 3D segmentation in thoracic neoplasms. 2. To detail, in a case-based approach, the steps necessary to do a pre-surgical 3D printing model combining magnetic resonance and computed tomography datasets. 3. To show our initial clinical results in the application of hybrid 3D printing prospectively for surgical planning of lung cancer and impact on the procedure.

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ECG-Gated Ultra High Resolution CT (UHRCT) in the Lower Lung Field

Station #1

Participants
Hiroshi Moriya, MD, Fukushima, Japan (Presenter) Advisory, Ziosoft Inc; Research Grant, Canon Medical Systems Corporation; Shun Muramatsu, RT, Fukushima, Japan (Abstract Co-Author) Nothing to Disclose

Yuka Nakajou I, Fukushima, Japan (Abstract Co-Author) Nothing to Disclose

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Takashi Tanaka, MENG, Nasushiobara, Japan (Abstract Co-Author) Employee, Canon Medical Systems Corporation

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TEACHING POINTS

Background: Ultra high resolution CT (UHRCT) allows for visualization of fine detail and easier interpretation of routine clinical images. However, motion artifact caused by heartbeat degrades image quality. The purpose of this presentation is to discuss the utility of electrocardiography (ECG)-gated UHRCT for assessing lung CT imaging.

TABLE OF CONTENTS/OUTLINE

Material/Methods: Thirty two cases with abnormal shadow in lower lung field were examined using UHRCT. The scanning parameters were as below. Whole lung UHRCT: SHR mode, helical scan, 0.25mm slice thickness. ECG-gated UHRCT: SHR mode, volume scan (40mm), 0.25mm slice thickness. Motion artifact of target lesion, image noise, and clinical advantages were evaluated. Results: Motion artifacts had occurred in 84% cases of UHRCT. Some artifacts were seen in rt.S3, S5, lt.S3, S4, S5, and S8, and severe artifact were seen in 53% of target lesion. And, 90% of severe artifacts were reduced by ECG gating. However, image noise was increased in ECG-gated UHRCT. Conclusions: ECG-gated CT reduced the motion artifacts and might be useful for UHRCT imaging, especially in region near the heart.

PDF UPLOAD


Superiority of Artificial Intelligence over Radiologists in Detecting Pulmonary Nodules

Station #2

Participants
Maarten A. Van de Weijer, MD, MSc, Alkmaar, Netherlands (Presenter) Nothing to Disclose

Paul R. Algra, MD, PhD, Alkmaar, Netherlands (Abstract Co-Author) Nothing to Disclose

Cornelis F. Van Dijke, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

Edwin J. van Beek, MD, PhD, Edinburgh, United Kingdom (Abstract Co-Author) Research support, Siemens AG; Research support, General Electric Company; Advisory Board, Aidence nv; Advisory Board, ImBio, LLC; Consultant, Holoxica Ltd; Founder, QCTIS UK, Ltd; Director, QCTIS UK, Ltd; Spouse, Director, QCTIS UK, Ltd;...}

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PURPOSE

The aim of this study is to evaluate a new Artificial Intelligence algorithm using different thresholds for detection of lung nodules.

METHOD AND MATERIALS

For the detection of lung nodules we used a new artificial intelligence (AI) derived imaging algorithm (Deep learning VeyeChest version 1.0, Aidence, Amsterdam, NL), using a detection threshold of either 0.35 or 0.80. A total of 106 and 77 CT chest (with/without contrast) were examined. Two thoracic radiologists with more than 20 years' experience independently reported the...
number of nodules, their location and the aspect of each nodule (solid, partly solid or pure ground glass). The reference standard was established by consensus of the two radiologists. In case of discrepancies, a third radiologist re-examined the CT scans and established the 'true' nature of the lesions.

RESULTS
A total of 278 and 211 nodules with a diameter >=3 mm were identified at threshold 0.35 and 0.8 respectively. A total of 246/187 solid, 26/18 partly solid and 6/6 pure ground glass nodules were found at threshold 0.35/0.8 respectively. The sensitivity of the AI algorithm was 0.91/0.75 at detection thresholds 0.35/0.8, respectively, while this was 0.69/0.76 and 0.68/0.77 for the individual radiologists (p<0.01). After review by the third radiologist, 87/50 and 88/48 false negative nodules were found for the two radiologists at detection threshold 0.35 and 0.8, respectively. AI detected 24/52 nodules at threshold 0.35/0.8 that were missed by radiologists. The average number of false positive nodules per scan was 1.45 and 0.52 at the detection threshold 0.35 and 0.8, respectively. Most false positives were due to concomitant findings, such as fibrosis, atelectasis or infection (132 and 27 false positives at detection thresholds 0.35 and 0.8, respectively).

CONCLUSION
The AI system outperformed experienced chest radiologists for the detection of lung nodules and performed equivalent to the radiologists at its highest threshold settings at the costs of a limited number of false positives.

CLINICAL RELEVANCE/APPLICATION
Artificial intelligence is superior in the detection of pulmonary nodules and by embracing artificial intelligence radiologists can become increasingly more accurate in their interpretations.

CH262-SD-SUB3 Validation of IPF Prediction Model Using Quantum Particle Swarm Optimization Hybridized Random Forest

Participants
Yu Shi, Los Angeles, CA (Presenter) Nothing to Disclose
Jonathan G. Goldin, MBChB, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Weng Kee Wong, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Joshua Lai, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Matthew S. Brown, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Hyung J. Kim, PhD, Los Angeles, CA (Abstract Co-Author) Research Consultant, MedQIA Imaging Core Laboratory

PURPOSE
Idiopathic Pulmonary Fibrosis (IPF) is a fatal lung disease with unpredictable progression status at the time of diagnosis. High resolution computed tomography (HRCT) images have shown to be useful for building a predictive model for IPF. Based on a previously proposed methodology using quantum particle swarm optimization (QPSO) for selecting HRCT features, we validate the algorithm with a larger data set of 172 IPF patients.

METHOD AND MATERIALS
We collect anonymized longitudinal serial volumetric HRCT scans from IPF. Radiologists visually contoured regions of interest (ROI) and annotated lung morphology types into progression or non-progression, at the previous visits before the changes occurred. 191 texture features were extracted from the grid sampled voxels of baseline ROIs. Using the QPSO hybridized random forest algorithm, we calibrated the algorithm on a data set of 99 patients (577 ROIs) using 5-fold cross validation and tested the algorithm on a separate test set of 73 patients (414 ROIs).

RESULTS
The algorithm yields a parsimonious model with 23 features (12% features selected) and achieves 70.8% sensitivity, 70.1% specificity and 70.4% accuracy at ROI level on the cross-validation set, and 68.2% sensitivity, 65.4% specificity and 66.6% accuracy on the independent test set. Compared to other state-of-the-art algorithms, our approach selects a smaller feature subset, has higher prediction accuracy and achieves more balanced classification.

CONCLUSION
We validated the previously proposed QPSO hybridized random forest algorithm with a much larger set and showed that the algorithm stably achieves superior prediction performance. This work is also first time showing the possibility to demonstrate the progression by voxel-by-voxel level at a single time-point HRCT scan to predict disease status of future 6 months or 1 year follow-up. The algorithm has great potentials on offering IPF patients timely treatments.

CLINICAL RELEVANCE/APPLICATION
Idiopathic pulmonary fibrosis exhibits a heterogeneous natural history. We build and validate a predictive model to anticipate disease courses and help clinicians make timely decisions.

CH263-SD-SUB4 Detection and Phenotyping of Emphysema Using a New Machine Learning Method

Participants
Martine J. Remy-Jardin, MD, PhD, Lille, France (Presenter) Research Grant, Siemens AG
Rainer Kaergel, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG
Michael Suehling, PhD, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG
Jean-Baptiste Faivre, MD, Lille, France (Abstract Co-Author) Nothing to Disclose
Thomas G. Flohr, PhD, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG
Jacques Remy, MD, Mouvaux, France (Abstract Co-Author) Research Consultant, Siemens AG

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PURPOSE
Emphysema is commonly visually detected but this approach suffers from slight to moderate inter-observer reproducibility that can be compensated by quantitative CT (>6% of pixels of less than -950 HU [LA 950]). Visual assessment remains important to describe the patterns of lung destruction. We describe the development and validation of a novel machine learning method to detect and phenotype emphysema.

**METHOD AND MATERIALS**

We used HRCT scans of 981 patients with ground truth labels established by consensus between two radiologists. In the first step, image features that describe the lung parenchyma, airways and vessels were extracted fully automatically for all scans, including 605 normal and 376 emphysematous. Together with the ground truth labels for the presence of various forms of emphysema (i.e. centrilobular [CLE], paraseptal [PSE], panlobular [PLE]), those features were used as the input of a subsequent machine learning step. For each type of emphysema, this procedure yields a discriminator between “this type is present” and “this type is absent”, thus enabling emphysema phenotyping. K-fold cross-validation of the machine learning step with all patients was used to validate that the system could correctly deduce the different forms of the disease for previously unseen cases. This prediction was compared to the known ground-truth annotations. The results of this comparison were accumulated over all cases to yield the final evaluation results.

**RESULTS**

The system predictions regarding the presence of emphysema for unseen patients were found to be significantly superior to those applying a threshold of 6% to the LA 950 value (p < 0.0001; sensitivity: 0.84 (CI: 0.80-0.87) vs 0.43 (CI: 0.38-0.48)); specificity: 0.84 (CI: 0.81-0.87) vs 0.86 (CI: 0.83-0.88)). The performance of the tested system for emphysema phenotyping was as follows: (a) CLE: se: 0.81 (CI: 0.76-0.85); sp: 0.85 (CI: 0.82-0.88); (b) PSE: se: 0.79 (CI: 0.74-0.84); sp: 0.84 (CI: 0.81-0.86); (c) PLE: se: 0.82 (CI: 0.73-0.91); sp: 0.92 (CI: 0.90-0.94).

**CONCLUSION**

The performance of our method for detecting and phenotyping emphysema is promising.

**CLINICAL RELEVANCE/APPLICATION**

Identification of emphysema and description of the predominant morphologic features are important steps in the personalized approach of COPD patients. The tested method could objectively contribute to this approach.

**Awards**

Certificate of Merit
Identified for RadioGraphics

**Participants**

Kevin R. Kalisz, MD, Cleveland, OH (Presenter) Nothing to Disclose
Nikhil H. Ramaiya, MD, Jamaica Plain, MA (Abstract Co-Author) Nothing to Disclose
Amit Gupta, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is to: - Review the indications and mechanism of action of immune checkpoint inhibitors as well as pathophysiology of lung toxicity - Describe the imaging patterns of immune checkpoint inhibitor-associated pneumonitis and related clinical classification schemes - Understand the management of immune-related adverse events and the role of the radiologist in the treatment course of these complex patients

**TABLE OF CONTENTS/OUTLINE**

1. Introduction
2. Review of commonly used immune checkpoint inhibitors as well as their current indications and mechanisms of action
3. Incidence and pathophysiology of immune checkpoint inhibitor-associated lung injury and adverse reactions
4. Illustration of the basic imaging patterns of immune checkpoint inhibitor-associated pneumonitis with case examples: - Acute interstitial pneumonia (AIP)/acute respiratory distress syndrome (ARDS) - Bronchiolitis - Cryptogenic organizing pneumonia (COP) - Hypersensitivity pneumonitis (HP) - Non-specific interstitial pneumonia (NSIP) - Radiation recall pneumonitis
5. Clinical classification scheme for pulmonary immune-related adverse events
6. Treatment strategies and follow-up for immunotherapy-related pneumonitis with review of 2018 American Society of Clinical Oncology guidelines

**Honored Educators**

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Interventional Oncology Series: Lung, Kidney and Bone

Sunday, Nov. 25 1:30PM - 6:00PM Room: S405AB

Participants
Christos S. Georgiades, MD, PhD, Baltimore, MD (Moderator) Consultant, Galil Medical Ltd
Sean M. Tutton, MD, Milwaukee, WI (Moderator) Medical Director, Benvenue Medical, Inc; Consultant, Benvenue Medical, Inc; Researcher, Siemens AG; Consultant, BTG International Ltd

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LEARNING OBJECTIVES
1) To understand the physics and physiology relevant to the main ablation modalities as applied to different target organs.
2) To become updated on the current evidence for kidney, lung and MSK tumor ablation.
3) To learn how to anticipate and mitigate potential complications related to lung, kidney and MSK ablations.
4) To learn techniques (including tackling challenging cases) that maximize oncologic outcomes.

Sub-Events

VSIO11-01 Keynote and Series Opening: Interventional Oncology-The 4th Pillar of Cancer Care

Sunday, Nov. 25 1:30PM - 1:55PM Room: S405AB

Participants
William S. Rilling, MD, Milwaukee, WI (Presenter) Research support, B. Braun Melsungen AG; Research support, Sirtex Medical Ltd; Research support, Siemens AG; Consultant, B. Braun Melsungen AG; Consultant, Cook Group Incorporated; Consultant, Terumo Corporation; Advisory Board, Terumo Corporation

VSIO11-02 Physics of MW, RF and Cryoablation: Clinically Relevant Parameters

Sunday, Nov. 25 1:55PM - 2:15PM Room: S405AB

Participants
Christos S. Georgiades, MD, PhD, Baltimore, MD (Presenter) Consultant, Galil Medical Ltd

LEARNING OBJECTIVES
1) Comprehend clinically relevant physical parameters of microwave, radiofrequency, and cryoablation technologies. 2) Apply the most appropriate thermal ablative technique for a patient.

VSIO11-03 Lung Cancer Ablation: Techniques to Optimize Outcome and Current Evidence

Sunday, Nov. 25 2:15PM - 2:35PM Room: S405AB

Participants
William H. Moore, MD, Port Washington, NY (Presenter) Consultant, Merck & Co, Inc; Consultant, BTG International Ltd;

LEARNING OBJECTIVES
1) Discuss Ablative Mechanism Understand Patient/Lesion selection Comparison of RFA/MVA/Cryo. 2) Review and describe outcomes including adverse events, local control, and survival abscopal effect.

VSIO11-05 Complications of Lung Ablation and Mitigating Actions

Sunday, Nov. 25 2:45PM - 3:05PM Room: S405AB

Participants
Stephen B. Solomon, MD, New York, NY (Presenter) Research Grant, General Electric Company; Consultant, Johnson & Johnson; Consultant, BTG International Ltd;

LEARNING OBJECTIVES
1) To review the complications associated with lung ablation and offer suggestions and approaches that would mitigate them.

**VSIO11-06 XRT versus Ablation with Curative Intent: Patient Selection and Outcomes**

Sunday, Nov. 25 3:05PM - 3:25PM Room: S405AB

Participants
Kelvin K. Hong, MD, Baltimore, MD (Presenter) Scientific Advisory Board, Boston Scientific Corporation Scientific Advisory Board, BTG International Ltd Research support, Merit Medical Systems, Inc

**LEARNING OBJECTIVES**

1) The current available data will be reviewed and contextualized.

**ABSTRACT**

Patients with early stage, non operable lung cancers suffer from local progression as the primary cause of failure. SBRT and thermal ablation (such as RFA) are promising non operative therapeutic options. At present, there are no randomized comparisons between SBRT or RFA, nor direct clinical comparisons- and no prospective trial is underway. It is difficult for cancer specialists to decide between the two, and it is not definitive which provides superior undisputable outcomes.

**VSIO11-07 Renal Cancer Ablation: Patient, Tumor Selection, Techniques and Current Evidence**

Sunday, Nov. 25 3:25PM - 3:45PM Room: S405AB

Participants
Debra A. Gervais, MD, Boston, MA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review selection criteria for renal tumor ablation cases. 2) To review reported effectiveness of the most common renal tumor ablation modalities and techniques.

**Honored Educators**

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**VSIO11-08 Percutaneous Microwave Ablation versus Laparoscopic Partial Nephrectomy for cT1a Renal Cell Carcinoma: A 12-Year Inception Cohort Study with 1955 Patients**

Sunday, Nov. 25 3:45PM - 3:55PM Room: S405AB

Participants
Jie Yu, Beijing, China (Presenter) Nothing to Disclose
Ping Liang, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xiaoling Yu, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhiheng Cheng, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhiyu Han, Beijing, China (Abstract Co-Author) Nothing to Disclose
Fangli Liu, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**

While partial nephrectomy (PN) is considered the standard approach for cT1a renal cell carcinoma (RCC). Objective of the study is to compare outcomes between percutaneous MWA (PMWA) and laparoscopic PN (LPN) for cT1a RCC.

**METHOD AND MATERIALS**

We performed a prospective study of patients who underwent either PMWA or LPN for cT1a RCC (<=4cm) between April 2006 and November 2017. To reduce the inherent biases of the study, PMWA and LPN groups were matched on the basis of key variables: tumor size and number, Charlson comorbidity index (CCI), age, pathology, preoperative serum creatinine, preoperative estimated glomerular filtration rate (C) and gender. The matching algorithm was 1:1 genetic matching with no replacement. The risk of having a post-treatment complication and percent drop in eGFR, as well as the risks of local tumor progression (LTP), distant metastasis, and cancer-specific mortality, were compared between groups using logistic, linear, and Fine-and-Gray competing risk regression models.

**RESULTS**

The cohort included 1955 patients (PMWA: 185; LPN: 1770) with a median follow-up of 40.6 mo (interquartile range 25.1, 63.4). After matching, there was no significant difference between the PMWA and LPN groups for tumor size (2.3 vs 2.3 cm; p = 0.86), age (63.2 vs 60.4 yr; p = 0.07), tumor location (p = 0.68) and pathology classification (p = 1.0). But PMWA group had higher CCI (4 vs 1; p<0.001), preoperative creatinine (84.4 vs 74.2 mg/dl; p<0.001) and preoperative eGFR (119.5 vs 106.8 ml/min/1.73m2; p = 0.002). There were significant differences between PMWA and LPN in percentage drop in eGFR at discharge (mean: 6% vs 17.9%; p = 0.002) and major complication (mean: 2.2% vs 4.9%; p = 0.16). Likewise, no significant differences were noted in LTP (3.2% vs 0.5%; p = 0.06), distant metastases (4.3% vs 4.3%; p = 1.0), or 5-year cancer-specific mortality (p = 0.68). But LPN group needed longer operative time(29.4 vs 108.1 min; p<0.001), more estimated blood loss(4.0 vs 50 ml; p<0.001).

**CONCLUSION**

Our study found no significant difference in complications, renal function outcomes, and oncologic outcomes between PMWA and LPN for patients with cT1a RCC. Validation in a larger multi-institutional analysis may be warranted.
PMWA with less invasion should be reserved for patients with imperative indications for nephron-sparing surgery who cannot be subjected to the risks of more invasive LPN.

**VSIO11-09 Complications of Renal Ablation and Mitigating Actions**

**Sunday, Nov. 25 4:05PM - 4:25PM Room: S405AB**

**Participants**
Shane A. Wells, MD, Madison, WI (Presenter) Consultant, Johnson & Johnson

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**LEARNING OBJECTIVES**
1) Differentiate expected imaging findings and complications on imaging performed immediately after renal mass ablation.
2) Differentiate expected imaging findings and complications on follow-up imaging.
3) Develop strategies to mitigate procedure-related complications.

**VSIO11-10 Usefulness of a Modified RENAL Nephrometry Score in Predicting Renal Function after Cryotherapy for Renal Mass**

**Sunday, Nov. 25 4:25PM - 4:35PM Room: S405AB**

**Participants**
Yoshiki Asayama, MD, Fukuoka, Japan (Presenter) Nothing to Disclose
Akhiro Nishie, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Yasuhiro Ushijima, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Koichiro Morita, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Seiichiro Takao, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Hiroshi Honda, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Daisuke Kakkara, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Keisuke Ishimatsu, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Kousei Ishigami, MD, Fukuoka City, Japan (Abstract Co-Author) Nothing to Disclose
Nobuhiro Fujita, MD, PhD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
We investigated the application of the modified RENAL nephrometry (MRN) score system for predicting post-cryotherapy renal function in T1 renal mass patients.

**METHOD AND MATERIALS**
A total of 75 patients with a T1 renal mass were enrolled. The MRN score is based on the tumor size (radius, R), the tumor’s exophytic/endophytic properties (E), the tumor's nearness to the collecting system (N), the anterior/posterior location of the kidney (A), and the location relative to the polar lines (L). The change in the estimated glomerular filtration rate (ΔeGFR) was calculated as follows: ΔeGFR = 100 (pretreatment eGFR - eGFR at 6 months after cryotherapy)/pretreatment eGFR. Based on the ΔeGFR results, we classified the patients into two groups: the preserved renal function group (ΔeGFR <10%, n=44) and the impaired group (ΔeGFR >=10%, n=31). We analyzed the relationship between the MRN score and the ΔeGFR and the chronic kidney disease (CKD) stage.

**RESULTS**
The mean ΔeGFR for all patients was 5.5%. The preserved group's MRN scores (5.8±0.3) were significantly lower than those of the impaired group (7.4±0.3) (p<0.001). With the MRN score cutoff value set at 7 points, the following values for predicting impaired status were obtained: 67.7% sensitivity, 72.7% specificity, 61.8% positive predictive value (PPV), 76.1% negative predictive value (NPV), and 70.7% accuracy. Those of predicting a down-stage of CKD status were 92.9% sensitivity, 67.2% specificity, 39.4% PPV, 97.6% NPV, and 72% accuracy.

**CONCLUSION**
The modified RENAL nephrometry score may be useful in predicting renal function after renal cryotherapy.

**CLINICAL RELEVANCE/APPLICATION**
(Dealing with renal function after cryoablation for renal mass) Our newly proposed modified RENAL nephrometry score may be useful for predicting impairment of renal function (especially in CKD down-stages) with high sensitivity and a high negative predictive value and is recommended as a part of a pretreatment workup.

**VSIO11-11 Bone Ablation and Augmentation Outside the Spine**

**Sunday, Nov. 25 4:35PM - 4:55PM Room: S405AB**

**Participants**
Sean M. Tutton, MD, Milwaukee, WI (Presenter) Medical Director, Benvenue Medical, Inc; Consultant, Benvenue Medical, Inc; Researcher, Siemens AG; Consultant, BTG International Ltd

**LEARNING OBJECTIVES**
1) Better understand the various ablative modalities available including their specific differences and relative benefits and limitations in certain clinical scenarios.
2) Be familiarized with the existing literature supporting ablative therapies.

**VSIO11-12 Interventional Oncology Palliative Treatment for Bone Metastases: Technique and Outcomes**
**Purpose**
Evaluate combined metal artifact reduction (MAR) and monoenergetic spectral analysis by dual energy computed tomography (DECT) for assessment of ice ball ablation margins during cryoablation of musculoskeletal (MSK) metastases.

**Method and Materials**
We retrospectively evaluated image with greatest cryoprobe metallic artifact from CT-guided cryoablation of MSK metastases (Somatom Edge 128 slice, Siemens Healthineers, Germany) in 9 patients (11 lesions, 8:3 bone:soft tissue adjacent to bone) from November 2017 to March 2018. Low and high KV images from DECT acquisition were first reconstructed with iterative MAR, then processed by monoenergetic spectral analysis. MAR+DECT monoenergetic images at 60KeV, 90KeV, and 120KeV were compared to corresponding DECT-only monoenergetic images, MAR-only composite CT images, and composite CT images at 120KV. All images were qualitatively ranked by 3 board-certified radiologists for visualization of ice ball margins and least amount of metal artifact in front of and adjacent to cryoprobe. Quantitative evaluation of contrast to noise ratio (CNR) was measured between ice adjacent to probes and soft tissue or bone at DECT 60, 90, and 120 KeV with and without MAR. Wilcoxon Signed Ranks test was used to compare CNR at the same KeV setting.

**Results**
The combined MAR+DECT at 120KeV and 90KeV were first and second most preferred for least metal artifact in front of and adjacent to probe respectively, with DECT-only at 120KeV ranked third. For ice ball margin assessment, MAR+DECT at 90KeV and 120KeV were most preferred in order. Overall, both DECT-only at 120KeV and MAR+DECT at 120KeV were most preferred images, followed by MAR-only images. Composite CT image at 120KeV that mimics standard CT acquisition was least preferred image. CNR in soft tissue at 90KeV showed a significant difference between DECT with and without MAR (DECT + MAR 2.6 ± 1.8 vs. DECT 2.0 ± 1.3, p < 0.05).

**Conclusion**
Combination of MAR and DECT analysis shows improved visualization for MSK cryoablation compared to standard CT acquisition, MAR-only, or DECT-only images.

**Clinical Relevance/Application**
Advanced image processing with combination of metal artifact reduction and dual energy CT may provide a real clinical advantage to delineate ice ball margins during MSK cryoablation.

**Learning Objectives**
1) Identify the different type of malignant bone lesions associated with Augmentation. 2) Classify the available support systems for Augmentation. 3) Assess and recommend proper lesion management and Augmentation technique.
RC101A  
**Pulmonary Fibrosis**

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

LEARNING OBJECTIVES
1) Understand the radiologic differential diagnosis of fibrotic lung disease. 2) Become familiar with the most recent diagnostic criteria for usual interstitial pneumonia (UIP) on CT. 3) Understand the significance of 'early interstitial abnormality' on CT.

RC101B  
**Hypersensitivity Pneumonitis**

Participants
Santiago E. Rossi, MD, Buenos Aires City, Argentina (Presenter) Advisory Board, Boehringer Ingelheim GmbH; Speaker, Boehringer Ingelheim GmbH; Royalties, Springer Nature

LEARNING OBJECTIVES
1) Review the most common imaging findings of hypersensitivity pneumonitis (HP) (case-based). 2) Describe clinical manifestations of HP. 3) Identify proposed classification of HP.

RC101C  
**Smoking-Related Interstitial Lung Diseases**

Participants
Carolina A. Souza, MD, Ottawa, ON (Presenter) Consultant, Pfizer Inc; Consultant, Boehringer Ingelheim GmbH; Consultant, AstraZeneca PLC; Speaker, Pfizer Inc; Speaker, Boehringer Ingelheim GmbH; Speaker, F. Hoffmann-La Roche Ltd; Speaker, AstraZeneca PLC; Advisory Board, AstraZeneca PLC

LEARNING OBJECTIVES
1) Describe the spectrum of smoking-related interstitial lung diseases and their clinical manifestations. 2) Recognize the high-resolution CT appearances of smoking-related lung diseases. 3) Identify the most common imaging differential diagnoses of smoking-related interstitial lung diseases.

RC101D  
**Sarcoidosis**

Participants
Lacey Washington, MD, Durham, NC (Presenter) Consultant, Novartis AG

LEARNING OBJECTIVES
1) Review the classic clinical and imaging manifestations and common complications of thoracic sarcoidosis. 2) Review less well known clinical features and imaging findings.
Quantification of Interstitial Lung Diseases

Participants
Joseph Jacob, MBBS, MRCP, London, United Kingdom (Presenter) Consultant, Boehringer Ingelheim GmbH; Consultant, F. Hoffmann-La Roche Ltd

For information about this presentation, contact:

j.jacob@ucl.ac.uk

LEARNING OBJECTIVES

1) Understand why computer analysis of CT imaging has relevance in interstitial lung diseases. 2) Understand the limitations of visual CT scoring. 3) Understand the various quantitative analytic techniques/tools. 4) Become aware of the latest results achieved by quantitative tools in predicting outcome across the various interstitial lung diseases.
**RC103**

**Rapid Fire: 80 Cardiac Cases in 80 Minutes**

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

**AMA PRA Category 1 Credits™:** 1.50
**ARRT Category A+ Credit:** 1.75
**FDA** Discussions may include off-label uses.

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

**Sub-Events**

**RC103A**  **Thoracic Vascular: 20 Cases**

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

For information about this presentation, contact:
saboo_100@yahoo.com

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

**Honored Educators**

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

**RC103B**  **Cardiothoracic Oncology: 20 Cases**

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

For information about this presentation, contact:
williamson.eric@mayo.edu

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

**RC103C**  **Pericardium: 20 Cases**

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

For information about this presentation, contact:
skligerman@ucsd.edu

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

**RC103D**  **Coronary Arteries and Myocardium: 20 Cases**

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

For information about this presentation, contact:
kirschj@ccf.org

**LEARNING OBJECTIVES**
1) To review the imaging manifestations of common and uncommon ischemic and non-ischemic cardiac pathologies.
Honored Educators

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

Jacobo Kirsch, MD - 2013 Honored Educator
**Pediatric Series: Fetal/Neonatal Imaging**

Sunday, Nov. 25 2:00PM - 3:30PM Room: E352

**RC113-01 Imaging of Congenital Lung Malformation**

Participants
Amy R. Mehollin-Ray, MD, Pearland, TX (Moderator) Nothing to Disclose
Carol E. Barnewolt, MD, Boston, MA (Moderator) Nothing to Disclose

For information about this presentation, contact:
armeholl@texaschildrens.org

**LEARNING OBJECTIVES**

1) Describe the various types of congenital lung malformations and characteristic prenatal imaging findings. 2) Understand the pathophysiology of abnormal lung development and how it impacts lesion appearance and behavior. 3) Discuss the management implications for appropriate prospective designation of lesions based on imaging.

**RC113-02 Quantitative Assessment of Posterior Fossa Malformations in Fetal MRI**

Participants
Gregor O. Dovjak, MD, Vienna, Austria (Presenter) Nothing to Disclose
Mariana G. Diogo, MD, Lisboa, Portugal (Abstract Co-Author) Nothing to Disclose
Gerlinde Gruber, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Peter C. Brugger, MD, PhD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Daniela Prayer, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Gregor Kasprian, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

For information about this presentation, contact:
Gregor.Dovjak@meduniwien.ac.at

**PURPOSE**

Assessment of posterior fossa malformations with fetal MRI after screening ultrasound is frequently demanded. Recently it has been shown, that fetal vermian lobules can be evaluated in detail by fetal neuroimaging. This fetal MRI study aimed to systematically segment rhombencephalic structures in common posterior fossa anomalies. The aim of the study was to determine which of the quantitative parameters is suitable to distinguish between a favorable and a less favorable outcome group.

**METHOD AND MATERIALS**

Group 1 (29 cases) included prenatal cases with a favorable outcome (Blake's pouch and Megacisterna magna) with a gestational age (GA) of 26.18±4.72 (mean GA ± standard deviation). Group 2 (33 cases, GA of 23.38±5.29) included the classical Dandy Walker malformation and other cystic posterior fossa malformations, known to be associated with a less favorable neurocognitive outcome. The number of vermian lobules, the brainstem-vermian angle, vermian and brainstem area (in mm²) and the vermis-brainstem ratio were assessed using an optimal T2-weighted median sagittal slice (resolution ranging from .57/.57/3.3 to 1.17/1.17/4.4). The parameters were compared with two-sided t-tests between the two groups.

**RESULTS**

All evaluated parameters were significantly different between the two groups. The number of lobules was 5.69±0.95 (mean ± standard deviation) in group 1 vs 3.91±1.31 in group 2 (p<0.001). The brainstem-vermian angle also differed significantly with 7.93±10.86 vs 72.24±27.52 (p<0.001). The vermis size was 118.68±66.83 vs 54.41±34.41 (p<0.001). The brainstem size was 174.97±69.24 vs 121.65±51.62 (p=0.002). The vermis-brainstem ratio was 64.24±16.47 vs 42.22±11.96 (p<0.001).

**CONCLUSION**

Brainstem and vermian biometry provide objective and quantitative measures, which significantly differ between favorable and non-
Brainstem and vermian biometry provide objective and quantitative measures, which significantly differ between favorable and non-
favorable neurodevelopmental outcome groups. Assessment of vermian lobulation (number and morphology) allows further
characterization of cystic posterior fossa malformations, given optimal fetal MR imaging conditions.

**CLINICAL RELEVANCE/APPLICATION**

Due to the functional importance of the brainstem and the cerebellar vermis, fetal MR based biometry is a promising tool in the
prognostic assessment of hindbrain malformations.

**RC113-03  Fetal Cardiac MRI in the Evaluation of Double and Right Aortic Arch**

**PURPOSE**

Right aortic arch (RAA) refers to a congenital abnormal position of the aortic arch to the right of the trachea. The aim of this study
was to evaluate the feasibility of fetal cardiac magnetic resonance (CMR) in the assessment of fetal double and right aortic arch.

**METHOD AND MATERIALS**

This retrospective review included 148 pregnant women (21-32 weeks gestation mean 24 weeks) referred to a children's hospital
for a fetal cardiac MRI from June 2005 to December 2017 due to the finding of a cardiovascular anomaly by fetal echocardiogram
(echo) performed by a cardiologist or due to a technically limited echo. CMR was performed using 1.5T or 3.0 T unit. Sequences
included steady-state free-precession (SSFP); non gated SSFP cine, single-shot turbo spin echo (STTSE) and non-gated phase
contrast (PC) cine sequences. Sequences included transverse fetal thorax, and four-chamber, short-axis, coronal and oblique
sagittal planes of the fetal heart when possible. The radiologists were not blinded to the echo findings. Echo and CMR findings were
compared with postnatal imaging and/or surgery.

**RESULTS**

Anomalies identified by CMR included double aortic arch (DAA) (n=36), right aortic arch (RAA) with aberrant left subclavian artery
(LSCA) (n=52), RAA with mirror image branching (n=48), RAA with right ductus arteriosus (RDA) (n=6, 4 with other cardiovascular
defects), RAA with mirror image branching with retroesophageal ductus (n=6). 93.8% (45/48) RAA with mirror image branching had
additional congenital intracardiac anomalies better seen by fetal echo. The remaining were not associated with additional congenital
heart defect. 75.7% (112/148) arch anomalies were correctly diagnosed by fetal echo, while Fetal CMR was correct in 87.8%
(130/148). 18 arch anomalies were missed by fetal echo but identified by MRI and confirmed postnatally, echoes were technically
limited in 6 cases due to maternal obesity, oligohydramnios, fetal position, twins. The cases echo missed/misdignosed included DAA
(n=7), RAA with aberrant LSCA (n=4), RAA with mirror image branching (n=1), RAA with RDA (n=3), RAA with mirror image branching
with retroesophageal ductus (n=3).

**CONCLUSION**

Fetal cardiac MRI can provide additional diagnostic information for fetal DAA and RAA and can be a useful adjunct.

**CLINICAL RELEVANCE/APPLICATION**

Fetal cardiac MRI can provide accurate diagnostic information for fetal DAA and RAA and is recommended as an adjunct to fetal
echocardiography.

**RC113-04  MR Imaging of Retroplacental Clear Space during the Course of Gestation in Pregnant Mice**

**PURPOSE**

Visualization of the retroplacental clear space is critical for the diagnosis of invasive placentation. In this pre-clinical study, we
evaluated MR imaging of the retroplacental clear space during the course of gestation in a mouse model using a liposomal-Gd
contrast agent that has been shown to not penetrate the placental barrier.

**METHOD AND MATERIALS**

In vivo studies were performed in pregnant C57BL/6 mice (8-10 week age at start of pregnancy). MR imaging was performed on a
1T permanent magnet scanner. Imaging was performed at five time points during the second half of gestation (e10.5, e12.5, e14.5,
e16.5, and e18.5 days). At each time point, pre-contrast and post-contrast images were acquired using a T1-weighted (T1w) 3D
RESULTS

Contrast-enhanced T1w images enabled the visualization of both the placenta and retrolental clear space. The shape of the placenta at the earliest time point (±0.5) was indicative of the development phase; however, during the later imaging time points, the placenta transformed into the typical round to oval disk shape. Although the retrolental clear space was visible at all time points, radiologist review for feature conspicuity indicated partial visibility at the first imaging time point (±0.5) and improved visibility during the mid to later stages of gestation. The CNR, determined from the analysis of retrolental space and adjacent placenta, varied between 12±4 at ±0.5 to 24±6 at ±8.5.

CONCLUSION

Contrast-enhanced MR imaging using a liposomal-Gd contrast agent enabled clear visualization of the retrolental space in a pregnant mouse model starting as early as ±12.5 day of gestation.

CLINICAL RELEVANCE/APPLICATION

Visualization of the retrolental clear space at the early stages of pregnancy using a liposomal-Gd blood-pool contrast agent may enable early detection of invasive placentation.

PURPOSE

Fetal MRI-based diaphragmatic segmentation in fetuses with congenital diaphragmatic hernia (CDH) has the potential to provide information regarding diaphragmatic defect typology and extent as well as three dimensional visualization of the diaphragmatic defect to the pediatric surgeon even during intrauterine life. This retrospective pilot study aims to determine the feasibility of fetal MRI-based manual diaphragmatic segmentation.

METHOD AND MATERIALS

22 CDH cases (gestational week 21 to 38) who had fetal MRI and diaphragmatic repair surgery performed were retrospectively identified. Manual segmentation of the fetal diaphragm and the diaphragmatic defect was performed based on routine T2-weighted TSE sequences using ITK-Snap. Surface area measurements of the diaphragm and the diaphragmatic defect were utilized to calculate diaphragmatic defect to thoracic aperture ratios. Three dimensional visualization of the fetal diaphragm was used to assign CDH typology according to Kardon et al. (Dis Model Tech 2017). Results were compared to data from surgery reports. CDH typology, diaphragmatic defect to thoracic aperture ratios, and use of patch for diaphragmatic repair were analyzed using descriptive statistics.

RESULTS

Fetal MRI-based diaphragmatic segmentation was feasible in 90.91% (20/22) of CDH cases. In two cases excessive fetal movement did not allow segmentation. CDH typology based on three dimensional visualization of the fetal diaphragm was in accordance with information extracted from surgery reports. All CDH cases with a diaphragmatic defect to thoracic aperture ratio of more than 0.4 received diaphragmatic patch repair.

CONCLUSION

Routine fetal MRI-based diaphragmatic segmentation is possible in a majority of cases. Surface area measurements of the fetal diaphragm and the diaphragmatic defect may allow prediction of optimal diaphragmatic repair technique. In conclusion, this new method has the potential to provide personalized management of CDH cases.

CLINICAL RELEVANCE/APPLICATION

The proposed new method can be applied on routine fetal MRI data and can provide CDH typology, extent of diaphragmatic defect, diaphragmatic defect to thoracic aperture ratio, and three dimensional visualizations to the managing team already at a stage of fetal development. Fetal MRI-based personalization of management in CDH cases is indispensable in a time of intensive research regarding tissue engineering-based therapy of CDH.

PURPOSE

Fast Temperature Mapping of the Fetal Brain During Routine 3T Fetal MR Imaging

Participants
Jason G. Parker, PhD, Indianapolis, IN (Presenter) Nothing to Disclose
Emily E. Diller, MS, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
Chang Y. Ho, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
Rupa Radhakrishnan, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
Brandon P. Brown, MD, MA, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
PURPOSE

To develop and evaluate a rapid technique capable of quantifying the effects of RF-heating on the fetal brain during normal clinical MR scanning.

METHOD AND MATERIALS

Patients

Sixteen (16) pregnant female patients underwent clinical fetal MRI at 3T. Normal scan sequences included T1, T2, DWI, and T2* sequences, and had a total scan time less than 60 mins. Scanning sequence To monitor potential heating of the fetus during MRI, temperature maps were acquired at the beginning (scan 1), mid-point (scan 2), and end of each fetal MRI (scan 3) session using a custom phase-based thermometry sequence. The thermometry sequence was designed to exploit the temperature dependence of the proton resonance frequency using a gradient-echo echo-planar imaging (GRE-EPI) technique with TR/TE: 150/8.3ms, 256x256 matrix, 5mm slice thickness, and 1mm gap. TE was chosen to maximize the SNR of brain tissue. The total acquisition time of the MR thermometry sequence was 4.3 seconds and required no special procedures to be performed by the technologist. All imaging was performed with an abdominal phased-array surface coil. Image Processing Phase unwrapping was performed for each acquisition using a magnitude-sorted list, multi-clustering phase unwrapping algorithm, and temperature maps were then created from the phase difference images. The mean, maximum, and standard deviation of a single whole brain ROI was calculated from the temperature maps for each patient. Analysis 2-way one-sample t-tests were used to investigate significant temperature changes in the ROIs at scan 2 and scan 3 compared to scan 1. A 2-way paired t-test was used to evaluate the absolute change in temperature between scan 2 and scan 3.

RESULTS

At 3T magnetic field strengths, the maximum temperature in the brain increased significantly from scan 1 to scan 2 by an average of $0.42 \pm 0.24 \degree C$ ($p=4.5*10^{-6}$) and from scan 1 to scan 3 by an average of $0.48 \pm 0.30 \degree C$ ($p=1.16*10^{-5}$). A significant difference between scan 2 and scan 3 was not found ($p=.084$).

CONCLUSION

We have demonstrated the clinical application of a fast, MR-based temperature mapping method to monitor RF-heating of the fetal brain during routine clinical imaging.

CLINICAL RELEVANCE/APPLICATION

RF-heating of the fetus during fetal MRI carries a theoretical risk of harm to the developing fetal brain, and this technique allows a practical method to monitor heating effects in vivo.

RC113-07  Perinatal Imaging of the Airway

Sunday, Nov. 25 3:10PM - 3:30PM Room: E352

Participants

Carol E. Barnewolt, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To define the nature of basic congenital airway abnormalities. 2) To identify general malformation categories that may require special attention at the time of delivery. 3) To help the attendee develop a perinatal imaging strategy, with the goal of optimizing the chances of prompt airway access, in settings where challenges may be expected.
The Best of RADIOLOGY in 2018: The Editors of RADIOLOGY Keep You up to Date

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

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

FDA

Discussions may include off-label uses.

Sub-Events


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

For information about this presentation, contact:
dbluemke@rsna.org

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

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

RC124B  Innovations in Cardiothoracic Imaging in 2018

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

For information about this presentation, contact:
a.de_roos@lumc.nl

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

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

RC124C  Research and Innovations in Breast Imaging in 2018

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

For information about this presentation, contact:
linda.moy@nyumc.org

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

RC124D  New Developments in Neuroimaging in 2018

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

For information about this presentation, contact:
LEARNING OBJECTIVES

1) Identify key publications over the past year that may affect your clinical practice. 2) Evaluate new research developments in the field of radiological imaging. 3) Describe new developments in radiology that may affect the management of your patients.
PS12

Sunday Afternoon Plenary Session

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

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

Participants

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

Sub-Events

PS12A Report of the RSNA Research and Education Foundation

Participants

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

PS12B Image Interpretation Session

Participants

Donald P. Frush, MD, Durham, NC (Moderator) Nothing to Disclose

John Eng, MD, Cockeysville, MD (Introduction) Nothing to Disclose

Laura W. Bancroft, MD, Orlando, FL (Presenter) Author with royalties, Wolters Kluwer nv; Speaker, World Class CME; Editor, Thieme Medical Publishers, Inc; Travel support, Thieme Medical Publishers, Inc

Matthew S. Davenport, MD, Ann Arbor, MI (Presenter) Nothing to Disclose

Tomas C. Franquet, MD, Barcelona, Spain (Presenter) Nothing to Disclose

R. Paul Guillerman, MD, Houston, TX (Presenter) Consultant, Guerbet SA

Christopher P. Hess, MD, Mill Valley, CA (Presenter) Nothing to Disclose

Andrea Laghi, MD, Rome, Italy (Presenter) Nothing to Disclose

Elizabeth A. Morris, MD, New York, NY (Presenter) Nothing to Disclose

Pamela K. Woodard, MD, Saint Louis, MO (Presenter) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd

For information about this presentation, contact:

woodardp@wustl.edu
Chest Monday Case of the Day

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

AMA PRA Category 1 Credit ™: .50

Participants
Rakesh D. Shah, MD, Manhasset, NY (Presenter) Nothing to Disclose
Pamela J. Lombardi, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Clinton E. Jokerst, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Daniel B. Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Nikhil Goyal, MD, Staten Island, NY (Abstract Co-Author) Nothing to Disclose
Timur Kotlyar, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher Kyriakakos, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Ross P. Frederick, MD, Phoenix, AZ (Abstract Co-Author) Nothing to Disclose
Lauren K. Groner, DO, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) To analyze interesting chest cases. 2) To understand appropriate differential diagnosis. 3) To understand the clinical significance of the diagnosis presented.
The Many Facets of Organizing Pneumonia: A Rad-Path Guide to Understanding and Diagnosis

Monday, Nov. 26 8:30AM - 10:00AM Room: E351

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
1) Understand the microscopic anatomy of the lung that explains the high resolution CT findings associated with organizing pneumonia. 2) Improve their diagnostic skills related to the imaging recognition of organizing pneumonia. 3) Recognize the range of injuries and inhaled insults that lead to organizing pneumonia. 4) Apply a new knowledge of the pathways to fibrosis that allows for the differentiation of organizing pneumonia, IPF and diffuse alveolar damage. 5) Appreciate the importance of communication between the clinician, radiologist, and pathologist to improve diagnosis.

ABSTRACT
This presentation will review the histologic and radiologic findings of organization in lung injury due to diffuse alveolar damage, organizing pneumonia and acute fibrinous and organizing pneumonia. It will clarify the role of organizing pneumonia in the pathway to fibrosis that will sharpen the radiologist's ability to separate the various forms of fibrosis including: idiopathic pulmonary fibrosis, non-specific interstitial pneumonia and diffuse alveolar damage. Finally it will describe the multidisciplinary diagnostic process of which the radiologist is a key member.

Active Handout: Jeffrey R. Galvin

Sub-Events
RC201A Introduction
Participants
Jeffrey R. Galvin, MD, Baltimore, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC201B Pathology of Organizing Pneumonia
Participants
Teri J. Franks, MD, Silver Spring, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Active Handout: Teri J. Franks

RC201C Imaging of Organizing Pneumonia
Participants
Seth J. Kligerman, MD, Denver, CO (Presenter) Nothing to Disclose

For information about this presentation, contact:
skligerman@ucsd.edu

LEARNING OBJECTIVES
View learning objectives under main course title.

Active Handout: Seth Jay Kligerman

RC201D Pathways to Fibrosis and Summary
Participants
Jeffrey R. Galvin, MD, Baltimore, MD (Presenter) Nothing to Disclose
LEARNING OBJECTIVES

View learning objectives under main course title.
RC213

Pediatric Series: Pediatric Chest/Cardiovascular Imaging
Monday, Nov. 26 8:30AM - 12:00PM Room: E353B

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

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

RC213-01 Cardiac CT in Neonates
Monday, Nov. 26 8:30AM - 8:50AM Room: E353B

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

RC213-02 Image Quality and Incidental Findings of Chest MRI in a Large Pediatric Population-Based Study
Monday, Nov. 26 8:50AM - 9:00AM Room: E353B

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

For information about this presentation, contact:
p.ciet@erasmusmc.nl

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

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

RESULTS
47 children were excluded for missing data (i.e. no inspiratory or expiratory scans). Final analysis included 2451 children (median age 9.9 years, range 9.5-11.9). Median IQ was good to excellent 4.5 (Interquartile Range, IQR=4-5). Median IQ-INSP and IQ-EXP was 4.5 (IQR=4-5) for both. Despite deemed excellent, IQ-EXP was significantly lower than IQ-INSP (Z=-8.487, p<0.0001). 1.7% of the cohort subjects had clinically relevant IFs, 45% had non-clinically relevant IFs. Clinically relevant IFs included pulmonary nodules (diameter >10 mm), severe tracheomalacia (collapse>70%), severe trapped-air (>25% lung lobe volume) and congenital abnormalities (i.e. sequestrer). Non-clinically relevant IFs were: mild trapped-air (23,8%), atelectasis (15,4%) and mild tracheomalacia (4,5%). IQ was mostly affected by motion artifact (31,9%), fat ghosting (7,9%) or both (6,3%). Inter-observer agreement for IQ was good (ICC=0.7, 95% CI 0.48-0.83).
CONCLUSION
Chest MRI is a robust technique for large cohort studies in children. Clinically relevant IFs are rare in children, but a large percentage of the cohort had non-clinically relevant IFs.

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

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

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

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

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

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

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48 patients from 1 month to 18 years, weighting 4.5 to 52 kg, heart rate 81-172 (117.3±27.26) were examined. The amount of contrast agent (CA) was 1.5-1.5 ml/kg, kV80/100, mR200/350, the effective radiation dose (ERD) was 0.9-3.2mSv. ERD was calculated using DLP (mGy*cm) multiplied to e (e is the dose coefficient for the corresponding anatomical region (0.017mSv/mGy*cm)) and multiplied by the age coefficient. Patients were divided: A - HR of up to 120beats/min(one volume scanning) (27patients 56.25%), B-HR over 120 beats/minute (two volumes) (21patients 43.75%). 5 patients underwent postoperative control CTA of the heart.

RESULTS
RD in group A-1.57±0.62mSv; B-1.84±0.58, mean dispersion within the group was 0.36, intergroup dispersion 0.018, total dispersion 0.387, and the empirical correlation ratio was 0.22, which clearly demonstrates the weak effect of heart rate on the choice of the scan mode. The CTA results coincided with the intraoperative in 100% of cases.

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

CLINICAL RELEVANCE/APPLICATION
Cardiac CT in pediatric: Row-640 MSCT recomending in diagnosing and planning of surgical treatment.

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

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

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

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

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

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

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

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

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

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

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

Adenosine may not be a reliable stressor agent in children. A lower incidence of splenic-switch off may infer a higher incidence of understress even with a standard pharmacological protocol.
This work demonstrates an innovative, quantitative MRI assessment of dynamic tracheal collapse in neonates with BPD, without bronchoscopy. Bronchoscopy is the gold standard for diagnosis of airway collapse but requires sedation and increased risk to patients. Extremely preterm infants face serious chronic lung disease (bronchopulmonary dysplasia, BPD), often complicated by comorbid dynamic tracheal collapse (tracheomalacia, TM). Tracheostomy can be used to bypass segments of the collapsing airway or to provide long-term positive pressure to improve respiratory mechanics in patients with TM or who otherwise struggle to wean from intubated support. Bronchoscopy is the gold standard for diagnosis of airway collapse but requires sedation and increased risk to patients. We present an innovative MRI technique for quantitative evaluation of dynamic tracheal collapse in non-sedated neonates.

METHOD AND MATERIALS

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

RESULTS

Our DCNNs trained on only pediatric patients from the NIH ChestX-ray14 database achieved similar overall performance and improved accuracy for certain diagnoses compared to prior DCNNs utilizing the entire dataset, demonstrating that DCNNs can optimize diagnostic accuracy when stratifying by age.

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

REFERENCE

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

PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

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

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

LEARNING OBJECTIVES

1) Review the commonly encountered cardiac masses in the pediatric patient and their CT and MRI imaging findings. 2) Develop a differential diagnosis for pediatric cardiac masses based on age, location, and imaging findings. 3) Discuss tips for applying CT and MRI to evaluate pediatric cardiac masses.
PURPOSE
A large number of patients undergo annual lung cancer screening with low-dose chest CT. The CT data contains significant information about the health of the patient, beyond simple lung cancer status. The National Lung Cancer Screening (NLST) database provides a large dataset with correlated clinical metadata, which can be used to train machine learning algorithms to extract as much useful health information as possible. The aim of the study is to develop and validate a 3D convolutional neural network algorithm on these CT studies to predict the likelihood of various major diseases: diabetes, heart disease, COPD, and stroke.

METHOD AND MATERIALS
We extracted random samples of 16,780 scans from NLST. Data preprocessing consisted of isotropic resolution resizing and standardization to 350 x 350 x 35 pixel size. Data was augmented with random rotations between -15 and 15 degrees. The processed samples were passed through a 3D convolutional neural network (CNN) with architecture loosely inspired by the VGG-Net. Modifications included generalization to 3D dataset, more gradual pooling across the z-axis, and use of batch normalization. Stochastic gradient descent optimizer and sparse categorical cross-entropy loss function were utilized. Final results were gathered using a separate testing set extracted from the NLST dataset. Error analysis was conducted.

RESULTS
We performed training and testing for classification of the following diseases: diabetes, heart disease, COPD, and stroke. For each disease respectively, we achieved an ROC AUC of 0.75, 0.70, 0.74, 0.69 on the test sets. ROC curves are displayed in Figure (1). For each of these results, a single radiologist with deep learning expertise manually inspected random samples of correct and incorrect predictions to ensure absence of any systematic errors. None was identified. Testing sets were confirmed to be an accurate representation of the training sets with regards to positive/negative example ratios.

CONCLUSION
Our 3D CNN model successfully predicted the likelihood of various diseases from lung cancer screening chest CT studies.

CLINICAL RELEVANCE/APPLICATION
The algorithm can be used to provide patients with useful health information about major diseases, in addition to the formal lung cancer screening interpretations by radiologists.

SSC03-02 Improving Specificity of Lung Cancer Screening CT Using Deep Learning

Participants
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METHOD AND MATERIALS

We analyzed 42,943 CT studies from 14,863 patients, 620 of which developed biopsy-confirmed cancer. All cases were from the National Lung Screening Trial (NLST) study. We randomly split patients into a training (70%), tuning (15%) and test (15%) sets. A study was marked "true" if the patient was diagnosed with biopsy confirmed lung cancer in the same screening year as the study. A deep learning model was trained over 3D CT volumes (400x512x512) as input. We used the 95% specificity operating point based on the tuning set, and evaluated our approach on the test set. To estimate radiologist performance, we retrospectively applied Lung-RADS criteria to each study in the test set. Lung-RADS categories 1 to 2 constitute negative screening results, and categories 3 to 4 constitute positive results. Neither the model nor the Lung-RADS results took into account prior studies, but all screening years were utilized in evaluation.

RESULTS

The area under the receiver operator curve of the deep learning model was 94.2% (95% CI 91.0, 96.9). Compared to Lung-RADS on the test set, the trained model achieved a statistically significant absolute 9.2% (95% CI 8.4, 10.1) higher specificity and trended a 3.4% (95% CI -5.2, 12.6) higher sensitivity (not statistically significant). Radiologists qualitatively reviewed disagreements between the model and Lung-RADS. Preliminary analysis suggests that the model may be superior in distinguishing scarring from early malignancy.

CONCLUSION

A deep learning based model improved the specificity of lung cancer screening over Lung-RADS on the NLST dataset and could potentially help reduce unnecessary procedures. This research could supplement future versions of Lung-RADS; or support assisted read or second read workflows.

CLINICAL RELEVANCE/APPLICATION

While Lung-RADS criteria is recommended for lung cancer screening with LDCT, there is still an opportunity to reduce false-positive rates which lead to unnecessary invasive procedures.

SSC03-03 New Algorithm Incorporating Machine Learning Improves Lung Cancer Risk Calculation on Screening CT Scans

Monday, Nov. 26 10:50AM - 11:00AM Room: E451A

Participants

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PURPOSE

Lung-RADS is widely used to classify nodules detected on lung cancer screening CT. Using data from the National Lung Cancer Screening Trial (NLST), we examined whether integration of patient demographics, clinical history, and CT texture features could improve our ability to predict long-term lung cancer development. Since most screening CTs detect early stage lung cancers, we further examined if our algorithm could predict cancer progression and overall survival in patients with resected stage I lung cancers.

METHOD AND MATERIALS

Demographics, clinical history, and baseline CT images from 24,386 NLST participants were analyzed using survival machine learning (SML). Nodule volume was calculated by \( V = \frac{3.14}{3} L^2 R \) where \( L \) = longest diameter, \( R \) = longest perpendicular diameter/2. Subjects were partitioned into 4 risk groups to test hazards ratios (HR). The SML partition was compared to that from Lung-RADS. For the stage I lung cancer subgroup, the time from lung cancer diagnosis to death was used as the SML endpoint.

RESULTS

At the time of baseline CTs, the 4 risk groups were classified by: high (largest nodule \( L > 10 \) mm, \( V > 6358 \) mm\(^3\); \( n = 85 \)), mid-high (largest nodule \( L > 10 \) mm, \( V < 6358 \) mm\(^3\); \( n = 1219 \)), mid-low (largest nodule \( L = 5 \) to \( 10 \) mm, smoking > 40 years; \( n = 1736 \)), and low (all
CONCLUSION

Using the NLST data, our new classification outperforms Lung-RADS in stratifying risk and predicting long-term lung cancer development. Furthermore, in pathologically defined stage 1 patients who received surgery, our new classification can identify those with poor survival suggesting that it can do so independently of cancer stage.

CLINICAL RELEVANCE/APPLICATION

Our new classification outperforms Lung-RADS in stratifying risk and predicting long-term lung cancer development and can identify stage 1 patients with poor survival suggesting that it can do so independently of cancer stage.

**SSC03-04** Effect of Semiautomated Segmentation and Computer-Aided Detection of Lung Nodules on Lung Cancer Screening with Low Dose CT: Experience from a Nationwide Lung Cancer Screening Project

Monday, Nov. 26 11:00AM - 11:10AM Room: E451A

Participants

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PURPOSE

To evaluate the effect of semiautomated segmentation and computer-aided detection (CAD) system for lung nodule on lung cancer screening based on the Lung-RADS.

METHOD AND MATERIALS

We utilized the data from an ongoing nationwide multi-center lung cancer screening project with low dose chest CT. This project started with a visual assessment and manual measurement system (a manual system) and changed into a cloud-based software system which equipped with a semiautomated nodule segmentation and CAD system (a software system). In a software system, an average diameter of a nodule for the Lung-RADS was calculated on a plane showing the maximal cross sectional area of a nodule. For this study, an average diameter on axial planes was also calculated. We compared the number of detected lung nodules and distribution of Lung-RADS categories between two systems. When the results of before and after CAD were available (the number of cases, 2374), the effect of CAD was evaluated.

RESULTS

The number of cases and the number of nodules for both systems are as follows: a manual system, 1821 cases, 1630 nodules; a software system, 4665 cases, 6116 nodules. Significantly greater number of nodules (0.90 vs. 1.31 nodule/case) were detected at a software system. The size of nodule was significantly larger (5.5 vs. 4.6 mm) at a software system, but there was no significant difference in the size of nodules between two systems when axial planes were used in calculating an average diameter in a software system. Both the per-case (9.8% vs. 17.4%) and per-nodule (12.9% vs. 17.9%) proportion of positive test (category 3/4) were significantly higher at a software system. By applying the CAD results, not only the number of the detected nodules (0.77 vs. 1.23 nodule/case) but also the per-case proportion of positive test (11.6% vs. 17.1%) were significantly increased.

CONCLUSION

By applying a semi-automated segmentation and CAD system, the number of detected nodules and the proportion of positive test were significantly increased.

CLINICAL RELEVANCE/APPLICATION

Semiautomated segmentation and CAD have important effects on the Lung-RADS positive rate. Therefore, detailed guidelines should be provided for the use of software in lung cancer screening.

**SSC03-05** Randomized Clinical Trial of CAD versus No CAD as First Reader of Lung Cancer Screening CT: Preliminary Report

Monday, Nov. 26 11:10AM - 11:20AM Room: E451A

Participants

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11,325 individuals between ages 55-77 were included (mean age 64.1, 52.8% female, 74.9% white) of whom 2.8% reported at least accounting for complex survey design elements.

METHOD AND MATERIALS
We conducted a randomized trial in 148 smokers participating in our ongoing Lung Cancer Screening Project (75M:73F, 66±yrs, 59 ex- vs. 89 current-smoker). Chest CTs were randomized into two arms. In the CAD and Technician first arm (CAD+Tech-1st), CAD findings were displayed first, a technician accepted or rejected CAD findings and added probable nodule(s), then a chest radiologist accepted or rejected the CAD +Tech findings adding additional nodule(s). In the RAD-first arm (RAD-1st) the same radiologist read the CT first with CAD marks hidden, then turned on CAD to accept true nodules including those only found by CAD and delete the non-nodule CAD findings. The number of true nodules and reading time were recorded.

RESULTS
The reading times were 6.2 ± 3.4 min (range: 2-18) vs. 8.3 ± 5.4 min (range: 3-30) for CAD+Tech-1st vs. RAD-1st arms (p=0.012) for CTs with >=1 nodule; and 4.4±1.5 min (range: 2-10) vs. 8.7±9.5 min (range: 3-30) for those without nodules (p=0.07). By the three detection methods, 212 true nodules were found in 97 CTs in the CAD+Tech-1st arm. CAD detected 82 and technician added 93 true nodules, giving a combined sensitivity of 83%.

The 37/212 nodules found only by the radiologist; 12/37 were the most important nodule, and 1/37 was the only nodule that drove follow-up. In the RAD-1st arm 71 true nodules were found in 51 CTs; 36/71 (51%) were found by both CAD and radiologist. The radiologist missed 2 true nodules in 2 participants (2/51, 4%) which were detected by CAD and altered their follow-up protocol. The radiologist’s detection sensitivity slightly increased with CAD (97% to 100%). CAD missed 33/71(46%) true nodules found by the radiologist, 16/33 (48%) were key nodules and 11/16 were the only nodule, changing follow-up.

CONCLUSION
CAD+Tech speed up the radiologist’s nodule detection on screening chest CT. CAD detected nodules in 4% subjects where no nodule was identified by the radiologist, changing imaging follow-up protocol.

CLINICAL RELEVANCE/APPLICATION
While CAD+Tech as first reader cannot replace the radiologist, CAD could play an important role in lung cancer screening by saving radiologists’ time, and importantly reduce their FN rate by 4%.

PURPOSE
Prior studies have found that patients with mental illness are more likely to smoke compared with patients without mental illness. Lung Cancer Screening (LCS) with LDCT decreases lung cancer mortality in eligible current or former smokers. There is limited population-based information about LCS eligibility in patients with mental illness. Our purpose was to determine if patients with self-reported mental illness are more likely to be eligible for LCS and smoking cessation interventions compared to patients without mental illness using nationally representative federal cross-sectional survey data.

METHOD AND MATERIALS
Retrospective analysis of 2015 National Health Interview Survey (NHIS), a nationally representative, federal cross sectional survey was conducted. Individuals 55-77 yrs without lung cancer were included. The proportion of survey participants eligible for LCS was calculated and compared in patients with and without self-reported mental illness. Multiple variable logistic regression analyses were conducted comparing LCS eligibility in patients with and without self-reported mental illness, adjusted for potential confounders (age, race, and insurance status). Adjusted odds ratios were calculated with 95% confidence intervals. Analyses were performed accounting for complex survey design elements.

RESULTS
11,325 individuals between ages 55-77 were included (mean age 64.1, 52.8% female, 74.9% white) of whom 2.8% reported at least
one mental illness. Of individuals with self-reported mental illness, 18.7% met eligibility criteria for LCS and 25.8% were current smokers. Of individuals without self-reported mental illness, 10.6% met eligibility criteria for LCS and 12.9% were current smokers. Patients self-reporting mental illness were more likely to be eligible for LCS (Adjusted OR 1.89, 95% CI 1.30 to 2.75, p = 0.001) and more likely to be current smokers (Adjusted OR 2.20, 95% CI 1.59 to 3.07, p < 0.001) than patients without mental illness.

CONCLUSION
Patients with self-reported mental illness have a higher smoking prevalence and are nearly twice as likely to be eligible for LCS compared with patients without mental illness.

CLINICAL RELEVANCE/APPLICATION
Radiologists have an opportunity to collaborate with psychiatry and primary care in developing targeted LCS outreach efforts for patients with mental illness who are at increased risk of developing lung cancer due to their higher smoking prevalence.

SSC03-07 Lung Cancer Screening in a Socioeconomically Disadvantaged Population: Baseline and 1st Annual Rescreening Results

Monday, Nov. 26 11:30AM - 11:40AM Room: E451A

Awards
Trainee Research Prize - Resident

Participants
Charles H. Li, MD, Los Angeles, CA (Presenter) Nothing to Disclose
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PURPOSE
To describe the results of the first two rounds of screening of our clinical low-dose CT lung cancer screening program targeting a minority, socioeconomically disadvantaged, high-risk population different from that studied in the National Lung Screening Trial.

METHOD AND MATERIALS
All participants met USPSTF and/or NCCN eligibility criteria for lung cancer screening. A coordinator enrolled eligible individuals, scheduled their screening exams, and organized their transportation.

RESULTS
1029 individuals were referred from 7/21/2015 through 3/20/2018. 119 individuals declined screening, and 230 were unable to be contacted. Of 717 participants who agreed to participate, 411 met eligibility criteria for lung cancer screening. 370 patients underwent their baseline LDCT during this time period. 203 males (55%) and 167 females received baseline LDCT, with a mean age of 60 years. The median pack-years was 42 (range 20-132), and 81% of participants were current smokers. The ethnic makeup of the population was 77% black, 9% white, 8% Hispanic/Latino, and 5% Asian. 57% of participants had no more than a high school education. 33% of participants reported occupational exposure to one or more lung carcinogens. 84% (312) of patients received a Lung-RADS score of 1 (92) or 2 (220), 8% (29) received a score of 3, 5% (19) a score of 4A, and 3% a score of 4B (8) or 4X (2). 3 patients have been diagnosed with lung cancer to date: 1 stage IIB, 1 stage IIIIB, and 1 stage IV. 28% (105) of patients had potentially significant incidental findings including interstitial lung disease (16), severe emphysema (14), aortic aneurysm (7), moderate-severe coronary calcifications (45), extrapulmonary masses (32), and pulmonary hypertension (4). 54% (147/271) of participants who were due for annual rescreening returned for their first annual LDCT. 93% (136) of these patients received a Lung-RADS score of 1 (21) or 2 (115), 3% (4) received a score of 3, 1% (2) a score of 4A, and 3% a score of 4B (5) or 4X (0).

CONCLUSION
Lung cancer screening with LDCT in a minority, socioeconomically disadvantaged, high-risk population is feasible but may yield a different lung cancer profile than screening in more privileged communities. Adherence to annual rescreening and follow-up recommendations is challenging in this population.

CLINICAL RELEVANCE/APPLICATION
Minority, socioeconomically disadvantaged populations may experience different benefits from LDCT lung cancer screening.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Cameron Hassani, MD - 2018 Honored Educator Farhood Saremi, MD - 2015 Honored Educator

SSC03-08 Performance of the Vancouver Risk Calculator Compared to ACR Lung-RADS in an Urban, Diverse Clinical Lung Cancer Screening Cohort
PURPOSE
To compare the performance of the Vancouver Risk Calculator (VRC) with ACR Lung-RADS for a lung cancer screening cohort in an urban, diverse clinical setting.

METHOD AND MATERIALS
IRB approval was obtained. All lung cancer screening patients who had their initial screening CT from December 2012-June 2016 demonstrating a nodule comprised the study population. Each exam was assigned a Lung-RADS score, with 4A and 4B considered positive. The VRC calculates the risk of cancer at different thresholds using 9 patient and imaging variables, with a 5% threshold considered positive. Analysis was performed on a per-patient level based on the largest nodule. Follow-up information was obtained via EMR, cancer registry and NDI. Patients with initial studies suspicious for malignancy but without histologic confirmation were adjudicated on a case-by-case basis. Performance characteristics to predict lung cancer were compared for Lung-RADS and VRC.

RESULTS
486 patients, 261 (53.7%) women, mean age 63±5.2, comprised the study population. Mean follow-up time was 36.9±11.1 months, and 61 (12.6%) patients were lost to follow-up. Lung cancer was diagnosed in 35 (7.2%). Lung-RADS had 10 FP and 14 FN while VRC 5% had 30 FP and 8 FN. Overall sensitivity, specificity and accuracy for Lung-RADS was 61.1%, 97.8%, and 94.9% and for VRC 5% was 77.8%, 93.3%, and 92.2%, respectively.

CONCLUSION
In comparison with Lung-RADS, the VRC demonstrated higher sensitivity but lower specificity and accuracy in predicting malignancy among patients in a diverse clinical lung cancer screening program.

CLINICAL RELEVANCE/APPLICATION
LungRADS and VRC achieved complementary results in a diverse urban clinical lung cancer screening program. Use of the two, in concert, may improve lung cancer prediction.
up, and treatment were extracted from CMS procedure cost data and the literature. Sensitivity analysis was performed on Sn/Sp of MRI and costs of MRI. Results of interest include life-years/patient (LYs), net monetary benefit (NMB), and cost-effectiveness (C/E) of MRI relative to LDCT.

RESULTS

LYs for MRI screening were 13.28 vs. 13.29 for LDCT. Using an acceptable cost/LY of $100,000, MRI resulted in a net-monetary benefit (NMB) of $3,744 over LDCT. MRI saves $2656/patient over LDCT, while losing only 3.97 life days, for a favorable C/E ratio of $244,189/LY. Cost ranging from $256 to $375 result in a favorable C/E ratio for MRI.

CONCLUSION

Based on this simulation, MRI provides an equivalent LY benefit with cost-savings over LDCT lung cancer screening at reasonable MRI costs. This finding is driven by improved specificity of MRI for solid nodule characterization.

CLINICAL RELEVANCE/APPLICATION

Markov simulation of a high-risk screening cohort shows that Lung MRI has the potential to be a cost-effective alternative to low-dose CT screening.
Model-Based Iterative Reconstruction on 80kV CT Pulmonary Angiography: Image Quality and Radiation Dose Saving Compared with Hybrid Iterative Reconstruction on 100kV CT Study

PURPOSE
To evaluate dose reduction and image quality of 80 kV CT pulmonary angiography (CTPA) reconstructed with model-based iterative reconstruction (IMR), and compared with 100 kV CTPA with hybrid iterative reconstruction (iDose4).

METHOD AND MATERIALS
One hundred and fifty-one patients were prospectively investigated for pulmonary embolism; a study group of 76 patients underwent low-kV setting (80kV, automated mAs) CTPA study, while a control group of 75 patients underwent standard CTPA protocol (100kV; automated mAs); all patients were examined on 256 MDCT scanner (Philips iCTelite). Study Group images were reconstructed using IMR while the Control Group ones with iDose4. CTDIvol, DLP and ED were evaluated. Region of interests placed in the main pulmonary vessels evaluated vascular enhancement (HU); signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated.

RESULTS
Compared to iDose4-CTPA, low kV IMR-CTPA presented lower CTDIvol (6.41 ± 0.84 vs 9.68 ± 3.5 mGy) and DLP (248.24 ± 3.2 vs 352.4 ± 3.59 mGy x cm), with ED of 3.48 ± 1.2 vs 4.93 ± 1.8 mGy. Moreover IMR-CTPA showed higher attenuation values (670.91 ± 9.09 HU vs 292.61 ± 15.5 HU) and a significantly higher SNR (p<0,0001) and CNR (p<0,0001). The subjective image quality of low kV IMR-CTPA was also higher compared with iDose4-CTPA (p<0,0001).

CONCLUSION
Low dose CT with IMR represents a feasible protocol for the diagnosis of pulmonary embolism in the emergency setting and permits to achieve excellent diagnostic images (in terms of subjective quality) with extremely low noise, and a significant reduction of the dose led to the patient (in terms of mSv) within reasonable reconstruction times (less than 120 seconds).

CLINICAL RELEVANCE/APPLICATION
Low kV IMR approach allows a significant dose reduction of CTPA studies improving attenuation values, SNR and CNR in the pulmonary vessels, as compared with standard kV iDose4-CTPA.
**PURPOSE**

Aim of this study was to evaluate the validity of a new system score and its utility in the Emergency Room to establish the necessity to drainage pneumothorax diagnosed by ultrasound in unstable adults major trauma.

**METHOD AND MATERIALS**

Retrospective observational study that involved, from January 2015 to January 2018, 274 adults patients with pneumothorax, evaluated by lung ultrasound in Emergency Room during Primary Survey. All ultrasound were performed with portable ultrasound machine in Emergency Room, with patients lying on the spinal board stretcher. It was applied a system score which included the evaluation of the lung point site (parasternal =1, emiclavear =2 or axillary line=3), the presence of pleural effusion (>300 ml=1 o 0) and the position of the heart (with o without dislocation=1 o 0). Cut off established to indicate the necessity of the thorax drainage was 4. All patients underwent to MDCT (gold standard) and the results compared.

**RESULTS**

Among the enrolled patients with pneumothorax 184/274 had a score > 4 and the necessity of a drainage was indicated on the report. Of these in 164 the necessity was confirmed by CT, while in 20 the patients were just observed. Among the 20 'false positive to need drainage' of our retrospective review, someone had a high BMI (8), someone had subcutaneous emphysema (5), while in the other or there was an overvaluation by the US evaluation or the patients conditions improved (7).

**CONCLUSION**

Our data regarding the validity of a new system score should be useful in deciding the necessity of a draining tube in major trauma unstable patients. This score would allow an early diagnosis and a promptly therapeutic decision, avoiding wasting time, essential in patients with many traumatic lesions and above all with serious pneumothorax.

**CLINICAL RELEVANCE/APPLICATION**

Identify an useful new scoring system, helpful to establish the necessity to drainage pneumothorax diagnosed by ultrasound, in unstable adults major trauma.

**SSC04-03 Identifying Patients with Low Cardiac Output Using Vessel Density at CTPA**

**METHOD AND MATERIALS**

We retrospectively identified patients who underwent SGC or CMR within 14 days of CTPA between 1/1/2006 to 12/30/2016. Using CO values from SGC or CMR as the gold standard, patients were stratified into three groups: CO < 4 L/min (low), 4-8 L/min (normal), and over 8 L/min (high).

All CT studies were performed using a standardized protocol with a fixed delay of 22 sec and an injection rate of 4 cc/s. For each patient, density (HU) was measured in the superior vena cava [SVC], main pulmonary trunk [PT], and ascending aorta [AO] on a single mid-thoracic transaxial slice. Densities and density differences were then compared with measured values of CO.

**RESULTS**

We identified 119 patients with concurrent CO measurements and CTPA studies within the study period. Compared to patients with normal CO (n=76, 63.9%), patients with low CO (n=35, 29.4%) exhibited higher attenuation in the SVC (1305±846 vs 944.4±556.8 HU, p=0.026) and PT (518.4±149.6 vs 385.3±122.4 HU, p<0.001). Adjusting for body surface area, PT-AO difference predicts low CO (OR per unit increase 1.007, 95% CI 1.004-1.010, p<0.001). ROC analysis yielded a PT-AO difference threshold of 130 HU for differentiating low from normal CO, with sensitivity and specificity of 74.3% and 87.7% (AUC 0.776, p<0.001).

**CONCLUSION**

This study provides a simple approach to estimate low CO status by measuring vessel density on a single transaxial CTPA image at the level of the mid-ascending aorta. We found that the greater the attenuation difference between the PT and AO, the greater the odds of low CO, with a difference of 130 HU serving as a useful threshold distinguishing low from normal CO.

**CLINICAL RELEVANCE/APPLICATION**

Using a standardized CTPA protocol it may be possible to confidently identify patients with reduced cardiac output.
**Multi Factorial Comparative Study of Dual Source CT Scanners in Acute Pulmonary Embolism**

Monday, Nov. 26 11:00AM - 11:10AM Room: S504AB

Participants
Waleed Abdellatif, MD, Vancouver, BC (Presenter) Nothing to Disclose
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**PURPOSE**
To compare mean acquisition time, image quality and diagnostic accuracy of two dual-energy CT scanners for the evaluation of acute pulmonary embolism (PE).

**METHOD AND MATERIALS**
Total of 50 scans on the 2nd generation dual source SOMATOM Definition Flash CT scanner (the Flash) and 49 scans on the 3rd generation dual source SOMATOM Force (the Force) were included. Scans with inadequate opacification of pulmonary artery or known chronic PE were excluded. Imaging acquisition parameters were adjusted to be the same on both the Force and the Flash. In a randomized blinded design, two radiologists independently reviewed both sets of scans in two settings (3-week interval) for image quality using a 5-point scale. The interobserver reliability and diagnostic accuracy were calculated for each reviewer. Diagnosis of acute PE was made using clinical data (acute chest pain), laboratory data (D-Dimer > 500 ug/L) and CTPA.

**RESULTS**
Mean acquisition time for the Force (x= 2.81 sec, SD= 0.1) and the Flash (x= 9.7 sec, SD = 0.15) was found to be very statistically significant (P= 0.0001; 95% CI = 6.8 - 6.9) with the Force 3.4 times faster than the Flash. The mean image quality was found to be 4.47/5 and 4/5 for the Force and the Flash respectively with statistical significance (P= 0.0064 on the unpaired t-test; 95% CI= 0.80-0.13). Interobserver reliability for image quality indicates strong agreement on both, the Force (K= 0.83, p <0.005) and the Flash-generated scans (k= 0.85, p < 0.005). Acute PE was diagnosed in 17 cases on the Force and in 21 cases on the Flash. Diagnostic accuracy was 94.1% and 98.2% on the Force and 90.2% and 94.8% on the Flash for reviewers one and two respectively. Although diagnostic accuracy was higher on the Force, the difference wasn't statistically significant. Study limitations includes retrospective design and Berkson's selection bias as the Force was routinely used for emergency patients while the Flash was used for inpatients.

**CONCLUSION**
Image quality is significantly higher on the Force CT scanner with significantly lower mean acquisition time and less motion artifact in comparison to the Flash.

**CLINICAL RELEVANCE/APPLICATION**
The improved image quality and speed of the Force CT scanner with resultant less motion artifact and repeated studies could be particularly useful in emergency radiology setting with large patient volume.

**Axial or Helical? CT Imaging of the Chest for Uncooperative Emergency Patients with 16-cm Wide Detector CT**

Monday, Nov. 26 11:10AM - 11:20AM Room: S504AB

Participants
Yanan Li, Xian, China (Presenter) Nothing to Disclose
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**PURPOSE**
To compare image quality and radiation dose between the fast-helical mode (FHM) and two-axial mode (TAM) in chest CT imaging for uncooperative emergency patients with 16-cm wide detector CT scanner.

**METHOD AND MATERIALS**
Thirty emergency patients who were unconscious or uncooperative with the breathing instructions underwent chest CT were prospectively divided randomly into two groups: FHM Group (n=15, helical scan mode with 80mm detector coverage and pitch 0.992:1), TAM Group (n=15, axial scan mode with 160mm detector coverage, two scans). Both groups used the 0.28s rotation speed and automatic tube current modulation. All scans were performed in free-breathing. CT value, image noise and signal-to-noise ratio (SNR) were measured at each of the following locations: descending thoracic aorta, lung parenchyma and paraspinal muscle at the level of the carina. Two radiologists assessed the images for subjective image quality, motion artefacts and diagnostic confidence. The volume CT dose index (CTDIvol) and dose-length product (DLP) were evaluated from the dose reports, and effective dose was calculated. All measurements between the two groups were statistically compared.

**RESULTS**
The mean total exposure time was significantly shorter for TAM group than FHM group (0.56s vs.1.12s, P<0.001). Image quality was generally better with TAM than with FHM (diagnostic confidence score, 3.87 vs. 3.47, P<0.05); However, there was no...
significant difference in CT value, image noise and SNR between two groups. The DLP value was higher in FHM than TAM (123.92±43.54mGy·cm vs. 94.22±33.63mGy·cm, P=0.041), while CTDIvol was not significantly different. TAM group reduced the total effective radiation dose by 24% compared to FHM (1.32±0.50 mSv vs. 1.73±0.54 mSv).

CONCLUSION

The use of the two-axial mode further reduces the scan time in chest CT for emergency patients and ensures good image quality with 24% radiation dose reduction, compared with chest CT that uses the fast-helical scan with 80mm collimation.

CLINICAL RELEVANCE/APPLICATION

The two-axial scan mode can be used for lung evaluation in uncooperative emergency patients in free breathing to obtain satisfactory image quality while reducing radiation dose.

SSC04-06 Utility of 3D Post-Processing Cinematic Rendering Reconstruction Images in Acute Trauma Setting: Initial Observations

PURPOSE

Multiple post-processing reconstruction techniques based on volumetric CT datasets are used to generate three-dimensional (3D) images to better depict complex anatomical details. Volume rendering (VR) is frequently used as a standard 3D technique, however recently an FDA-approved alternative called Cinematic Rendering (CR) is emerging with vast clinical potentials (1,2). Contrary to traditional VR reconstruction, CR utilizes a global illumination model to create high definition photo-realistic images. We describe our initial experience with CR images in the setting of acute trauma.

METHOD AND MATERIALS

A set of polytrauma patients with ISS score >16 with simple to complex injuries presenting to Vancouver General Hospital, level 1 trauma center were evaluated. Source DICOM images using a 2nd generation 128-slice dual-source CT (Somatom Definition Flash, Siemens Healthineers, Forchheim, Germany) were used to create CR images. Cinematic Rendering software (Siemens Syngo.via Frontier) was used applying default and customized presets. CR images were assessed for image quality, depth and shape perception, delineation of osseous, vascular, soft tissue and solid organ anatomy in comparison to VR images. The images were also evaluated for their role in clinical decision making and education. Multiple trauma surgeons assessed the images using Likert scale analysis with 1 being much lower, 3 equivocal, and 5 much higher. Frequencies, percentages, mean and standard deviation were calculated.

RESULTS

CR images were rated higher than VR images with a mean±SD of 4.0±0.8. 67 % of trauma surgeons categorized CR images as much higher for use as an education tool and 61% graded them as higher in helping with clinical decision compared to VR images.

CONCLUSION

Our observations are one of the very few initial studies to evaluate the clinical utility of CR images. Understanding complex and challenging anatomical and pathological details are imperative for better patient management from a trauma surgeon assessment. CR provides remarkable details relative to VR reconstructions in context of complex acute trauma.

CLINICAL RELEVANCE/APPLICATION

Cinematic Rendering is a promising novel technique to display visually receptive 3D photorealistic high definition images with exquisite anatomical details. Formal evaluations and research is needed to assess the CR images in order to understand their clinical application in patient management.

SSC04-07 Improving Pulmonary Embolism Detectability for Computer-Aided Detection Software Using Optimal Kev Monochromatic Images in Dual-Energy Spectral CT

PURPOSE

To compare pulmonary embolism detectability using computer-aided detection (CAD) software with optimal keV monochromatic images and conventional images.
METHOD AND MATERIALS
Retrospectively analyzed CT images of 20 patients with clinically proven pulmonary embolism (PE). These patients underwent CT pulmonary angiography (CTPA) with spectral imaging mode. The conventional images (140kVp polychromatic, group A) were reconstructed. Using the standard Gemstone Spectral Imaging (GSI) viewer on an advanced workstation (AW4.6), an optimal energy level (group B) could be automatically obtained. The images in two group were independently analyzed for detecting PE using a commercially available CAD software. Two experienced radiologists reviewed all images and recorded the number of emboli, and the results were used as the gold standard. The attenuation in the main pulmonary artery (MPA) and the embolus (in the most substantial part of the embolus) were measured. The difference in attenuation (MPA-embolus), as well as the detectability for pulmonary embolism in each case (sensitivity, false positive rate) were calculated. Data were statistically compared between the two groups.

RESULTS
The optimal energy levels were 62.4keV. The attenuation in the MPA, difference in attenuation (MPA-embolus) for group A and B were (314.46±81.41HU vs. 446.30±151.88HU) and (281.89±73.82HU vs. 404.75±138.74HU), respectively (all p<0.001). The mean sensitivity for pulmonary embolism detection in group A was 74.63±6.16%, which was lower than the 82.17±4.51% in group B (t=-4.26, p<0.001). The mean false positive rate in group A was 32.71±4.89%, which was higher than the 13.41±3.02% in group B (t=13.41, p=0.00).

CONCLUSION
Compared with conventional images, the combination of optimal keV monochromatic images and CAD improves the diagnostic accuracy of CAD.

CLINICAL RELEVANCE/APPLICATION
The combination of optimal keV monochromatic images and CAD could improve the detection rate for emboli.

SSC04-09 Implementation of Fully Automated Computer-Aided Detection of Nodules in The Lung Bases on Emergent Abdominal CT Scans: Accuracy and Effect on Workflow

Participants
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Vahid Yaghmai, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the value of fully automated computer-aided diagnosis (CAD) for detection of lung nodules on emergent abdominal CT studies in.

METHOD AND MATERIALS
Abdominal CT scans of 50 patients in the emergency department were reviewed. A radiologist with 5 years’ experience (RAD) reviewed the scans to detect pulmonary nodules in the lung bases. In order to simulate the emergency setting, time limit of 30 seconds was set in each case for RAD to review image datasets. The CAD detection performance was also evaluated in the same session by RAD. CAD nodule detection was fully automated and required no additional processing time by RAD. Fisher’s exact test and T-test were used to determine the differences between the rate of detection between RAD and CAD.

RESULTS
A total number of 54 nodules were detected by RAD in 50 patients (28 male, mean±SD age, 51.2±17.6 years). Adding the CAD increased the rate of detection by 30% (1.47 vs. 1.13 nodule/scan, P<0.05). Moreover, there was no significant difference in the rate of missed nodules per scan between CAD and RAD (0.33 nodule /scan vs. 0.25 nodule/scan), respectively. 25 out of 74 nodules detected by CAD were false positives.

CONCLUSION
Using fully automated CAD may significantly improve the performance of the radiologist in detecting nodules located in the lung bases on abdominal CT scans obtained in the emergency department.

CLINICAL RELEVANCE/APPLICATION
The role of CAD as a second reader may improve detection of lung base nodules on emergency department abdominal CT scans.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Vahid Yaghmai, MD - 2012 Honored EducatorVahid Yaghmai, MD - 2015 Honored EducatorVahid Yaghmai, MD - 2017 Honored Educator

SSC04-08 Implementation of Fully Automated Computer-Aided Detection of Nodules in the Lung Bases on Emergent Abdominal CT Scans: Accuracy and Effect on Workflow

Participants
Leena Robinson Vimala, MD, Vellore, India (Presenter) Nothing to Disclose

PURPOSE
To assess the value of fully automated computer-aided diagnosis (CAD) for detection of lung nodules on emergent abdominal CT scans in.
Melioidosis being a mimicker of its more common clinical counterpart tuberculosis, is often mismanaged. The primary objective is to describe the spectrum of radiological manifestations of melioidosis. Secondary objectives are to evaluate the association between the organ involvement, known risk factors, predisposing conditions and also to predict effect on clinical outcome.

**METHOD AND MATERIALS**

Retrospective image analysis of all culture proven cases of Burkholderia pseudomallei, between January 2011 & October 2017 was done. Demographic data, clinical characteristics, risk factors and clinical outcome were analysed. Unfavourable clinical outcome considered were those patients with severe disease condition requiring ICU admission for administration of ionotropes, requirement of ventilation or death.

**RESULTS**

194 patients (162 males) with median age of 45 years, were included. Among the risk factors, diabetes mellitus was most common (63%), followed by alcohol abuse (28%). Table 1 demonstrates the radiological manifestation of organ/system involvement of melioidosis. Patients with diabetes were found to have increased incidence of liver, spleen, bone and soft tissue involvement (p<0.05). Significant association of diabetes with liver, spleen and bone and soft tissue involvement seen, having odds ratios 3.213 (95% CI: 1.048 - 9.855; p=0.04), 3.478 (95% CI: 1.728-7; p<0.001) & 2.668 (95% CI: 1.232 - 5.778; p<0.001) respectively. Statistical significant difference was identified in the melioidosis involvement of genitourinary tract between the positive and negative TB group. 25% of patients suffered unfavourable outcome. Mortality was 11%. Using univariate binary logistic regression analysis, lung involvement was found to have 4.3 times risk for unfavourable outcome (95% CI 1.971 - 9.496; p< 0.001), whereas spleen and lymph node involvement, protected from unfavourable outcome (odds ratio being 0.202 & 0.457 respectively).

**CONCLUSION**

The constellation of imaging findings could mimic disseminated tuberculosis or other pyogenic infection. Combination of organ involvement, associated superficial soft tissue involvement are imaging diagnostic clues. Knowledge about the radiological manifestations of melioidosis is essential for accurate diagnosis and management.

**CLINICAL RELEVANCE/APPLICATION**

Present study is the largest study that has illustrated the radiological manifestations of melioidosis and its association with clinical outcome and risk factors.
Correlation of Sterno-Aortic Distance with FEV1/FVC and FEV1 in Patients with COPD

**METHOD AND MATERIALS**

Eighty-one patients diagnosed with COPD who underwent chest CT scan and PFT within the period of one year were included. Sterno-aortic distance were measured and correlated with PFT results and severity of COPD. Patient's age, gender, height, and weight were recorded. The sterno-aortic distance was obtained thru their CT scan. The sterno-aortic distance was measured from the posterior surface of the sternum to the anterior margin of the aorta at the level of the carina. Two radiologists reviewed the CT scan images independently. These radiologists were blinded to the results of the pulmonary function tests (FEV1/FVC and FEV1). Measurements obtained by these radiologists were analyzed using t-test to check for interobserver variability. These measurements were correlated with the FEV1/FVC and FEV1 of patients who underwent pulmonary function tests results using Pearson correlation. These measurements were correlated with the severity of COPD according to the GOLD criteria.

**RESULTS**

Most patients enrolled were males with average age of 64 ± 11years old. Most of these patients are categorized as mild COPD with 38 % and severe COPD with 38% of the total population. Patients classified as moderate COPD comprise 24 % of the total population. There is significant weak inverse correlation between sterno-aortic distance and PFT results, FEV1 (r = -0.419, p < 0.001) and FEV1/FVC(r = -0.322, p value of0.003). There is a significant correlation derived between sterno aortic distance and severity of COPD(rho = 0.88, p-value of <0.001).

**CONCLUSION**

There is a significant correlation derived between sterno aortic distance and severity of COPD (rho = 0.88, p-value of <0.001).

**CLINICAL RELEVANCE/APPLICATION**

Sterno-aortic distance is a valuable parameter in the assessment of severity of COPD and is recommended in the initial work up for patients with COPD.
PURPOSE
The utility of MRI for N-staging in non-small cell lung cancer (NSCLC) has been investigated, and a meta-analysis showed that sensitivity and specificity of STIR and DWI for per-patient were 84% and 91%, and 69% and 93%, respectively. These studies used various MR scanners, pulse sequences and different diagnostic criteria; thus the purpose of our study was to elucidate the utility of STIR and DWI for N-staging in NSCLC patients in comparison with FDG-PET/CT in a multi-center study.

METHOD AND MATERIALS
A total of 125 consecutive NSCLC patients (85 men, 40 women; mean 67.4 years) from 8 hospitals prospectively underwent preoperative STIR, DWI with 1.5-T MR units under a standardized protocol. All patients underwent FDG-PET/CT in the same period. Surgical and pathologic examinations were used as a final diagnosis. To assess the utility of qualitative analysis, two chest radiologists independently analyzed STIR and DWI, and one nuclear medicine radiologist assessed FDG-PET/CT images, respectively. McNemar test was used to compare the diagnostic capabilities for N-staging per-patient, and receiver operating characteristic curve (ROC) analysis was used to compare those per-node-area.

RESULTS
Pathologic examinations showed that 68% (85/125) patients were negative, and 32% (40/125) had positive lymph node metastasis. For qualitative analysis of N-staging per patient, sensitivity, specificity and accuracy were 59.0-74.4%, 73.3-76.7%, 71.2-73.6% for STIR, 74.4-76.9%, 76.7-83.7%, 76.0-81.6% for DWI, and 74.4%, 67.4%, 71.2% for FDG-PET/CT, respectively. McNemar test showed that there was no significant difference in sensitivity; however, specificity and accuracy of DWI in reader 1 were superior to those of FDG-PET/CT. As for N-staging per node-area, areas under the ROC curve (AUC) were 0.760-0.844 for STIR, 0.787-0.827 for DWI, and 0.789 for FDG-PET/CT, respectively. There was no significant difference in AUC between STIR and FDG-PET/CT, DWI and FDG-PET/CT.

CONCLUSION
The multi-center study under a standardized protocol and diagnostic criteria using STIR and DWI showed that MRI seems to be useful as well as FDG-PET/CT in N-staging for NSCLC patients.

CLINICAL RELEVANCE/APPLICATION
The standardized protocol and criteria of N-staging using STIR and DWI might benefit patients with non-small cell lung cancer to avoid expensive costs and radiation exposure for FDG-PET/CT.
Prediction of Response to Endobronchial Coiling Based on Morphologic Emphysema Characterization of the Lung Lobe to be Treated and the Ipsilateral Non-Treated Lobe as well as on Functional CT-Data: Correlation with Clinical and Pulmonary Function

Participants
Christopher Kloth, Ulm, Germany (Abstract Co-Author) Nothing to Disclose
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Jan Fritz, MD, Baltimore, MD (Abstract Co-Author) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG
Konstantin Nikolau, MD, Tuebingen, Germany (Abstract Co-Author) Advisory Panel, Siemens AG; Speakers Bureau, Siemens AG; Speaker Bureau, Bayer AG
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Purpose
To test if the emphysema type of the targeted lobe, ipsilateral non-targeted lobe, and lobes of the contralateral lung impact outcome of endobronchial lung volume reduction (ELVR) treatment, and to document lobar volume changes in treated and non-treated lung lobes.

Method and Materials
Thirty patients (women =14; median age, 66.07± 6.66; range, 48-78y) underwent chest-CT before and after endobronchial coiling for lung volume reduction (LVR) at our institution between 12/2011 and 03/2016. Forty-five pulmonary lobes were coiled. We classified the treated lobes into homogeneous or heterogeneous emphysema phenotype based on the distribution of voxels showing tissue attenuation of less than -950 HU. Clinical response was defined as an increase or consistency in the walking distance (6MWT) 6 months after LVR-therapy. Lung volume changes were compared for treated lobes, ipsilateral lobes, and contralateral lobes. Additionally, pulmonary function tests (PFT), COPD Assessment Test (CAT), and blood gas analysis were performed

Results
Responder (19/30, 63.3%) showed a significant improvement of 6 MWT from 281.05 to 335.26 (p=0.001). Non-responder (11/30, 36.7%) showed a decrease in 6MWT from 308.18 to 255.45 (p=0.001). Responders showed a significant reduction in CAT test from 23.23 to 20.73 points (p= 0.038) and pCO2 from 42.94 to 40.31 (p=0.001). In responders, there was a significant volume reduction in treated lobes from 1627.68 mL to 1519.21 mL (p= 0.009). In responders, treated lobes/non-treated ipsilateral lobes were homogenous (n=11/5) and heterogeneous (n=10/28). In responders and non-responders, the emphysema phenotype in treated, ipsilateral non-treated and even contralateral lobes (p=0.250) did not differ and or change significantly before and after therapy. Only the volume of treated lobe in responders changed significantly after coiling.

Conclusion
The emphysema-phenotype in the targeted and non-targeted ipsilateral lobe has no impact on the outcome of endobronchial coiling for LVR and also does not change significantly after treatment, whereas the volume of the treated lobe significantly decreases in responders.

Clinical Relevance/Application
The purpose of our study was to test if the emphysema type of the targeted lobe, ipsilateral non-targeted lobe, and lobes of the contralateral lung impact outcome of ELVR treatment. Furthermore to document lobar volume changes in the different lung lobes.

Computer-aided Detection of Pulmonary Nodules Can Serve as a First Reader for Lung Cancer Screening Exams When Utilizing Lung-RADs Categorization and Management

Participants
Michelle L. Hershman, MD, Tucson, AZ (Presenter) Nothing to Disclose
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Purpose
To assess if nodule detection using CAD for lung cancer screening as an initial reader may correctly determine Lung-RADs categorization with suitable sensitivity and low false-positive rate.

Method and Materials
A retrospective study of 86 low-dose CT lung screening exams were first assessed using proposed CAD marks by 3 independent readers of variable experience (novice-expert) and then reviewed for any additional nodules. For each finding, readers specified nodule type, diameter and confidence level (1 = "not a nodule", 10 = "definitively a nodule"). The standard of reference was determined by majority agreement and arbitrated by an expert chest radiologist. The average reader sensitivity, specificity and AUC were calculated with respect to nodule as well as LRAD cutoff scores of 2 and 3. CAD standalone sensitivity and CAD and average reader per case false-positive rates were computed. Standard errors and 95% confidence intervals were derived from 1000 bootstrap samples, which were used to derive p-value comparing CAD alone and CAD plus reader.
RESULTS
CAD and/or readers identified 505 findings. True nodules (n=119) included findings >=4mm, confidence >=7.5 and were part-coded, solid or subsolid. Smaller and calcified nodules and lymph nodes were excluded (n=195). Sensitivity of CAD alone was 86% (95% CI, 80-92%) compared to the 3 reader average which was 64% (95% CI 58-69%). False-positives per case for CAD alone was 1.952 (95% CI 1.506-2.446) while the reader average was 0.088 (95% CI 0.052-0.129). Reader average specificity was 96% (95% CI 95-98%) and AUC was 0.799 (95% CI 0.770-0.829) accounting for the 191 false-positives. AUC using LRAD >=2 cutoff demonstrated no significant difference (p=0.80) for CAD alone (0.847, 95% CI 0.795-0.892) compared to CAD plus reader average (0.844, 95% CI 0.796-0.886). Using LRAD >=3 cutoff, AUC also demonstrated no significant difference (p=0.47) for CAD alone (0.821, 95% CI 0.754-0.884) versus CAD plus reader average (0.839, 95% CI 0.778-0.898).

CONCLUSION
Using a workflow with CAD as a first reader followed by radiologist review is feasible for determining Lung-RADs categorization and management.

CLINICAL RELEVANCE/APPLICATION
Computer-aided detection can serve as a first reader for detection of pulmonary nodules on lung cancer screening CT exams, producing improved sensitivity to the human reader with a very low false-positive rate and no significant changes in patient management.

CH241-ED-
MOA6
Bubbling Over: What Radiologists Should Look for Following a Positive Bubble Study
Station #6
Awards
Certificate of Merit
Participants
Jennifer A. Febbo, Chicago, IL (Presenter) Nothing to Disclose
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Haritha Yepuri, MBBS, Vijayawada, India (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS
Saline contrast echo is performed to evaluate hypoxemia and in paradoxical embolization to look for RT to LT shunting. Visualizing saline bubbles in the left heart is a positive study due to RT to LT shunt. Presence of bubbles in the left heart chambers <= 3 heartbeats indicates an intracardiac shunt; bubbles after > 3 heartbeats imply intrapulmonary shunt. Common causes of RT to LT shunting include pulmonary AVMs and pulmonary AV anastomosis such as hepatopulmonary syndrome. Familiarity with the causes of RT to LT shunt will aid the radiologist to detect it on a preexisting chest CT and also help to protocol a chest CT to detect one.

TABLE OF CONTENTS/OUTLINE
Indications and procedure for agitated saline contrast echo. Clinical context, pathophysiology and implications of positive study. Brief history of the study to better understand the positive interpretation. Echo imaging examples and limitations. V/Q scan findings. Imaging common and uncommon intracardiac, intrapulmonary RT to LT shunts. Eg: pulmonary AVM, hepatopulmonary syndrome, anomalous venous return with anomalous SVC draining into LA, SVC obstruction often with confusing bubble study results. CT protocol tips. List other causes of intrapulmonary shunting.

CH244-ED-
MOA7
Novel Ultra-High-Resolution CT Imaging for Lung Diseases
Station #7
Participants
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Noriko Kikuchi, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Shinsuke Tsukagoshi, PhD, Otawara, Japan (Abstract Co-Author) Employee, Canon Medical Systems Corporation
Ayumi Uramishi, Osaka, Japan (Abstract Co-Author) Employee, Canon Medical Systems Corporation
Noriyuki Tomiyama, MD, PhD, Suita, Japan (Abstract Co-Author) Research Grant, Canon Medical Systems Corporation

TEACHING POINTS
Ultra-high-resolution CT (U-HRCT), which has a smaller detector element and X-ray tube focus size, has become commercially available recently. U-HRCT shows improved spatial resolution and has been reported to provide better image quality for lung diseases. The purpose of this exhibit is: 1. To learn the structural and reconstruction features of U-HRCT. 2. To know the image quality of U-HRCT comparing with conventional CT. 3. To understand the clinical usefulness of U-HRCT.

TABLE OF CONTENTS/OUTLINE
**Visibility of Intralobular Bronchioles by Ultra-High Resolution CT**

**Objective:** To assess the spatial resolution on the bronchiole of ultra high resolution CT (UHRCT). To present intralobular bronchioles and intra-acinar bronchioles of extension fixed lung in UHRCT images. To compare UHRCT images with HRCT images.

**Materials and methods:**
2. CT scanners: UHRCT (Aquilion Precision), HRCT (Aquilion ONE).
3. Reconstruction using 512, 1024, and 2048 matrix sizes.
4. Evaluated bronchioles: diameter of lumen was 0.4-0.8mm, bronchial wall thickness was 0.1-0.5mm.
5. Observer subjectively scored the images on a 5 point scale (1=worst, 3=middle, 5=best), in terms of image quality of bronchial wall and bronchial lumen, and the invisible images were scored zero point.

**Results and conclusions:** Intralobular bronchioles (Ø 0.8mm) and intra-acinar bronchioles (Ø 0.4mm) were depicted by UHRCT. In chest phantom, intralobular bronchioles were depicted by UHRCT, however, intra-acinar bronchioles were not depicted. Both bronchioles were not depicted by HRCT. In the fat type phantom, the visualization was poor. We expect a further noise reduction of iterative reconstruction.

**Machine Learning-Based Analysis of MRI Radiomics: Pathological Classification and Clinical Staging Prediction of Thymic Epithelial Tumors**

**Purpose:** To predict the pathological classification and clinical staging of thymic epithelial tumors (TETs) with machine learning-based analysis of MRI radiomics.

**Method and materials:** Preoperative MRI were retrospectively obtained in 189 TETs patients with confirmed pathological classification and clinical stage.
Radiomic features (histogram, texture, form factor, co-occurrence matrix, run-length matrix and size zone matrix) were extracted from T2-weighted and T2-weighted fat-suppressed images. Cases were randomly assigned to either the training or validation cohort, and the patient imbalance were adjusted using synthetic minority oversampling technique (SMOTE). By using support vector machine with recursive feature elimination (SVM-RFE), the optimal feature subsets with the best discriminative performance were selected and used to construct two predictive models for pathological classification and clinical staging, respectively, and the performance of models were assessed.

RESULTS

Of the 2088 extracted features, the optimal feature subset including 78 features or 29 features for pathological three classification or clinical binary staging were selected to generate the predictive model. The model used for differentiating low-, high-risk thymoma and thymic carcinoma achieved accuracies of 76% (area under the curve [AUC] = 0.892) in the training cohort and 67% (AUC = 0.747) in the validation cohort, and the model used for differentiating early (stage I, II) from advanced stages (stage III, IV) of TETs achieved accuracies of 93% (area under the curve [AUC] = 0.942) in the training cohort and 83% (AUC = 0.878) in the validation cohort.

CONCLUSION

Results show that machine learning analysis of MRI radiomic features can facilitate the accurate prediction of pathological classification and clinical staging in TETs.

CLINICAL RELEVANCE/APPLICATION

Our findings indicate that quantitative radiomic analysis is a noninvasive, reliable, and reproducible methodology that may help assess and characterize TETs.

CH271-SD-MOB3  
Assessment of Different Lung Cancer Subtypes: Diagnostic Value of Quantitative Dual-Energy CT Iodine Maps Combined with Morphological CT Features

Participants
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Lan Song, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
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PURPOSE

To investigate the clinical usefulness of quantitative dual-energy CT (DECT) iodine enhancement metrics combined with morphological CT features in distinguishing lung cancer subtypes.

METHOD AND MATERIALS

Consecutive patients suspected with lung cancer were prospectively enrolled and underwent dual-source DECT prior to biopsy or surgery. Tumor histological subtypes were determined in 110 patients. Two radiologists interpreted CT morphologic features of 110 lesions in a consensual manner. Besides, radiologists contoured lesions and acquired automated computer measurements, including iodine density and iodine ratio (the ratio of iodine density of lesion to that of artery on the same section). Multinomial logistic regression models were applied to evaluate the accuracy of DECT parameters combined with CT features and CT features alone in discriminating lung cancer subtypes.

RESULTS

Histology revealed adenocarcinoma in 48, squamous cell carcinoma (SCC) in 36 and small cell lung cancer (SCLC) in 26 patients. In analysis of CT features, tumor diameter, distribution, spiculation, pleural retraction, vascular involvement, confluent mediastinal lymphadenopathy, encasement of mediastinal structures and enhancement heterogeneity showed statistical difference (all Ps<0.05). Iodine density and iodine ratio were statistically different among three lung cancer subtypes (H=16.817, P<0.001; H=20.336, P<0.001). Iodine density of adenocarcinoma and SCC was (1.50±0.80) mg/ml and (1.40±0.40) mg/ml, respectively, higher than the (1.20±0.40) mg/ml for SCLC (Ps<0.01). Iodine ratio of adenocarcinoma and SCC was (16.10±7.02) % and (15.05±6.2) %, higher than the (11.55±3.15) mg/ml for SCLC (Ps<0.01). No significant difference of DECT parameters were observed between adenocarcinoma and SCC. Accuracy of the model based on CT features was 69.1%, accuracy of the model based on CT features combined with DECT parameters was 80.9%.

CONCLUSION

Quantitative DECT metrics were different among adenocarcinoma, SCC and SCLC, when combined with morphological CT features for differentiating lung cancer subtypes, higher diagnostic performance can be achieved.

CLINICAL RELEVANCE/APPLICATION

Quantitative iodine-related parameters of dual-energy CT can improve the diagnostic performance of lung cancer subtypes on the basis of CT morphological features and is recommended in the routine evaluation of suspected lung cancers.

CH272-SD-MOB4  
Evaluation of a Virtual Anti-Scatter Grid for Bedside Chest Radiography at Intensive Care Unit: Effects on Image Quality and Radiation Dose

Participants
Ibrahim Yel, Frankfurt, Germany (Presenter) Nothing to Disclose
Benjamin Kaltenbach, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Julian L. Wichmann, MD, Frankfurt, Germany (Abstract Co-Author) Speaker, General Electric Company; Speaker, Siemens AG
**PURPOSE**

To assess the performance of a post-processed virtual anti-scatter grid (VG) for intensive care unit (ICU) bedside chest radiography compared to a conventional grid (CG).

**METHOD AND MATERIALS**

127 consecutive ICU patients underwent bedside chest radiography using three different acquisition techniques with the same flat-panel detector: CG (125 kV; 1.4 mAs), VG1 (125 kV; 1.4 mAs) and VG2 (125 kV; 1.0 mAs). Overall image quality, lung parenchyma, soft tissue, thoracic spine, foreign bodies and assessment of pathology were evaluated by four radiologists using a 9-point visibility scale. Dose-area product was noted for each examination.

**RESULTS**

Overall image quality was significantly better for VG1/VG2 compared to CG (7.3±1.1 / 7.2±0.8 vs. 6.7±0.8; p<0.001). Soft tissue, thoracic spine, foreign bodies and visibility of pathology were also rated significantly higher for both VG protocols compared to the CG examination (p<0.001), whereas visibility of lung parenchyma was equivalent (p=0.53). Lowest dose-area product was achieved with the VG2 protocol (1.1±0.2 mGy*cm²; p<0.001) while VG1 and CG showed the same dose-area product (1.5±0.3 vs. 1.5±0.3 mGy*cm²; p=0.54).

**CONCLUSION**

Bedside ICU chest radiography using a virtual anti-scatter grid resulted in largely superior image quality and similar or lower radiation exposure.

**CLINICAL RELEVANCE/APPLICATION**

Virtual anti-scatter grid post-processing may be particularly useful to optimize radiation exposure for ICU patients undergoing frequent follow-up imaging and to improve image quality in often suboptimal contrast conditions.

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**Workup of Positive Findings on Baseline Lung Cancer Screening: Implications of the Use of Two Protocols and Methods of Nodule Measurement**

**PURPOSE**

Several protocols guide the management of positive findings on low-dose CT screening for lung cancer, in order to minimize unnecessary workup. We aimed to compare the recommendations for workup based on two protocols, I-ELCAP and Lung-RADS, and to investigate the implications of using different methods for measuring of pulmonary nodule size on the rate of positive findings and, consequently, on the rates of additional follow-up exams.

**METHOD AND MATERIALS**

The effect of using either I-ELCAP or Lung-RADS protocol on workup recommendations was evaluated by applying each protocol to all 105 available cases which included at least one non-calcified nodule >=5.5 mm in our database of 1233 cases. Two nodule measurement methods were also applied to the eligible cases, and were evaluated independently for each of the two protocols. Comparison between protocols and the methods of measurement were analyzed by the McNamer test.

**RESULTS**

The follow-up recommendations according to the I-ELCAP protocol were significantly inconsistent (p < 0.001) with the Lung-RADS recommendations, mostly due to the significantly higher recommendation rate for PET-CT by Lung-RADS (p < 0.001). Measuring of only the maximal diameter of the nodule vs. the average of maximal diameter and width, resulted in a higher rate of recommendations for invasive procedures. These differences were significant for each of the protocols (Lung-RADS and I-ELCAP) separately (p<0.001). The difference in the recommendations when rounding up to the next millimeter vs. avoiding rounding up, was significant for both I-ELCAP (p <0.011) and Lung-RADS (p <0.018).

**CONCLUSION**

Application of the I-ELCAP protocol and a policy that doesn't support rounding up of nodule size may reduce the rate of unnecessary workup and prevent collateral harm. A measurement method that considers only the maximal diameter results in a higher invasive procedure rate.

**CLINICAL RELEVANCE/APPLICATION**

Use of I-ELCAP protocol and nodule measurement method may reduce unnecessary workup but prospective studies are required to assess any possible delay in lung cancer diagnosis and its consequences.
Recent Modifications to the TNM Lung Cancer Stage Classification: Wait, What? How Do I Do That?

Participants
Tugce Agirlar Trabzonlu, MD, Chicago, IL (Presenter) Grant, Siemens AG
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Hatice Savas, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
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Vahid Yaghmai, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
CT is commonly used for assessing acute and chronic lung pathologies. Although MRI is emerging as a valuable lung imaging modality to provide diagnostic utility in the evaluation of lung pathologies, it is not routinely used in clinical practice. MRI can provide a combination of valuable anatomical and functional information without the risk of radiation. MRI is widely available and may be an alternative method in evaluation the lung pathologies. The aim of this exhibit is to illustrate lung pathologies on MRI and correlate those findings with CT. Advantages of MRI in diagnosis, follow-up and characterization of lung disease will be discussed.

TABLE OF CONTENTS/OUTLINE

Honored Educators
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Vahid Yaghmai, MD - 2012 Honored Educator
Vahid Yaghmai, MD - 2015 Honored Educator
Frank H. Miller, MD - 2012 Honored Educator
Frank H. Miller, MD - 2014 Honored Educator
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Frank H. Miller, MD - 2018 Honored Educator

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CH243-ED- Recent Modifications to the TNM Lung Cancer Stage Classification: Wait, What? How Do I Do That?

Participants
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Alan M. Ropp, MD, Brooklyn, NY (Abstract Co-Author) Nothing to Disclose
Juliana M. Bueno, MD, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
After reviewing this educational exhibit, the learner will be able to: Identify the key distinguishing features of the 8th edition of the TNM lung cancer stage classification. Identify specific challenging situations that may arise when applying the new T and M descriptors. Apply the new criteria for lung cancer staging in potentially challenging cases with a better understanding of the classification.

TABLE OF CONTENTS/OUTLINE
Key distinguishing features between the 7th and 8th editions Potential challenges to application in clinical practice: Distance of a lesion from the carina is no longer a T descriptor, but involvement of the carina is. How is carinal involvement defined? Diaphragmatic invasion is now classified as T4. How is diaphragmatic invasion defined? Parietal pleural invasion is defined as T3. How is parietal pleural invasion defined? Mediastinal pleural invasion is no longer a descriptor, although parietal pericardial invasion is considered T3 and cardiac invasion is considered T4. How is pericardial invasion identified and distinguished? Involvement of the great vessels is considered T4. How is vascular involvement defined? How are multiple synchronous lung cancers staged? How are infiltrative tumors measured?

Monday, Nov. 26 1:30PM - 3:30PM Room: E451A

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

FDA Discussions may include off-label uses.

Participants
Jose L. Criales, MD, Mexico City, Mexico (Moderator) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (Moderator) Royalties, Reed Elsevier

LEARNING OBJECTIVES
1) Identify the morphological and functional modifications post treatment in oncological patients / Identificar los cambios morfológicos y funcionales post tratamiento en el paciente oncológico. 2) Review potential pitfalls in the evaluation of imaging studies performed on patients who received therapy for malignant neoplasms / Revisar causas de posibles errores diagnósticos en la evaluación de imágenes post tratamiento de neoplasias malignas. 3) Describe the most appropriate imaging tests for identification of possible recurrence of malignant tumors after therapy / Describir los estudios de imágenes más apropiados para identificar recurrencias de tumores malignos post tratamiento

Sub-Events

Participants
Jose L. Criales, MD, Mexico City, Mexico (Presenter) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (Presenter) Royalties, Reed Elsevier

LEARNING OBJECTIVES
1) Identify the morphological and functional modifications post treatment in oncological patients / Identificar los cambios morfológicos y funcionales post tratamiento en el paciente oncológico. 2) Review potential pitfalls in the evaluation of imaging studies performed on patients who received therapy for malignant neoplasms / Revisar causas de posibles errores diagnósticos en la evaluación de imágenes post tratamiento de neoplasias malignas. 3) Describe the most appropriate imaging tests for identification of possible recurrence of malignant tumors after therapy / Describir los estudios de imágenes más apropiados para identificar recurrencias de tumores malignos post tratamiento

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Jorge A. Soto, MD - 2013 Honored EducatorJorge A. Soto, MD - 2014 Honored EducatorJorge A. Soto, MD - 2015 Honored EducatorJorge A. Soto, MD - 2017 Honored EducatorJorge A. Soto, MD - 2018 Honored Educator

SPSP21A Bienvenida / Welcome

Participants
Jose L. Criales, MD, Mexico City, Mexico (Moderator) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (Moderator) Royalties, Reed Elsevier

LEARNING OBJECTIVES
1) Be familiar with the overall incidence of lung cancer and survival curves in patients undergoing treatment. 2) Learn how new treatment options are being utilized to improve overall outcomes. 3) Understand the difference between the traditional forms of lung cancer treatment such as surgical resection, chemotherapy (adjuvant), radiation therapy and new therapies such as targeted therapy that disrupt the cancer cell ability to reproduce. 4) Be aware of how follow up imaging findings such as those of PET/CT may be different in the traditional treatment than in new forms of therapy.

SPSP21B Cáncer de Pulmón / Lung Cancer

Participants
Fernando R. Gutierrez, MD, Saint Louis, MO (Presenter) Spouse, Stockholder, UnitedHealth Group

For information about this presentation, contact:
gutierrezf@wustl.edu

LEARNING OBJECTIVES
1) Be familiar with the overall incidence of lung cancer and survival curves in patients undergoing treatment. 2) Learn how new treatment options are being utilized to improve overall outcomes. 3) Understand the difference between the traditional forms of lung cancer treatment such as surgical resection, chemotherapy (adjuvant), radiation therapy and new therapies such as targeted therapy that disrupt the cancer cell ability to reproduce. 4) Be aware of how follow up imaging findings such as those of PET/CT may be different in the traditional treatment than in new forms of therapy.

SPSP21C Linfoma / Lymphoma

Participants
Sebastian A. Rossini SR, Mar del Plata, Argentina (Presenter) Educational Exhibit, Baye AG; Educational Exhibit, Boehringer Ingelheim GmbH;
LEARNING OBJECTIVES
1) Show the typical images of lymphoma. 2) Method of choice images for pre and post-treatment assessment. 3) Forms of post-treatment presentation in PET-CT. 4) Importance of the correct post-therapeutic imaging evaluation.

**SPSP21D**  Melanoma / Melanoma

Participants
Guillermo Elizondo-Riojas, MD, PhD, Monterrey, Mexico (Presenter) Nothing to Disclose

For information about this presentation, contact: elizondoguillermo@hotmail.com

LEARNING OBJECTIVES
1) Apply the most appropriate imaging examinations to patients with melanoma. 2) Understand the rationale for using a specific imaging test in the follow-up of melanoma patients. 3) Interpret the imaging findings associated with the different therapies for melanoma patients.

**SPSP21E**  Preguntas / Q & A

**SPSP21F**  Presentación del CIR / CIR Update

Participants
Henrique Carrete Jr, MD, Sao Paulo, Brazil (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Present the CIR and its main educational activities. 2) Address the activities of the CIR throughout the year 2018. 3) Outline future directions of CIR.

URL
http://www.webcir.org/

**SPSP21G**  Tumores Neuroendocrinos / Neuroendocrine Tumors

Participants
Giancarlo Schiappacasse, MD, Las Condes, Chile (Presenter) Nothing to Disclose

For information about this presentation, contact: gschiappacasse@gmail.com

LEARNING OBJECTIVES
1) Be familiar with the epidemiology, incidence and survival of neuroendocrine tumors. 2) Know the most appropriate imaging modalities (CT, MRI and PET/CT) for control and follow up. 3) Understand the different therapies such as surgical procedures, conventional chemotherapy, immunotherapy and targeted therapy.

**SPSP21H**  Cáncer Cervico-uterino / Cervical Cancer

Participants
Javier A. Romero, MD, Bogota, Colombia (Presenter) Speakers Bureau, Novartis AG; Speakers Bureau, Bristol-Myers Squibb Company

LEARNING OBJECTIVES
1) Describe basic principles of cervical Cancer treatment. 2) Why using MRI in cervical Cancer. 3) MRI findings in post treatment in cervical cancer. 4) Other imaging methods for evaluating patients in post cervical Cancer Therapy.

**SPSP21I**  Cáncer de Ovario / Ovarian Cancer

Participants
Alice Cristina C. Brandao Salomao, MD, Rio de Janeiro, Brazil (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
Postoperative evaluation ovarian cancer How to follow up How to perform recurrence investigation What is the recurrence pattern, typical and atypical

**ABSTRACT**
Ovarian cancer is the most aggressive gynecological cancer. Its standard post treatment is remission and recurrence due to primary and secondary cytoreductive surgery, chemotherapy and immunotherapy. During our presentation we aim to evaluate post-therapeutic follow-up, including screening and suspected relapse, identifying which tests should be performed. In addition, we will evaluate the pattern of recurrence, common and unusual.

**SPSP21J**  Preguntas / Q & A

**SPSP21K**  Clausura / Closing

Participants
Jose L. Criales, MD, Mexico City, Mexico (Presenter) Nothing to Disclose
LEARNING OBJECTIVES

1) Identify the morphological and functional modifications post treatment in oncological patients / Identificar los cambios morfológicos y funcionales post tratamiento en el paciente oncológico. 2) Review potential pitfalls in the evaluation of imaging studies performed on patients who received therapy for malignant neoplasms / Revisar causas de posibles errores diagnósticos en la evaluación de imágenes post tratamiento de neoplasias malignas. 3) Describe the most appropriate imaging tests for identification of possible recurrence of malignant tumors after therapy / Describir los estudios de imágenes más apropiados para identificar recurrencias de tumores malignos post tratamiento.

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SSE05-01  Generation-Based Airway Remodeling in Smokers with Normal-Looking CT: After Normalization to Control Inter-Subject Variability

**Participants**

Yoshiharu Ohno, MD, PhD, Kobe, Japan (Moderator) Research Grant, Canon Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Fuji Pharma Co, Ltd; Research Grant, Guerbet SA; Matthew J. DeVries, MD, Omaha, NE (Moderator) Nothing to Disclose

**Sub-Events**

**SSE05-02**  Enhanced Evaluation of Tracheomalacia with Use of Cyclic Ultra-low Dose Dynamic Expiratory CT

**Participants**

Kum Ju Chae, MD, Jeonju, Korea, Republic Of (Presenter) Nothing to Disclose

Gong Yong Jin, MD, PhD, Jeonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Jiwoong Choi, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Chang Hyun Lee, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Sanghun Choi, Daegu, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Ching-Long Lin, PhD, Iowa City, IA (Abstract Co-Author) Founder, VIDA Diagnostics, Inc; Shareholder, VIDA Diagnostics, Inc; Advisory Board, Siemens AG

**For information about this presentation, contact:**
para2727@gmail.com

**PURPOSE**

As the quantitative airway analysis has been evolved, the effect of smoking has been established. However, the generation-based smoking effect where inter-subject variabilities are normalized is rarely known. The purpose of this study is to evaluate a prediction model of airway parameters, and further to investigate generation-based structural and functional airway alterations in smokers with the derived normalization scheme.

**METHOD AND MATERIALS**

68 smokers and 174 nonsmokers with inspiratory/expiratory CT findings, and normal pulmonary function tests were included in the study. VIDA Apollo software (Coralville, IA) was used for the airway size analysis. To control inter-subject variability, multiple linear regressions of tracheal wall thickness (WT), diameter (D), and luminal area (LA) were used for the normalization of airway parameters considering the effects of age, sex and height. Using this scheme, each airway parameter was normalized by individual predicted values, and normalized WT (WT*), D (D*), LA (LA*) from the 1st to 8th generation of each lobe were compared between smokers and non-smokers.

**RESULTS**

LA* and D* decreased and WT* increased in the smokers after normalization (p<0.05), which was not observed before normalization. The wall thickness of the segmental airways in smokers was not changed between inspiration and expiration (WT*ins-WT*exp= 0.01±0.01), whereas that in non-smokers was thicker at expiration than inspiration (-0.02±0.01). Besides, airways at the 3rd generation showed significant wall thickening in smokers than nonsmokers (p=0.003).

**CONCLUSION**

Quantitative CT assessment using a normalization scheme suggest that smoking may induce airway wall thickening and reduce changes of wall thickening during respiration, which means a decrease in airway wall compliance. Generation-based analysis showed that the 3rd generation is most affected by smoking.

**CLINICAL RELEVANCE/APPLICATION**

When it comes to the effect of smoking, it is important to perform normalization and focus on wall thickening of segmental airways.
also showed positive correlation with serum IgE and induced sputum MMP-9 ($r=0.509, 0.636$, all $P<0.05$).

were significantly negative correlated with FEV1/FVC and FEV1% (WT, $r=-0.621, -0.483$, WA%, $r=-0.729, -0.548$, all $P<0.05$). WA% $r=0.669, 0.533$, Ai, $r=0.681, 0.552$, all $P<0.05$). Ai also showed positive correlation with FEV1% ($r=0.452$, $P<0.05$). WT and WA% were significantly less than the corresponding group ($t=-2.448$, $P<0.05$). LD and Ai had negative correlation with course of disease and induced sputum Eos% ($LD, r=-0.512, -0.841$, Ai, $r=-0.489, -0.841$, all $P<0.05$), and positive correlation with FEV1/FVC and serum leptin ($LD, r=0.276, 0.245, -0.492$, all $P<0.05$). 40% Percentage of patients with TM diagnosis, and distribution of TM severity between DECT1, DECT2 and mDECT were analyzed using paired 2-tailed t-test, 2-tailed binomial proportions test, and chi-squared test, respectively.

RESULTS

184 patients (41% male) with mean age of 64 were analyzed. Mean radiation dose for each DECT phase was 0.07 mSv with all studies deemed diagnostic. mDECT demonstrated 57 mean %TN, 10% greater than DECT1 and 6% greater than DECT2 (each $P<0.001$), with DECT2 9% greater mean %TN than DECT1 ($P<0.05$). 40% Percentage of patients with TM diagnosis with mDECT (40%) was 10% greater than DECT1 or 2 (each 30%, $P<0.05$). mDECT (199 negative, 31 mild, 24 moderate, and 20 severe) had significantly greater number of patients diagnosed with TM with a significantly more severe distribution of disease than DECT1 (128, 27, 21, 12) or DECT2 (127, 21, 21, 15), (each $P<0.05$) without significant differences between DECT1 and 2.

CONCLUSION

For CT evaluation of TM, mDECT demonstrated low patient radiation dose with an increase in mean %TN, a higher rate of TM diagnosis and a more severe distribution of disease than a single DECT phase alone.

CLINICAL RELEVANCE/APPLICATION

CT evaluation of TM with two ultra low dose DECTs should be considered to diagnose and grade TM.

SSE05-04 Correlation of CT Small Airway Measurement with Clinical and Inflammation Factors in Asthma Patients

Participants

Meijiao Li, MD, Beijing, China (Presenter) Nothing to Disclose
Wei Guo, Beijing, China (Abstract Co-Author) Nothing to Disclose
Huishu Yuan, Beijing, China (Abstract Co-Author) Nothing to Disclose

For information about this presentation, contact:
newgljyk@163.com

PURPOSE

To evaluate the correlation of CT small airway measurement with clinical and inflammatory indicators in Asthma Patients.

METHOD AND MATERIALS

20 patients with asthma were enrolled, all received spiral CT, pulmonary function test, serum leptin, IgE and TGF-β1, induced sputum cytology and MMP-9. Asthma Control Test (ACT) and smoking condition were recorded. At the end of 6th generation airway, adjusted by body surface area, Luminal diameter(LD), luminal area(Ai), wall thickness(WT) and wall area%(WA%) were measured. Inter-observer repeatability was estimated by intra-class correlation coefficients(ICCs). Comparison of the CT airway indexes between groups of onset age <=12yrs and >12yrs, ACT well/partly controlled and poorly controlled, with and without smoking history, induced sputum Eos%<3% and >=3% were made. Correlations between CT airway measurements with clinical and inflammatory indicators were determined.

RESULTS

The ICC of LD, Ai, WT and WA% was 0.813, 0.923, 0.850, 0.958. In asthma patients, both LD and Ai were significantly lower in groups of onset age <=12yrs, patients with smoking history and induced sputum Eos%>=3% than corresponding groups(LD, $t=2.760, -2.459, -3.935$, Ai, $t=-2.851, -2.267, -4.492$, all $P<0.05$). WA% was significantly higher in groups of induced sputum Eos%>3% than the corresponding group ($t=2.448$, $P<0.05$). LD and Ai had negative correlation with course of disease and induced sputum Eos% (LD, $r=-0.512, -0.841$, Ai, $r=-0.489, -0.841$, all $P<0.05$), and positive correlation with FEV1/FVC and serum leptin (LD, $r=0.669, 0.533$, Ai, $r=0.681, 0.552$, all $P<0.05$). Ai also showed positive correlation with FEV1% ($r=0.452$, $P<0.05$). WT and WA% were significantly negative correlated with FEV1/FVC and FEV1% (WT, $r=-0.621, -0.483$, WA%, $r=-0.729, -0.548$, all $P<0.05$). WA% also showed positive correlation with serum IgE and induced sputum MMP-9 ($r=0.509, 0.636$, all $P<0.05$).
CONCLUSION

CT airway indexes were found partially associated with asthma onset age, course of disease, smoking condition, serum leptin and IgE, induced sputum Eos% and MMP-9. CT airway indexes showed correlation with FEV1/FVC and FEV1%.

CLINICAL RELEVANCE/APPLICATION

CT indexes of small airway were found associated with asthma onset age, course of disease, smoking condition, serum leptin and IgE, induced sputum Eos% and MMP-9, as well as FEV1/FVC and FEV1%.

SSE05-05 A Comparative Study of Performance Between Radiographers and Machine Learning Model (MLM) for Airway Measurement

Participants
Hye Jeon, MS, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Sang Min Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyungi Seo, Seoul, Korea, Republic Of (Abstract Co-Author) Employee, Coreline Soft, Co Ltd
Mi Jeong Song, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jiahua Zhang, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Jiang Wu, MS, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jongha Park, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon Beom Seo, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Stockholder, Coreline Soft, Co Ltd
Sang Young Oh, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sang Min Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hye Joon Hwang, MD,PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this study is to compare the performance between radiographers and machine learning model of analyzing airway.

METHOD AND MATERIALS

Total 182 patients' thin slice CT data of KOLD cohort was used and their all airway branches were semi-automatically segmented by AView software (Coreline Soft, Co., Ltd, South Korea). 46,436 airway axial images were used to train MLM using DenseNet 201 that we changed the last DenseLayer to binary classification. All airway axial images were colored using integral-based half-band method and they were labeled as accept or reject to clarify and precise airway results. In randomly selected 50 axial images, accuracy was compared among two radiographers with 4-year experience on airway measurement and MLM. Cohen's Kappa was used to assess the inter-observers agreement and elapsed time was measured. T-test, in addition, was performed to compare airway results on 182 patients of KOLD cohort between one blinded radiographer and MLM.

RESULTS

The ROC analysis of the test data sets showed 0.92 of area under curve. In the 50 randomly selected airway axial images, Sensitivity, specificity of MLM were 0.96, 0.88 and its accuracy was 0.92. In radiographers, respectively, 0.86, 0.7 and 0.78 were shown (Cohen's kappa = 0.62). Elapsed time between two control groups, two radiographers and MLM, showed statistically significant difference (190.3 and 1.8 seconds, p < 0.05). The mean airway pi-10 and wall area percent showed no statistically significant difference (4.12 ± 0.89 mm, 66.43 ± 7.56 %; MLM, 4.15 ± 0.88 mm, 66.66 ± 7.35 %, p > 0.05, respectively).

CONCLUSION

Trained MLM showed no differences comparing with skilled radiographers in the results of airway measurement with short elapsed time. Consequentially, MLM measures all airway branches fully automatically without expert interactions, if airway segmentation well performed.

CLINICAL RELEVANCE/APPLICATION

The airway is considered as an imperative index of lung. Fully automatic airway measurement of whole branch would be more efficient for imaging biomarker in COPD patients.

SSE05-06 Catheter-Based Endobronchial Navigation with a Novel Cone Beam CT Airway Segmentation Platform to Reach Peripheral Lung in a Swine Model Without Bronchoscopy

Participants
Quirina M. de Ruiter, PhD, Bethesda, MD (Presenter) Former Employee, Koninklijke Philips NV; ;
John W. Karanian, PhD, Laurel, MD (Abstract Co-Author) Nothing to Disclose
Stephanie Schampaert, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
Martijn Van Der Bom, MSC, Andover, MA (Abstract Co-Author) Employee, Koninklijke Philips NV
Joseph Fontana, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Bradford J. Wood, MD, Bethesda, MD (Abstract Co-Author) 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; ; ;
Alessandro G. Radaelli, PhD, MS, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
William van der Sterren, MSc, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
Juan Esparza-Trujillo, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Ivane Bakhtushvili, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
William F. Pritchard Jr, MD, PhD, Bethesda, MD (Abstract Co-Author) Research collaboration, Koninklijke Philips NV; Research collaboration, Biocompatibles International plc; Research collaboration, BTG International Ltd; Research collaboration, Siemens AG; Research collaboration, Act Robotics; Research collaboration, W. L. Gore & Associates, Inc; Research collaboration, Celsion
Corporation

PURPOSE
To investigate the feasibility of catheter-based endobronchial navigation to peripheral lung without a bronchoscope using a novel Cone Beam CT (CBCT) image-guidance prototype in a swine model.

METHOD AND MATERIALS
All animal procedures were approved by the Animal Care and Use Committee. Swine (n=3) were placed under general anesthesia. Thoracic CBCT (FD20, Philips Healthcare) was imported into a workstation with prototype software (Philips) that provides for 3D airway segmentation, manual identification of targets and 3D navigation guidance superimposed on fluoroscopic imaging. Peripheral targets (bronchial subsegments) were identified. Catheter-based endobronchial navigation to targets was performed with 4 and 5 Fr catheters (Cook Medical) with varying shapes (e.g., C2, multipurpose, DAV) over 0.035' hydrophilic vascular guidewires of various curves and stiffness (Terumo). The primary endpoint was successful navigation of a catheter into a bronchial target. Success was assessed by catheter position on multiple X-ray images at preplanned C-arm angles and CBCT.

RESULTS
Catheter-based navigation to primarily 3rd and 4th order airway segments was successful in 11/13 tasks in the first two swine. Failure to navigate guidewires to distal targets occurred when the guide wire or catheter tip was too stiff with poor maneuverability or had a sub-optimal shape for the airway geometry. With optimization of device selection and imaging settings, catheter-based navigation to even more complex 4th and 5th order segments targets was successful in 8/11 tasks; navigation failures occurred due to suboptimal catheter or wire shape or stiffness for the target (n = 2) or suboptimal imaging settings (n=1). In these cases, operator adherence to predefined fluoroscopic imaging protocols also restricted identification of malposition and adjustments that might otherwise occur.

CONCLUSION
Catheter-based endobronchial navigation without a bronchoscope is feasible with CBCT 3D segmentation and image-guidance combined with fluoroscopy. Catheter and wire design, including size, shape and physical properties, are important predictors of navigation success, especially for more peripheral airway tasks.

CLINICAL RELEVANCE/APPLICATION
CBCT airway segmentation and guidance software may advance endobronchial catheter-based approaches for lung diagnostics and treatments beyond the reach of a bronchoscope. Catheter and wire selection impacts procedural success.
LEARNING OBJECTIVES

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

ABSTRACT

The extremely popular audience participation educational experience, Diagnosis Live!, is an expert-moderated session featuring a series of interactive case studies that will challenge radiologists' diagnostic skills and knowledge. The session features a lively, fast-paced game format: participants will be automatically assigned to teams who will then use their personal mobile devices to test their knowledge in a fast-paced session that will be both educational and entertaining. After the session, attendees will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance.
Participants
Rakesh D. Shah, MD, Manhasset, NY (Presenter) Nothing to Disclose
Pamela J. Lombardi, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Clinton E. Jokerst, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Daniel B. Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Nikhil Goyal, MD, Staten Island, NY (Abstract Co-Author) Nothing to Disclose
Timur Kotlyar, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher Kyriakakos, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Ross P. Frederick, MD, Phoenix, AZ (Abstract Co-Author) Nothing to Disclose
Lauren K. Groner, DO, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) To analyze interesting chest cases. 2) To understand appropriate differential diagnosis. 3) To understand the clinical significance of the diagnosis presented.
LEARNING OBJECTIVES

1) Differentiate the common causes of unilateral and bilateral pleural effusions. 2) Prioritize a differential diagnosis of unilateral pleural effusions on CT based on relevant imaging findings. 3) Produce a differential of at least 3 causes of pleural masses.

Active Handout: Travis S. Henry

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MSES31B Lung Cancer Staging 8th Edition

Participants
Jeremy J. Erasmus, MD, Houston, TX (Presenter) Nothing to Disclose

Honored Educators

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MSES31C ACR Lung RADS / Lung Cancer Screening

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (Presenter) Nothing to Disclose

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MSES31D 2017 Fleischner Society Criteria for Pulmonary Nodules

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

LEARNING OBJECTIVES

1) To apply the 2017 Fleischner Society Guidelines for the assessment and management of incidentally detected pulmonary nodules in clinical practice.

ABSTRACT

The Fleischner Society Guidelines for management of solid nodules were published in 2005, and separate guidelines for subsolid nodules were issued in 2013. Since then, new information has become available; therefore, the guidelines have been revised to reflect current thinking on nodule management. The revised guidelines incorporate several substantive changes that reflect current thinking on the management of small nodules. The minimum threshold size for routine follow-up has been increased, and recommended follow-up intervals are now given as a range rather than as a precise time period to give radiologists, clinicians, and patients greater discretion to accommodate individual risk factors and preferences. The guidelines for solid and subsolid nodules have been combined in one simplified table, and specific recommendations have been included for multiple nodules. These guidelines represent the consensus of the Fleischner Society, and as such, they incorporate the opinions of a multidisciplinary international...
MSRO35

BOOST: Lung-Oncology Anatomy (Interactive Session)

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

Participants
Subba R. Digumarthy, MD, Boston, MA (Presenter) Nothing to Disclose
Amita Sharma, MBBS, Boston, MA (Presenter) Nothing to Disclose
Melin J. Khandekar, MD, PhD, Boston, MA (Presenter) Nothing to Disclose

For information about this presentation, contact:
sdigumarthy@mgh.harvard.edu

LEARNING OBJECTIVES
1) Explain the different techniques and approaches for radiation therapy delivery. 2) Identify the anatomy relevant for thoracic oncology treatment planning. 3) Define targets and organs at risk for thoracic radiation therapy.

Honored Educators
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RC301A Imaging of Acute Pulmonary Embolism

Participants
Ioannis Vlahos, MRCP,FRCR, London, United Kingdom (Presenter) Research Consultant, Siemens AG Research Consultant, General Electric Company

LEARNING OBJECTIVES
1) Overview current imaging strategies and key facts in acute pulmonary embolism imaging. 2) Provide an update on current issues and challenges in acute pulmonary embolism imaging.

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

For information about this presentation, contact:
cdennie@toh.ca

RC301B Imaging of Chronic Pulmonary Embolism and Pulmonary Hypertension

Participants
Carole J. Dennie, MD, Ottawa, ON (Presenter) Speaker, Bayer AG; Spouse, Consultant, Abbott Laboratories

LEARNING OBJECTIVES
1) Review the classification of pulmonary hypertension. 2) List CT and MRI features of PH. 3) Describe imaging characteristics of chronic pulmonary embolism.

RC301C Imaging of Pulmonary Arteriovenous Malformations

Participants
Kristopher W. Cummings, MD, Phoenix, AZ (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Explain the role MDCT plays in the evaluation of suspected hereditary hemorrhagic telangiectasia. 2) List the most important information provided by MDCT for management of pulmonary arteriovenous malformations.

RC301D Pulmonary MRA: Practical Applications

Participants
Christopher J. Francois, MD, Madison, WI (Presenter) Departmental research support, General Electric Company;

LEARNING OBJECTIVES
1) Identify roles for magnetic resonance angiography (MRA) in imaging patients with pulmonary artery disease, particularly on the use of MRA in pulmonary embolism. 2) Describe techniques and protocols for robust, clinical pulmonary MRA. 3) Summarize the evidence supporting the use of pulmonary MRA for pulmonary embolism.

ABSTRACT
1) Pulmonary MRA is appropriate for imaging patients suspected of having pulmonary embolism who have contra-indications to CTA, particularly those in whom avoiding iodinated contrast (due to allergy or decreased renal function) or minimizing radiation exposure
(younger patients) would be beneficial. 2) Current, commercially available MRA sequences that take advantage of newer parallel imaging techniques help ensure consistent pulmonary MRA in a clinical setting. 3) Following multi-center studies (using older MRA techniques and protocols) in the last decade that indicated that pulmonary MRA may not be accurate enough for routine clinical use, more recent studies suggest that pulmonary MRA is effect in identifying clinically significant pulmonary embolism.

Active Handout: Christopher Jean-Pierre Francois

**Participants**

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

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

For information about this presentation, contact:

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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

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**Sub-Events**

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

**Tuesday, Nov. 27 8:30AM - 8:45AM Room: E352**

Participants

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

**LEARNING OBJECTIVES**

1) Understand the stratification of acute PE and its rationale.

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**RC314-03**  
Catheter-Directed Thrombolysis for Submassive Pulmonary Embolism: Retrospective Review of 113 Patients with 6 Month Follow-Up

**Tuesday, Nov. 27 9:00AM - 9:10AM Room: E352**

**Purposes**

Catheter-directed thrombolysis (CDT) is an established treatment option for patients with massive pulmonary embolism (PE); however, there is limited literature about its role for patients with submassive PE. This work evaluated the long-term clinical outcomes of CDT therapy for submassive PE.

**Method and Materials**

A single center retrospective observational study was performed with institutional IRB approval. Imaging and medical records of patients who underwent CDT for submassive PE (n=113, 52%M:48%F, 18% with cancer history) from 2013-2017 were reviewed. The primary outcomes evaluated were pre and post-procedure systolic pulmonary arterial pressure (PAP), post-procedure complications, follow up assessments at 1 and 6 months and right ventricular systolic pressure (RVSP) at 6 months post procedure.

**Results**

Pre-procedural mean blood pressure was 132.0 ± 5.1 / 80.0 ± 3.0 mmHg, heart rate was 105.5 ± 3.4 bpm, RV/LV ratio by CT angiogram was 1.6 ± 0.1, PAP was 55.5 ± 2.7 mmHg, and RVSP was 48.3 ± 3.6 mmHg. Duration of tPA therapy was 20.7 ± 1.5 hrs and mean tPA dose was 23.7 ± 2.4 mg. Post-procedure, the mean PAP decreased to 38.3 ± 3.5 mmHg (p <0.01). Hemorrhagic
complications relating to CDT occurred in 6.1% of patients who underwent treatment and the mortality rate, unrelated to the
procedure, during hospitalization was 3.5%. During follow-up, 94.1% of patients expressed clinical improvement at 1 month and
90.3% at 6 months post-procedure. Of those with 6 month follow-up echocardiograms after treatment (n=36), RVSP significantly
decreased to 32.2 ± 5.7 mmHg (p < 0.01).

CONCLUSION
With a low complication and mortality rate, decreased PAP and RVSP, and high rates of clinical improvement, long-term clinical
outcomes support the use of CDT as a safe and effective treatment option for patients with submassive PE.

CLINICAL RELEVANCE/APPLICATION
The data regarding the long-term consequences of using CDT in patients with submassive PE is limited. The results of this large,
single-center, retrospective study demonstrate improved PAP and RVSP, excellent clinical outcomes and low complication rates,
supporting the use of CDT in this patient population.

RC314-04 Early Catheter Directed Thrombolysis (CDT) Has No Effect on Survival or Escalation to Massive Pulmonary Embolism (PE) in Patients Presenting with High Risk Submassive PE

Tuesday, Nov. 27 9:10AM - 9:20AM Room: E352

Participants
Barbara Manchec, MD, Orlando, FL (Presenter) Nothing to Disclose
Bo Liu, MD, Maitland, FL (Abstract Co-Author) Nothing to Disclose
Tri Tran, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Colin Zuchowski, BS, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Kharina Guruvadoo, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Ryan Parente, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Rebecca Vicenti, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Carole Coyne, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Julie Pepe, Orlando, FL (Abstract Co-Author) Nothing to Disclose
Nicholas C. Feranec, MD, Winter Park, FL (Abstract Co-Author) Speakers Bureau, Pacira Pharmaceuticals, Inc
Thomas J. Ward, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

For information about this presentation, contact:
Barbara.manchec.md@flhosp.org

PURPOSE
To evaluate the impact on time from diagnosis to catheter directed thrombolysis (CDT) in patients with acute, high-risk,
submassive pulmonary embolism (PE) on escalation to massive PE and survival.

METHOD AND MATERIALS
This single-center, IRB approved, retrospective study identified 835 contiguous patients with acute submassive PE between
January 2011 and July 2017. This cohort was reviewed to identify patients with high-risk submassive PE (simplified Pulmonary
Embolism Seventy Index (PESI) score >= 1, evidence of right ventricular (RV) dysfunction as seen on computed tomography or
echocardiography, and an elevated RV biomarker, troponin or brain natriuretic peptide) treated with catheter directed thrombolysis
(CDT). 76 contiguous patients (60.5 ± 15.5 years old, 45% male, PESI score 104.4 ± 29.3) were identified. Demographic,
treatment, and outcome details were retrospectively reviewed. Patients were treated with intravenous heparin prior to initiation of
CDT.

RESULTS
39 (51%) patients had CDT within 12 hours of diagnosis, 37 (49%) had CDT after 12 hours. 72 (95%) patients had bilateral
thrombolysis, 5% had unilateral thrombolysis - 3 (4%) on the right and 1 (1%) on the right. The average duration of lysis was
20±6.9 hours with an average tPA infusion rate of 1.5±0.6 mg/catheter/hour. Escalation to massive PE occurred in 4 patients
(5.3%, 95% CI: 2-13%), 2 in each group (5.4% vs 5.1%, p=1.0). Survival at 30 and 90 days was 95.5% and 95.3%. Multiple
regression analysis demonstrated that increased time to treatment (30-day p=0.413; 90-day p=0.44) and PESI score (30-day
p=0.95; 90-day p=0.98) were not predictive of worse survival while escalation to massive PE prior to CDT was predictive of worse
survival (30-day p=0.04; 90-day p=0.04).

CONCLUSION
In patients with acute, high-risk, submassive PE, up to 13% of patients may escalate to massive PE prior to CDT. Early CDT was
not associated with decreased escalation to massive PE or increased survival at 30 and 90 days. However, escalation to massive
was associated with worse survival.

CLINICAL RELEVANCE/APPLICATION
In patients with acute, high-risk, submassive PE, up to 13% of patients may escalate to massive PE prior to CDT. Early CDT was
not associated with decreased escalation to massive PE or increased survival at 30 and 90 days. However, escalation to massive
was associated with worse survival.

RC314-05 Chronic Venous Recanalization

Tuesday, Nov. 27 9:20AM - 9:35AM Room: E352

Participants
Kari J. Nelson, MD, Orange, CA (Presenter) Nothing to Disclose

For information about this presentation, contact:
k2nelson@uci.edu

LEARNING OBJECTIVES
1) To review indications and techniques for chronic venous recanalization. 2) To discuss clinical follow-up and management of chronic venous recanalization patients.

**RC314-06 Biology of Pulmonary Embolism**

Tuesday, Nov. 27 9:35AM - 9:50AM Room: E352

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

LEARNING OBJECTIVES

1) Describe the method by which pulmonary embolism causes right ventricular failure.

**RC314-07 Two Methods for Blocking Superficial Venous Blood Flow during Thrombolytic Treatment on Lower Extremity Deep Venous Thrombosis: A Comparative Study**

Tuesday, Nov. 27 9:50AM - 10:00AM Room: E352

Participants
Yan Li, Nanjing, China (Presenter) Nothing to Disclose
Yu-Chen Chen, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Jian-Ping Gu, Nanjing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare the effectiveness and patient comfort between two methods for blocking superficial venous blood flow during thrombolytic treatment on lower extremity deep venous thrombosis (DVT) so as to provide the evidence for clinical choice.

METHOD AND MATERIALS

Eighty patients with lower extremity DVT were randomly divided into sphygmomanometer and tourniquet group (group A and group B), 40 patients for each group. All the patients were treated with daily dosage of urokinase using dial sphygmomanometer cuff and tourniquet to block lower extremity superficial vein blood flow, respectively. The pressure of the dial sphygmomanometer blocking lower extremity superficial vein blood flow was measured during lower extremity venography. Leg swelling reduction rate, venous patency, thrombus removal rate and average comfort index were observed during the blocking process.

RESULTS

The average pressure value for group A was 70mmHg±10mmHg. The difference of the swelling reduction rate and venous patency was significant between groups. Comparing the two groups at different time points, the average thrombus clearance rate of group A was higher than that of group B. The leg pain scores of group A were lower than those of group B. Postoperative comfort ratio of group A was higher than that of group B, and the proportion of severe discomfort in group A was lower than that of group B.

CONCLUSION

Compared with the tourniquet, using dial sphygmomanometer cuff to block lower extremity superficial vein blood flow would get better thrombolytic effect on DVT and higher patient comfort during the treatment process.

CLINICAL RELEVANCE/APPLICATION

In summary, compared with the tourniquet, using the dial sphygmomanometer cuff to block the superficial vein of lower extremity blood flow will obtain a better thrombolytic effect, higher patients' comforts during the treatment process, and provide a simpler and easier nursing tool that is worth spreading in clinical use.

**RC314-08 Compressive Venous Syndromes**

Tuesday, Nov. 27 10:00AM - 10:15AM Room: E352

Participants
Sanjeeva P. Kalva, MD, Dallas, TX (Presenter) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Healthcare; Consultant, C. F. Koo Foundation; Consultant, Medtronic plc; Research Grant, AngioDynamics, Inc

For information about this presentation, contact:
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LEARNING OBJECTIVES

1) Discuss the pathophysiology of compressive venous syndromes. 2) Review the etiology, symptoms, work up and imaging findings of common venous compression syndromes - May Thurner, Thoracic outlet, Nutcracker Syndrome, Popliteal Venous Compression. 3) Discuss the management options of these entities.

**RC314-09 IVC Filters: Evidence and Ongoing Trials**

Tuesday, Nov. 27 10:30AM - 10:45AM Room: E352

Participants
Matthew S. Johnson, MD, Indianapolis, IN (Presenter) 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; ;

LEARNING OBJECTIVES

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

**RC314-10**  
**A Retrospective Comparison of Patients Receiving EKOS Thrombolysis for Massive or Sub-Massive Pulmonary Embolism to Historic Controls Receiving Medical Therapy**

Tuesday, Nov. 27 10:45AM - 10:55AM Room: E352

**Awards**  
**Student Travel Stipend Award**

Participants  
Anushi Patel, MD, Longwood, FL (Presenter) Nothing to Disclose  
Marsela H. Campbell, DO, Jacksonville, FL (Abstract Co-Author) Nothing to Disclose  
Mario Agrait-Bertran, MD, Jacksonville, FL (Abstract Co-Author) Nothing to Disclose  
Daniel A. Siragusa, MD, Jacksonville, FL (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**

Treatment of massive or sub-massive pulmonary embolism (PE) poses a unique challenge as conventional medical therapy alone may be insufficient to restore adequate cardiac function in patients with right ventricular dysfunction. This has led to growing interest in alternative therapy, specifically EKOS thrombolysis, with hopes to improve outcomes in this specific patient population. We evaluated differences in outcomes between patients receiving both EKOS thrombolysis plus systemic anticoagulation versus systemic anticoagulation alone.

**METHOD AND MATERIALS**

Retrospective single center data was compiled of ICU patients with imaging proven PE admitted between January 2014 and December 2016. 31 patients received adjunctive EKOS thrombolysis in addition to systemic anticoagulation. 92 control patients were treated with systemic anticoagulation alone. At our institution, patients that receive EKOS thrombolysis have radiologic and clinical signs of sub-massive or massive PE including right heart strain. Groups were compared using the non-parametric Wilcoxon rank sum test for continuous data (total length of stay [LOS], ICU LOS, and total hospitalization costs) and using Fisher's exact tests for categorical data (survival rates at discharge, 30- and 90-days after treatment).

**RESULTS**

All 31 patients in the treatment group and 75 patients (82%) in the control group were alive 90 days after treatment (p=0.006). Higher 30-day survival rate was seen in the treatment group (100%) compared to control group (86%, p=0.037). The length of stay (LOS) was significantly longer for the control group (median 384 hours) compared to EKOS group (median 168 hours, p<0.001). ICU LOS was longer (p<0.001) and total cost was higher (p<0.001) in the control group as well. The exception is no statistically significant difference in survival at time of discharge.

**CONCLUSION**

Patients treated with adjunctive EKOS thrombolysis benefited from improved outcomes, specifically, lower total and ICU LOS and higher 30- and 90- day survival rates. In addition, lower total care costs suggests that EKOS is a cost-effective treatment.

**CLINICAL RELEVANCE/APPLICATION**

Compared to systemic anticoagulation alone, adjunctive EKOS thrombolysis demonstrates improved clinical outcomes and cost-effectiveness and is recommended in the appropriate patient population.

**RC314-11**  
**Low-Voltage Computed Tomography Venography for Patients with Deep Vein Thrombosis of the Lower Extremities: A Comparison with Venous Ultrasonography**

Tuesday, Nov. 27 10:55AM - 11:05AM Room: E352

Participants  
Tatsuhiko Sato, MD, Niigata-City, Japan (Presenter) Nothing to Disclose  
Norihiko Yoshimura, MD, PhD, Niigata, Japan (Abstract Co-Author) Nothing to Disclose  
Yosuke Hori, Niigata, Japan (Abstract Co-Author) Nothing to Disclose  
Rei Ogawa, Chuo, Japan (Abstract Co-Author) Nothing to Disclose  
Ken Sato, Niigata-Shi, Japan (Abstract Co-Author) Nothing to Disclose  
Kazuki Kumagai, Niigata, Japan (Abstract Co-Author) Nothing to Disclose  
Motohiko Yamazaki, MD, Niigata, Japan (Abstract Co-Author) Nothing to Disclose  
Hidefumi Aoyama, MD, PhD, Niigata, Japan (Abstract Co-Author) Nothing to Disclose

For information about this presentation, contact:  
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**PURPOSE**

To compare the ability of computed tomography venography (CTV) with that of venous ultrasonography (US) to visualize deep vein thrombosis (DVT) of the lower extremities from the femoropopliteal to calf veins.

**METHOD AND MATERIALS**

We retrospectively reevaluated CTV data sets for 308 consecutive patients suspected of DVT or pulmonary embolism (PE). Fifty-five of the 308 patients who had undergone US within 1 day of low-voltage CTV (SIEMENS) were included. In these patients, we compared CTV and US regarding the distribution of DVT in 10 segments of the lower extremities (each side of the femoral, popliteal, posterior-tibial, peroneal and soleus veins). Sixteen of the total 550 segments were not examined by US; hence, 534 segments in
RESULTS

CTV readings were evaluated using US as the standard. As a result, 64 of the 534 segments were true positive, 46 were false positive, 23 were false negative, and 401 were true negative. Total sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were 73.6%, 89.7%, 58.2%, 94.6% and 87.1%, respectively. Results for the 216 segments above the knee (each side of femoral and popliteal veins) vs 318 segments below the knee (each side of posterior-tibial, peroneal and soleus veins) were as follows: sensitivity, 90.0% vs 71.4%, specificity, 93.2% vs 86.7%, PPV, 39.1% vs 63.2%, NPV, 99.5% vs 90.5% and accuracy, 93.1% vs 83.0%, respectively.

CONCLUSION

Compared to US, low-voltage CTV has sufficient sensitivity and specificity above the knee and useful specificity below the knee for evaluation of DVT.

CLINICAL RELEVANCE/APPLICATION

(Dealing with low-voltage CT venography) 'Compared to US, low-voltage CTV has sufficient sensitivity and specificity above the knee and useful specificity below the knee for evaluation of DVT.'

PURPOSE

To evaluate the accuracy of CT and time-resolved MR (TR-MRA) angiography for evaluation of recurrence of pulmonary arteriovenous malformations (PAVMs) after coil embolization in comparison with selective pulmonary angiography (PAG).

METHOD AND MATERIALS

Between 2007 and 2017, consecutive 37 patients with PAVM were treated by coil embolization. Among the 37 patients, 23 patients underwent follow-up PAG after embolization with 25.6 months mean follow-up period. We retrospectively reviewed CT, TR-MRA, and selective pulmonary angiography in the 23 cases. In all cases, CT and/or TR-MRA were performed within 3 months prior to PAG. We evaluated recurrence rate by MDCT and TR-MRA compared with PAG as gold standard. The "recurrence" on TR-MRA and PAG was defined as the embolized lesion showing the early venous filling. For evaluation of CT, recurrence was defined as less than 70% reduction in size of dilated sac or draining vein.

RESULTS

All 49 PAVMs were successfully occluded immediately after embolization. 36 PAVMs were evaluated by TR-MRA, and 46 PAVMs were evaluated by MDCT. Recurrence was detected in 6 lesions (12.2%) by PAG. Sensitivity of TR-MRA and CT were 25%, 33.3%, and specificity were 96.9% and 77.5%, respectively.

CONCLUSION

More than half of recurrent PAVMs could not be detected by CT and/or TR-MRA, PAG are required for accurate evaluation of recurrent PAVMs.

CLINICAL RELEVANCE/APPLICATION

Recurrent PAVMs could not be correctly diagnosed by CT and/or TR-MRA. Furthermore, specificity of CT was lower than TR-MRA, PAG are required for accurate diagnosis of recurrent PAVMs.
Participants
Thuong G. Van Ha, MD, Chicago, IL (*Presenter*) Research Grant, Cook Group Incorporated

**LEARNING OBJECTIVES**

1) List reasons for failure of standard IVC filter retrieval techniques. 2) Describe different advanced retrieval techniques and when to use them. 3) Discuss risk and benefits of advanced retrieval techniques. 4) List potential complications of advanced retrieval techniques.
Emerging Technology: Dual Energy and Spectral CT Update 2018

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S505AB

CH  CT  GI  MK  NR

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

LEARNING OBJECTIVES

1) Briefly review the principles of Dual Energy CT/Spectral imaging. 2) Review virtual non-contrast imaging, iodine mapping, material decomposition, and monoenergetic imaging. 3) Review cases demonstrating abdominal organ perfusion and oncologic applications in the abdomen. 4) To outline novel applications of dual energy CT in assessing bone marrow edema, gout, ligament/tendon analysis and metal artifact reduction. 5) To outline novel techniques using Dual Energy CT in pulmonary embolism, cardiac ischemia assessment. 6) Review DECT/spectral imaging applications in the brain.

Sub-Events

RC317A  Update on the Clinical Applications of Multi-Energy CT in Cardiothoracic Imaging

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

For information about this presentation, contact:
radpr73@gmail.com

LEARNING OBJECTIVES

1) To describe the different implementations of multi-energy CT technology. 2) To discuss the updates on the utility of multi-energy CT in cardiothoracic imaging. 3) To review the applications of multi-energy CT in cardiothoracic imaging.

Honored Educators

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

RC317B  Novel Neuroradiology Dual Energy/Spectral CT Clinical Applications

Participants
Aaron D. Sodickson, MD,PhD, Boston, MA (Presenter) Institutional research agreement, Siemens AG; Speaker, Siemens AG; Speaker, General Electric Company

For information about this presentation, contact:
asodickson@bwh.harvard.edu

LEARNING OBJECTIVES

1) Review Dual Energy CT fundamentals and post-processing applications. 2) Demonstrate the utility of Dual Energy CT to add value in neuro-imaging, including pathology detection, lesion characterization, diagnostic confidence, and reduced length-of-stay.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Aaron D. Sodickson, MD,PhD - 2016 Honored EducatorAaron D. Sodickson, MD,PhD - 2018 Honored Educator

RC317C  Dual Energy/Spectral CT of the Abdomen: What Matters Most to the Clinician

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

For information about this presentation, contact:
dmorgan@uabmc.edu
LEARNING OBJECTIVES

1) Apply strategies of dual energy CT for streamlined characterization of incidentally detected intra-abdominal abnormalities such as hepatic steatosis, adrenal adenomas, and renal lesions. 2) Develop and utilize post processing techniques that improve detection and identification of clinically relevant imaging features of abdominal tumors. 3) Understand limitations and compare workflow differences among major dual/multienergy scanning systems for abdominal applications.

RC317D  Current and New Clinical Applications in Musculoskeletal Dual Energy/Spectral CT

Participants
Fabio Becce, MD, Lausanne, Switzerland (Presenter) Nothing to Disclose

For information about this presentation, contact:
fabio.becce@chuv.ch

LEARNING OBJECTIVES

1) Comprehend the basic principles and technical aspects of dual- and multi-energy CT when imaging the musculoskeletal system. 2) Apply dual-energy CT when assessing various musculoskeletal disorders, from crystal-related arthropathies to bone marrow edema. 3) Identify potential new applications of dual-energy CT in musculoskeletal imaging, such as CT arthrography and iron-related disorders.
Case-based Review of Nuclear Medicine: PET/CT Workshop-Chest and Musculoskeletal PET/CT (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E450B

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

Participants
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (Director) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (Director) Nothing to Disclose
Delphine L. Chen, MD, Saint Louis, MO (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the classic PET/CT appearance of various types of lung cancer. 2) Compare the imaging features that are similar between different types of lung cancer.

ABSTRACT
The classic PET/CT appearance of various types of lung cancers will be reviewed. Similarities and differences between different types of lung cancer will be presented in an effort to help attendees interpret thoracic imaging with more confidence and be more helpful in interdisciplinary settings.

Sub-Events

MSCC32A Chest

Participants
David M. Naeger, MD, San Francisco, CA (Presenter) Nothing to Disclose

For information about this presentation, contact:
david.naeger@ucsf.edu

LEARNING OBJECTIVES
1) Demonstrate how to integrate the FDG PET and CT components of an FDG PET/CT exam to distinguish benign and malignant osseous lesions. 2) Identify common benign causes of FDG-avidity in the musculoskeletal system.

MSCC32B Musculoskeletal

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

For information about this presentation, contact:
ulanerg@mskcc.org

LEARNING OBJECTIVES
1) Demonstrate how to integrate the FDG PET and CT components of an FDG PET/CT exam to distinguish benign and malignant osseous lesions. 2) Identify common benign causes of FDG-avidity in the musculoskeletal system.
MSRO36

BOOST: Mediastinum and Pleura-Oncology Anatomy (Interactive Session)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S103CD

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, MPH, Newton, MA (Presenter) Institutional Research Grant, Merck & Co, Inc.; Institutional Research Grant, Canon Medical Systems Corporation; Institutional Research Grant, AstraZeneca PLC; Speaker, F. Hoffmann-La Roche Ltd; Consultant, DAIICHI SANKYO Group
Alexander Louie, MD, FRCPC, London, ON (Presenter) Nothing to Disclose

For information about this presentation, contact:
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meng.welliver@osumc.edu

LEARNING OBJECTIVES
1) Describe the mediastinal and pleural anatomy on imaging for treatment planning and monitoring for thoracic malignancy with a focus on thymic tumors and mesothelioma. 2) Discuss the cutting-edge strategies and pitfalls for treatment planning and disease surveillance for thymic tumors and mesothelioma. 3) Understand the importance of multidisciplinary approaches to thoracic malignancy involving the mediastinum and pleura.

ABSTRACT
The purpose of this course is to provide attendees with a practical knowledge of the mediastinal and pleural anatomy and the understanding of the treatment planning strategies and pitfalls for thoracic malignancy with a focus on thymic tumors and mesothelioma, highlighting the importance of multidisciplinary approaches to these tumors.
Tuesday Morning Plenary Session

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E451B

**Participants**

Vijay M. Rao, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Bruce R. Thomadsen, PhD, Madison, WI (Introduction) Nothing to Disclose

**Sub-Events**

**RSNA/AAPM Symposium: State of the Art in CT Imaging**

Participants

Paul E. Kinahan, PhD, Seattle, WA (Moderator) Research Grant, General Electric Company; Co-founder, PET/X LLC

**CT Technology - and Dose - in the 21st Century**

Participants

Cynthia H. McCollough, PhD, Rochester, MN (Presenter) Research Grant, Siemens AG

For information about this presentation, contact:
McCollough.cynthia@mayo.edu

**LEARNING OBJECTIVES**

1) Identify key technological advances in x-ray computed tomography. 2) Describe new clinical applications that have been enabled by these technology advances. 3) List important technical advances that have facilitated CT dose reduction. 4) Appreciate the continued decline in CT doses since its inception. 5) Apply caution in reducing CT doses for low-contrast detection tasks.

**Contemporary CT of the Indeterminate Lung Nodule: Where We Are and Why it Matters**

Participants

Denise R. Aberle, MD, Los Angeles, CA (Presenter) Consultant, Siemens AG

**LEARNING OBJECTIVES**

1) To learn the current role of CT in lung cancer screening and early detection. 2) To examine current approaches to the classification of indeterminate lung nodules. 3) To understand the basis for using an atlas to standardize semantic features of lung nodules. 4) To appreciate the potential of semantic, quantitative, and machine learning approaches in nodule classification.
**SSG03**

**Chest (Lung Nodule)**

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S504AB

**AIMS**
- A retrospective, multi-center clinical study for validating increased lesion detection accuracy of radiologists when using computer-aided detection system in reading digital chest X-ray images.

**METHOD AND MATERIALS**
We developed new CAD system using deep learning for detecting multiple lesions with 4 different patterns (nodule/mass, interstitial opacity, pleural effusion, and pneumothorax) on chest radiograph. To train the deep learning network, 17917 images were collected in two tertiary hospitals. Numbers of normal and abnormal patients are 11000 and 6917, respectively. We labeled disease type and delineate region of interests (ROI) drawn as ground truths by two thoracic radiologists with consensus. To validate the effect of the developed CAD on observer's performance, 9 observers including 7 board-certified radiologists and two radiology residents reviewed 200 chest radiographs twice with two weeks interval. 200 chest radiographs consists of 100 normal and 100 abnormal (nodule/mass: 60, interstitial opacity: 10, pleural effusion: 10, pneumothorax: 10) chest radiographs. The diagnostic performance of the developed CAD, observers with and without CAD were evaluated and compared using jackknife free-response receiver operating characteristic (JAFROC) figure of merits (FOMs) on a per-lesion basis. The reading time for review was recorded.

**RESULTS**
The developed CAD showed FOMs of 0.931 for nodule/mass, 0.900 for interstitial opacity, 1 for pleural effusion, and 1 for pneumothorax. The mean FOMs of 9 observers without CAD were 0.916 for nodule/mass, 0.922 for interstitial opacity, 0.944 for pleural effusion, and 0.978 for pneumothorax. After applying the CAD, the mean FOMs of 9 observers were 0.942 for nodule/mass, 0.900 for interstitial opacity, 0.967 for pleural effusion, and 1 for pneumothorax. Except for interstitial opacity, the accuracy of three patterns with CAD increased. The mean reading time was 91.5 minutes ± 53.2 without CAD and 79.1 minutes ± 28.2 with CAD.

**CONCLUSION**
The deep-learning based CAD may help improve observer performance for reading chest radiograph as well as reducing reading time.

**CLINICAL RELEVANCE/APPLICATION**
The deep-learning based CAD has the potential to improve observer efficiency in terms of accuracy and reading and may provide preliminary interpretation for chest radiographs.

**SSG03-02**

A Retrospective, Multi-Center Clinical Study for Validating Increased Lesion Detection Accuracy of Radiologists When Using Computer-Aided Detection System in Reading Digital Chest X-Ray Images
To assess the impact of automated segmentation of pulmonary nodules by measuring the accuracy of the prediction of malignancy.

PURPOSE

To evaluate performance of radiologists detecting pulmonary malignant nodules assisted by deep-learning based computer-aided detection (CAD) software, compared with performance of radiologist or CAD alone.

METHOD AND MATERIALS

Each of four participating centers in three countries retrospectively collected 150 lung cancer radiographs and 50 normal radiographs. Normal x-ray images are from healthy adults, confirmed by a CT scan taken within 14 days. Each cancer x-ray image has 1 to 3 pathologically confirmed nodule(s), whose sizes are between 1 and 3 centimeters. The estimated location of each nodule was marked on x-ray image referring to the CT scan. 12 radiologists from 4 institutions with various experiences independently analyzed a set of x-ray images and marked region of interests (ROIs) on each radiograph in suspicion of a nodule. Deep learning-based computer-aided detection (CAD) software was applied to find suspicious nodules on chest radiographs. Finally, 12 radiologists reviewed whole set of images with assistance of CAD, accepting or dismissing ROIs suggested by CAD. Sensitivity and false negative per image (FPPI) of radiologist alone, CAD alone and radiologist with CAD were statistically analyzed.

RESULTS

The overall sensitivity and FPPI of the CAD system were 63.75% and 0.20, which was not statistically distinct from those of radiologists. The average sensitivity of radiologists appeared to increase significantly from 65.1% to 70.3%, after aided by the CAD software (p<0.0001). On subgroup analysis, incremental effects of CAD on nodule detection sensitivity were not affected by radiologists' experience, size, location, type (primary or metastatic) of nodules and modality of acquisition.

CONCLUSION

The overall sensitivity and FPPI of our CAD system were not statically different from those of radiologists. When radiologists were assisted by the CAD, overall sensitivity increased significantly while FPPI seemed to decrease. Incremental effect of the CAD system was not affected by radiologist's experience, characteristics of a nodule or modality, which can support the potential general use of this software.

CLINICAL RELEVANCE/APPLICATION

Radiologists' performance in lung cancer nodule detection can be improved with a deep learning-based CAD system regarding both sensitivity and false positive rate.
using the Brock University Cancer Prediction Model.

**METHOD AND MATERIALS**

Retrospective analysis was carried out of 7927 nodules (of which 314 were malignant) from 5394 patients who were scanned as part of the US NLST (mean age 62±5 years; of which 3192 were male). Following BTS guidelines, nodules <5mm in size were excluded, but all other nodules were included regardless of type, attenuation, and margin. Automatic 3D nodule segmentations were generated via a deep learned model and initiated with a single click point inside the nodule. We used the following methods for measuring nodule size: the NSLT radiologist measurements, D2D, the long axis from the automatic segmentations, D3D, and in order to characterize the nodule volumes more accurately, the volumes of the automatic segmentations, V, were converted to an equivalent linear size using the equation for a sphere. Each was tested as the size term in the standard Brock model to generate a malignancy risk and Area-Under-the-Receiver-Operating-Characteristics (AUC-ROC) curve calculated.

**RESULTS**

The AUC-ROC was 85.96% (95% confidence interval (CI): 84.33, 87.76) for D2D, 86.64 (95% CI: 85.04, 88.19) for D3D, and 88.17 (95% CI: 86.71, 89.82) for Dsph. The expected increase in AUC Dsph offers over D2D is 2.21 (95% CI: 1.28, 3.12).

**CONCLUSION**

The automatic nodule size measurements outperformed the manual radiologist measurements in predicting lung cancer as an input to the Brock model. The non-axial Dsph, which is derived from the volumetric segmentation outperforms both long axis-based methods. Assessing nodule segmentation by measuring prediction efficacy is a viable alternative to overlap measures such as DICE.

**CLINICAL RELEVANCE/APPLICATION**

Automatic segmentation removes the need for manual extraction of axial diameters of lung nodules. It is not subject to intra- and inter-radiologist variation thereby improving consistency.

**SSG03-04 Effect of Artificial Intelligence Based Vessel Suppression and Automatic Detection of Part-Solid and Ground-Glass Nodules on Low-Dose Chest CT**

Tuesday, Nov. 27 11:00AM - 11:10AM Room: SS04AB

**Awards**

**Student Travel Stipend Award**

Participants

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**PURPOSE**

Most studies with CAD and artificial intelligence (AI) software have focused on solid lung nodules. We assessed the effect of AI-based vessel suppression (AI-VS) and automatic detection (AI-AD) on ground glass (GGN) and part-solid lung nodules (PSN) in low-dose CT (LDCT).

**METHOD AND MATERIALS**

Our study included 100 LDCT examinations with mixed attenuation pulmonary nodules (average diameter>5mm) identified from the National Lung Cancer Screening Trial (NLST). These exams were not used in training or validation of the AI software (ClearRead CT, Riverain Inc.). All 100 LDCT were processed to generate three image series per case - unprocessed, AI-VS, and AI-AD series with annotated lung nodules. Two thoracic radiologists (R1: 3-year experience, R2: 27-year experience) independently assessed the unprocessed images alone, then together with AI-VS series, and finally with AI-AD. For each assessment, number of all >5mm with location & size of dominant GGN and PSN were recorded. Descriptive statistics and student t tests were performed for data analysis.

**RESULTS**

On unprocessed images, R1 and R2 detected 278 nodules (123 PSN, 155 GGN) and 269 (117 PSN, 152 GGN), respectively (p>0.05). With addition of AI-VS images, R1 and R2 detected 290 nodules (126 PSN, 164 SSN) and 293 (132 PSN, 161 GGN), respectively, which were significantly greater than those detected without the AI-VS (p= 0.004). AI-VS aided in detection of solid component in 22 PSN which were deemed SSN by both readers. Conversely, AI-AD annotated only 75 PSN and 54 GGN (total 129 nodules). In 21 patients, AI-AD did not detect the dominant PSN or SSN; it detected 14 false positive nodules (vessels, atelectasis, anterior junctional line). Average respective sizes of 69-matched and detected PSN on unprocessed and AI-AD series were 15 ±7 mm and 13 ± 6 mm (p =0.07).

**CONCLUSION**

AI-VS improves detection and characterization of GGN and PSN on LDCT of the chest. Specifically, improved and easier detection of the solid component in non-solid nodules with AI-VS can avoid false down-grading of Lung-RADS category, and thus help in appropriate patient management.

**CLINICAL RELEVANCE/APPLICATION**

AI software can aid in improved detection and confident detection of ground-glass and part-solid lung nodules on low dose chest CT.
Indeterminate pulmonary nodules in a multi-site, heterogeneous population. To assess the follow-up rule-out accuracy of a convolutional neural network (CNN) in patients with incidentally detected,

**PURPOSE**

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For information about this presentation, contact:
Fergus V. Gleeson, MBBS, Oxford, United Kingdom (Timor Vaclav Jerome M. Declerck, PhD, Oxford, United Kingdom (Emily Catarina Petr William Samia Sarim Maria Lyndsey C. Pickup, MEng, DPhil, Oxford, United Kingdom (Carlos Heiko)

SSG03-05  Evaluation of Lung Nodules with FDG PET-CT: The Value of MIP Reconstructions in Conventional Thoracic CT Images During Shallow Breathing versus Images in Deep Inspiration

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S504AB

Participants
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**PURPOSE**

Detection of small lung nodules is important for appropriate staging of cancer. There is controversy in literature about the value of adding a separate CT of the lungs in deep inspiration. Radiation dose is no longer an issue with the use of modern equipment because only approximately 3 mSv are added to the usual dose. The purpose of this study was to assess the value of additional thoracic CT in deep inspiration and the use of maximum intensity projection (MIP) reconstructions in PET-CT of oncologic patients.

**METHOD AND MATERIALS**

186 consecutive patients (99 male and 89 female; mean age, 72 years; range: 26-93 y) underwent FDG PET-CT for one of the following indications: characterization of a new detected lung nodule/mass (n=101), staging of cancer (n=31), therapy response monitoring (n=33), suspicion of tumor relapse (n=19) and cancer of unknown origin (n=2). After PET-CT acquisition with shallow breathing, a thoracic CT in deep inspiration was performed to all patients (slice thickness: 1.25 mm). MIP of the two sets of lung images were performed. Two experienced radiologist analyzed the 4 sets of CT studies. The number of lung nodules was recorded. Lung nodule was defined as a rounded opacity smaller than 10 mm completely surrounded by lung parenchyma. The clinical relevance of the eventual discrepancies between CT studies was analyzed (i.e. upstaging).

**RESULTS**

120/186 patients presented with nodules. PET-CT with shallow breathing detected 393 nodules, and 578 when MIP images were analyzed. Thoracic CT with deep inspiration found 534 nodules and 905 when MIP was used. The number of detected nodules increased from free breathing to breathe hold CT in 42 patients. The detected number of nodules with breath hold technique compared with free breathing increased increased in 51 patients when MIP was used. The extradetected nodules were considered clinical relevant in 7/120 (6%) of patients because they influence patient management for example by increasing TNM staging.

**CONCLUSION**

According to our results the addition of deep inspiration thoracic CT with MIP reconstructions can be recommended in clinical practice because this approach yields better performance in TNM staging in oncologic patients.

**CLINICAL RELEVANCE/APPLICATION**

Addition of deep inspiration CT with MIP reconstructions to conventional FDG PET-CT in oncologic patients yields better performance in TNM staging.

SSG03-06  Deep Learning for Rule-Out of Unnecessary Follow-Up in Patients with Incidentally Detected, Indeterminate Pulmonary Nodules: Results on an Independent Dataset

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S504AB

Participants
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**PURPOSE**

To assess the follow-up rule-out accuracy of a convolutional neural network (CNN) in patients with incidentally detected, indeterminate pulmonary nodules in a multi-site, heterogeneous population.
METHOD AND MATERIALS
The US National Lung Screening Trial (NLST) dataset was manually curated and used to create a training set: each reported nodule and cancer was located, contoured and diagnostically characterised (9310 benign nodule patients; 1058 cancer patients). All patients with solid and semi-solid nodules of 6mm and above, where benign nodules and cancers could be confidently identified by clinicians (5972 patients, of which 575 were cancer patients), were selected. A CNN was trained using Deep Learning and three thresholds for benign rule-out were calculated at three levels of sensitivity: 100%, 99.5% and 99%. An independent dataset of patients with incidentally detected indeterminate pulmonary nodules was retrospectively collected from a tertiary referral centre and surrounding hospitals in the UK with a heterogeneous mix of scan parameters, manufacturers and clinical indications (610 patients, 698 nodules, 5-15mm). Diagnosis was established according to British Thoracic Society guidelines (2015). The dataset contained 50 cancers from 47 patients (7% of all nodules). Performance was evaluated by measuring the specificity at the three benign rule-out thresholds; i.e. to measure the proportion of benign nodules correctly stratified while missing no or few cancers. Overall Area-Under-the-ROC-Curve analysis (AUC) was also calculated.

RESULTS
The specificity (sensitivity) was 24% (100%), 24% (100%) and 48.6% (100%) at the three thresholds respectively. AUC was 0.93 (95%CI = 0.90-0.96).

CONCLUSION
On this independent dataset, the CNN was able to correctly classify just under half of the benign nodules whilst not misclassifying any cancers.

CLINICAL RELEVANCE/APPLICATION
Our work shows the potential of CNNs in ruling out benign pulmonary nodules and therefore reducing the need for follow up scans in a large number of patients.

SSG03-07  A Decision Analysis of Follow-Up and Treatment Algorithms for Subsolid Pulmonary Nodules

Participants
Mark M. Hammer, MD, Saint Louis, MO (Presenter) Nothing to Disclose
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PURPOSE
To use simulation modeling based on evidence from the literature to evaluate several management strategies and treatment options for patients with ground glass nodules (GGNs).

METHOD AND MATERIALS
We developed a Monte Carlo model for patients with GGNs as they underwent follow-up per Lung-RADS for up to ten years. Nodules could grow and develop solid components over time. Rates of clinically-significant malignancy were calibrated to data from the National Lung Cancer Screening Trial. We investigated modifications to the follow-up schedule and tested different treatment strategies, specifically lobectomy, radiation therapy, and no therapy.

RESULTS
Overall, 2.3% of nodules represented clinically significant malignancies, and 6.3% of nodules were treated. Only 29.8% of Lung-RADS 4B/4X nodules were clinically-significant malignancies. We compared outcomes of patients with Lung-RADS 2 nodules followed at 1-, 2-, and 3-year intervals; overall survival at 10 years of follow-up was similar, ranging from 74.7% (annual) to 73.5% (triennial). We also evaluated 10-year outcomes from Lung-RADS 4B/4X non-solid nodules treated with different modalities; at 10 years, overall survival was highest in the radiation therapy arm, at 83.9%, and lowest in the no treatment arm, at 78.1%.

CONCLUSION
Our results suggest a conservative approach to the follow-up and treatment of GGNs. The follow-up interval for GGNs can be increased to 3 years with minimal change in outcomes. Our results also favor the use of radiation therapy when a nodule has met criteria for treatment. Prospective randomized trials are needed to evaluate thresholds for management and different treatment modalities for GGNs.

CLINICAL RELEVANCE/APPLICATION
Conservative management strategies for non-solid nodules, such as triennial follow-up for Lung-RADS 2 nodules and radiation therapy instead of lobectomy for Lung-RADS 4B/4X nodules, are preferable to more aggressive treatment.

SSG03-08  A Robust Model for Prediction of Pulmonary Nodule Malignancy with CT Scans

Participants
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PURPOSE

Pulmonary nodules could be early manifestations of lung cancer, but the morphological complexity makes it difficult to differentiate benign and malignant nodules. This paper proposes two deep learning models aiming to accurately determine the malignancy of pulmonary nodules from CT images.

METHOD AND MATERIALS

Model-1 was adapted from the winning model in Data Science Bowl 2017. We chose ResNet as its backbone and integrated U-Net and Capsule Network architectures to enable the model to comprehensively capture multiscale features of pulmonary nodules. Model-2 took extracted features from Model-1 as input to a random forest classifier to further predict nodule malignancy, as inspired from the NoduleX model. Two datasets were adopted to validate the performance of the proposed two models. Dataset 1 contains 1061 samples (benign/malignant: 703/353) from Lung Image Database Consortium and Image Database Resource Initiative (LIDC-IDRI), and Dataset 2 consists of 1117 samples (benign/malignant: 354/763) provided by collaborating hospitals. Nodules in both datasets were biopsy or surgery proven, and pathology diagnoses were used as gold standard. We randomly selected 20% from each dataset as the testing set and used the rest 80% as the training set. We trained and tested our two models on the above two datasets respectively.

RESULTS

On Dataset 1 (LIDC-IDRI), Model-1 achieved an AUC of 0.91 in the prediction of pulmonary nodule malignancy while Model-2 achieved an AUC of 0.96. On Dataset 2, Model-1 again reached a high AUC of 0.90, which significantly outperformed the Model-2 with AUC=0.80.

CONCLUSION

Model-1 showed consistently high accuracy in pulmonary nodule malignancy prediction on both the LIDC dataset and CT scans collected from collaborating hospitals. Our two models achieved comparable results with NoduleX model which had got the state-of-the-art performance in LIDC dataset. The experimental results demonstrated that Model-1 showed more stable performance across datasets and had better model robustness. The strength of Model-1 may lie in its Capsule Network structure that could extract more universally informative features and the end-to-end deep learning architecture.

CLINICAL RELEVANCE/APPLICATION

Our proposed model can serve as a useful tool for early diagnosis of lung cancer and has the potential to be applied in clinical treatment planning.
External validation is necessary to assess generalizability of a prediction model to new patients. We show how discrimination and calibration can be examined to assess how models can likely enter in clinical practice.
Thin-Section CT May Identify the Cases Meeting the Histological Criteria of Interstitial Pneumonia with Autoimmune Features Among the Population Showing Usual Interstitial Pneumonia Pattern Fibrosis

Station #1

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PURPOSE
To find thin-section CT (TSCT) findings which correspond to the histological criteria of interstitial pneumonia with autoimmune features (IPAF) among the population showing usual interstitial pneumonia (UIP) pattern fibrosis.

METHOD AND MATERIALS
This retrospective study included 149 consecutive cases with unknown causes who had undergone surgical lung biopsy and showing UIP pattern fibrosis on histology (M:F=105:44; median age, 65). TSCT images were evaluated for the disease extent, and presence or absence of parenchymal findings considered as the candidates. Histological images were reviewed for the findings sited as IPAF findings. TSCT findings were compared with each histological finding and clinical information using chi-square test/Fisher's test and multivariate logistic regression analyses by stepwise method.

RESULTS
Histopathological IPAF findings were seen in a total of 34 cases (interstitial lymphoid aggregates with germinal center, 12; diffuse lymphoplasmacytic infiltration, 14; pleuritis, 8; airway disease, 15; vasculopathy, 0). On multivariate analyses, following CT findings were significantly associated with histological features: extent of ground-glass opacification and focal fissure thickening for any of histological criteria (P=0.046 and 0.007, respectively), extent of consolidation, dense reticulation and focal fissure thickening for interstitial lymphoid aggregates with germinal center (P=0.008, 0.022 and 0.245, respectively); subpleural sparing and centrilobular nodules for airway lesion (P=0.008 and 0.024, respectively); subpleural sparing and centrilobular nodules for pleuritis (P=0.0007 and 0.042, respectively). In addition, mosaic attenuation, shaggy thickening of interlobular septa, pulmonary artery enlargement were independent factors for positive serological domain (P=0.003, 0.049 and 0.016 respectively), mosaic attenuation was for IPAF cases (P=0.016).

CONCLUSION
Several CT findings including centrilobular nodules and extent of ground-glass opacification might be a potential marker of histopathological IPAF features in UIP pattern cases without doing surgical lung biopsy.

CLINICAL RELEVANCE/APPLICATION
TSCT may help identify the cases with IPAF showing UIP pattern which immunosuppressive therapy work well without invasive surgical lung biopsy.
To evaluate the performance of various machine learning method based on CT texture analysis to differentiate lung cancer from benign nodule with solitary ground-glass opacity nodules.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. The requirement to obtain informed consent was waived. We included 132 patients who was pointed out small (<3cm) ground- or opacity nodules with lung CT scan and were diagnosed by the biopsy. Of 132 patients, 59 was diagnosed as benign nodule and 73 was diagnosed as lung cancer. Twelve kinds of the histogram and the texture parameters (minimum normalized signal, mean normalized signal, standard deviation of normalized signal, max normalized signal, skewness, kurtosis, homogeneity, energy, contrast, correlation, entropy, dissimilarity) were assessed for unenhanced CT. A prediction model was developed using various machine learning methods (univariate logistic regression and K-nearest neighbor, Support vector machine, Random forest, multivariate Logistic regression and eXtreme gradient boosting with all features) and the area under the receiver operating characteristic curve of this model was calculated via 5-fold cross validation. In addition, the performance of the machine learning method was compared with the judgments of three board certified radiologists.

RESULTS

With the univariate logistic regression models, the skewness offered the highest AUC (0.66), followed by mean value (0.65), standard value (0.59), kurtosis (0.58), max value (0.57) and entropy (0.56). With the multivariate models, the eXtreme Gradient Boosting offered the highest AUC (0.73), followed by multivariate Logistic regression (0.70), Random Forest (0.69), Support Vector Machine (0.67) and K-Nearest Neighbor (0.65). The AUC of the eXtreme Gradient Boosting was comparable to that of the two radiologists (0.68 and 0.73, respectively)

CONCLUSION

The performance of machine learning was comparable to that of experienced radiologists to differentiate lung cancer from benign nodule with solitary ground-glass opacity nodules, and the diagnostic performance varies by the machine learning algorithms.

CLINICAL RELEVANCE/APPLICATION

We must choose adequate machine learning algorithm for datasets to improve the diagnostic performance of machine learning.

CH276-SD-TUA3 Prognostic Implications of Radiomic Features for EGFR Mutation Status in Patients with Lung Adenocarcinoma

PURPOSE

This study retrospectively evaluated the clinical availability of computed-tomography (CT) based radiomic features to predict EGFR mutation status in patients with lung adenocarcinoma.

METHOD AND MATERIALS

We analyzed 417 primary lung adenocarcinomas from an unselected Chinese population. 219 quantitative 3D features were extracted from segmented volumes of each tumor, and 59 of these which were considered as independent features were included in the analysis. Clinical and pathological information were obtained from the institutional database.

RESULTS

Mutant EGFR was significantly associated with female gender (p=0.0005); never smoker status (p<0.0001), lepidic predominant adenocarcinomas (p=0.017), and low or intermediate pathologic grade (p=0.0002). Statistically significant differences were found in 11 radiomic features between EGFR mutant and wild type groups on univariate analysis. Mutant EGFR status could be predicted by a set of seven radiomic features that fall in three broad groups: CT attenuation energy, tumor main direction and texture defined by wavelets and Laws (AUC 0.740). Multiple logistic regression model showed that adding radiomic features to a clinical model resulted in a significant improvement of predicting power, as the AUC increased from 0.667 to 0.720 (p<0.0001).

CONCLUSION

CT-based radiomic features of lung adenocarcinomas can capture useful information regarding tumor phenotype, and the model we built can be useful to predict the presence of EGFR mutations in lung adenocarcinoma in patients when mutational profiling is not available or possible.

CLINICAL RELEVANCE/APPLICATION
Based on the analysis of the histologic features of CT images, the EGFR mutation prediction system for non-small cell lung cancer was established.

**Automatic Segmentation for Pulmonary Pure Ground-Glass Nodules from Follow-Up CT Scans Using Recurrent Convolutional Neural Networks**

**METHOD AND MATERIALS**

The test dataset contains 104 pGGNs from 104 patients with 441 follow-up CT scans. As for the method, we present a recurrent convolutional neural networks to segment pGGNs iteratively for automatic segmentation and assisting observation of pGGNs in follow-up CT scans. Specifically, a 3D UNet was utilized as the base segmentation model to generate prior nodule boundaries, while a proposed recurrent neural network with ranking loss was adopted to refine the nodule boundaries based on all previous segmentation results in a recurrent way. The proposed network was first trained with the Lung Image Database Consortium and Image Database Resource Initiative (LIDC-IDRI) dataset with a test Dice coefficient of 83.18% and then fine tuned by a pGGN dataset from our hospital. In addition, several key indicators of the pGGNs were derived automatically from the segmentation results including volume, mass, volume double time (VDT), mass double time (MDT), etc., which can assist doctors in deciding on strategy of follow-up.

**RESULTS**

The present segmentation method was tested on the above test dataset, with a total of 441 pGGNs. Consider each slice as an individual nodule sample, 8091 pGGN slices were included in the test dataset. Experimental results show that 6746 pGGN ROIs were identified and segmented successfully while the false positive rate is 24.51% and the recall is 96.54%. The average F-measure is 0.8473 which shows that our method is reliable for the segmentation of various shapes of pGGNs. Besides, the results also show that our method is robust to the growth of pGGNs. As for the efficiency, it takes only an average time of 0.39s to segment one nodule on a single Titan X pascal GPU.

**CONCLUSION**

In this study, we presented a recurrent convolutional neural networks and showed the feasibility of the proposed method on segmenting pure ground-glass nodules from follow-up CT scans.

**Automatic Segmentation for Pulmonary Pure Ground-Glass Nodules from Follow-Up CT Scans Using Recurrent Convolutional Neural Networks**

**STIR Turbo Spin-echo Imaging versus Contrast-Enhanced Thin-Section CT: Capability for Chest Wall Invasion Assessment in Candidates for Surgical Resection due to Non-Small Cell Lung Cancer**

**METHOD AND MATERIALS**

51 consecutive NSCLC patients who were candidates for surgical treatment underwent CE-MDCT, STIR turbo SE imaging, surgical resection and pathological examination. STIR turbo SE imaging was obtained by using the respiratory-triggered STIR turbo SE imaging (TR=2-4 ms, TEeff=15 ms, TI=150 ms) at a 1.5T whole body scanner in each subject. According to the final pathological diagnosis of chest wall invasion, all patients were divided into two groups as follows: invasion group (n=10) and non-invasion group (n=41). In this study, prevalence of chest wall invasion on CE-MDCT was evaluated by 5-point visual score based on previously
published criteria such as 1) contact angle, 2) contact length longer than 3 cm, 3) pleural thickening, 4) the obliteration of subpleural fat of chest wall, 5) the obvious infiltrating mass, and 6) rib destruction. On STIR turbo SE imaging, chest wall invasion was assessed by using the contrast ratio (CNR) of signal intensity of abutting chest wall and muscle. To determine difference of each index between invasive and non-invasive groups, Fischer's PLSD or Student's t-test were performed. To determine the feasible threshold values of each index for chest wall invasion evaluation, ROC-based positive test was performed. Finally, diagnostic performance was compared by McNemar's test.

RESULTS

CNR and visual CT findings except contact angle, pleural thickening and rib destruction had significant difference between two groups (p<0.05). When feasible threshold value applied to each index, specificity (SP: 100 [41/41] %) and accuracy (AC: 94.1 [48/51] %) were significantly higher than those of contact length longer than 3 cm (SP: 68.3 [28/41] %, p=0.0002; AC: 70.6 [36/51] %, p = 0.0005).

CONCLUSION

STIR turbo SE imaging is more useful than CE-MDCT to assess chest wall invasion in candidates for surgical treatment due to NSCLC.

CLINICAL RELEVANCE/APPLICATION

STIR turbo SE imaging is more useful than CE-MDCT to assess chest wall invasion in candidates for surgical treatment due to NSCLC.

TEACHING POINTS

1) To describe the Radiomics process 2) To discuss Radiomics clinical role in lung cancer management

TABLE OF CONTENTS/OUTLINE

Tumour's stage is the prognosticator used in the management of lung cancer, indeed, in addition to the anatomic extend other factors determine prognosis. The interaction between microenvironment and neoplastic cells is responsible of the genetic/phenotypic mutations in neoplastic tissue and of the deriving heterogeneity. Radiomics refers to the extraction of quantitative image features from standard-of-care medical imaging that can be related to underlie phenotype/genotype, to their analysis and modelling in relation to prediction targets. The workflow includes: - Data selection and image acquisition; - Segmentation; - Features extraction;- Model building and validation. Radiomics's field of interest are multiple: - Histopathology correlation; To obtain a "virtual biopsy" by relating imaging analysis with the genetic one.- Lesion Characterization; Malignant lesions are characterized by greater heterogeneity and irregular shape.- Prediction of tumour aggressiveness and clinical outcome; heterogeneous tumours tend to be more aggressive and to have be poorer outcomes. Strength and critical points of the process will be described.

TEACHING POINTS

Radiation therapy has a major role in adjuvant, neoadjuvant and palliative therapies for lung cancer and includes conventional (CRT) and 3D conformal techniques. Stereotactic body radiation therapy (SBRT) uses a small number of fractions for definitive treatment of early stage lung cancer and metastatic disease. Post-CRT and -SBRT therapy changes manifest with differing appearances of which the radiologist should be aware to avoid pitfalls in interpretation and identify when tumor recurrence exists. The reviewer of
this exhibit will have an improved understanding of a) Indications for CRT and SBRT and amenable lesions for these therapies b) the patterns of radiation pneumonitis for CRT and SBRT that can occur to improve understanding of complications and c) complications, including tumor recurrence.

**TABLE OF CONTENTS/OUTLINE**

1. RT techniques and indications - CRT - 3D techniques - SBRT
2. Imaging of the post RT patient: time and technique
3. CRT and SBRT complications - Acute and chronic radiation pneumonitis: CRT (conventional pattern) SBRT (masslike consolidation, modified conventional pattern) - Pericarditis/pleuritis
4. Complications and tumor recurrence: CT findings - Tumor recurrence - Infection - Rib fracture
Case Review: Lung-RADS - Bring Your Own Device (Hands-on)

Tuesday, Nov. 27 12:30PM - 2:00PM Room: S503AB

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

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Elizabeth Lee, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
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Maria D. Martin, MD, Madison, WI (Presenter) Nothing to Disclose
Brett M. Elicker, MD, San Francisco, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe patient risk factors for lung cancer and current requirements for patients to be eligible for lung cancer screening based on the coverage decision outlined by the Centers for Medicare and Medicaid Services. 2) Explain the rational for each category used in Lung-RADS. 3) Apply Lung-RADS to case examples and recommend appropriate follow up.

ABSTRACT
Participants will review cases on their own devices and answer questions. The cases will then be reviewed by the presenters. Note: this activity is best done on a laptop or tablet. Although phones will work, their small size limits optimal image view. Lung-RADS was established in 2014 as a means to standardized reporting and management in high-risk patients undergoing screening for lung cancer with low dose CT. This workshop will begin with an approximately 20 minute review of the National Lung Screening Trial (NLST) and other supporting evidence for the efficacy of screening, recommendations for screening as per the U.S. Preventative Services Task Force and the coverage decision by the Centers for Medicare and Medicaid Services. Additionally, concepts regarding the structure and rational for Lung-RADS will be highlighted. After a didactic portion, participants will review cases independently on their own devices. Faculty support will be available throughout the room to answer individual questions. Following this, cases will be reviewed by the presenters in order to highlight key concepts in the use of Lung-RADS. This session will focus on the application of Lung-RADS including: recognizing important imaging features and applying findings to assign the correct Lung-RADS category. Attendees will be given tips and tools to help with use of Lung-RADS and requirements for establishments of a lung cancer screening program.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Ella A. Kazerooni, MD - 2014 Honored Educator
PURPOSE
To evaluate the quantitative computed tomography (QCT) phenotypes, airflow limitations, and exacerbation-like episodes in heavy smokers undergoing a screening for lung cancer.

METHOD AND MATERIALS
We enrolled 172 smokers with a smoking history >=30 pack-years who underwent pulmonary function tests (PFTs) and CT scan for screening of lung cancer. Patients were classified regarding airflow limitation (VEF1/FVC <0.7) and the presence of emphysema on the QCT. The QCT were analyzed in a specialized software and patients were classified in two disease-predominant phenotypes: emphysemapredominant (EP) and non-emphysema-predominant (NEP). EP was defined as 6% or more pixels with less than -950 Hounsfield units, while NEP shows less than 6% of pixels below this value.

RESULTS
Most patients in our sample had air-flow limitation (61%), of those most were male (68.5%) and had a mean smoking history of 77.2 ±38.0 packs-year. The group with limitation had more exacerbation-like episodes compared to those without airflow limitation (26.6% vs. 9%, p <0.001) and greater areas of low attenuation on QCT (17.01 ±9.96 vs. 4.52 ±3.55, p<0.001). Most of our patients were classified in the EP phenotype. The EP group had significant worse pulmonary function (VEF1 60.6 ±22.9 vs. 89.7 ±15.9, p <0.001), and had more exacerbation episodes (25.8% vs. 8.3%, p <0.001) compared to the NEP group.

CONCLUSION
Heavy smokers with the EP phenotype on QCT had worse pulmonary function, and more exacerbation-like episodes than those with the NEP phenotype. About 23.8% of those with no airflow limitation on PFTs were classified as EP.

CLINICAL RELEVANCE/APPLICATION
Quantitative computed tomography (QCT) allows objective and noninvasive identification and quantification of emphysema earlier than spirometry, and possibly before the emergence of symptoms. Assessment of airway morphology and other underlying conditions can be used to define the patient's predominant phenotype, which plays an important role in determining outcomes related to exacerbations, antimicrobial therapy, decline in pulmonary function, and mortality.
To determine if a chest CT alone with measurable chest disease is sufficient to determine progression of disease (PD) in stage 4 lung cancer patients on clinical trial as assessed by RECIST 1.1.

METHOD AND MATERIALS

IRB approved HIPAA compliant retrospective review of treatment response of patients with stage 4 lung cancer on clinical trial assessed by RECIST 1.1 in a tumor metrics database (Precision Imaging Metrics). Only patients with known progression of measurable disease were analyzed for sites of PD classified as chest only progression, outside chest only progression or a combination of chest and outside chest progression. Further classifications of the sites were grouped as abdomen, brain versus pelvis. An equivalence test of the observed proportion using chest alone with null hypothesis proportion observed proportion using chest and other and equivalence margin of 0.07 was conducted.

RESULTS

Of the 328 patients identified, 188 had PD. 116 (61.7%) patients were classified as PD based on the chest, 57 (30.3%) based on chest and other sites, and 15 (7.98%) based only on sites outside the chest. The most common site of chest independent progression was the brain. Altogether, 61.7% of patients could be labelled as PD with only a chest CT, 96.81% would be labelled if an abdomen CT was included, and 99.47% of patients would be labelled if a brain MRI was included. Only 1 case (0.53% of patients) had PD exclusively in the pelvis. The two one-sided tests (TOST) for equivalence yielded an overall p-value of 1, indicating the null hypothesis of non-equivalence of a chest CT alone compared to chest with other should not be rejected.

CONCLUSION

Although a chest CT alone in this sample of patients with stage 4 lung cancer on clinical trial with measurable disease in the chest can determine PD in 61.7%, it was statistically inferior to chest CT plus abdomen and brain MRI. However CT pelvis only rarely is necessary to establish progression of disease alone and may not be necessary at each follow-up time point.

CLINICAL RELEVANCE/APPLICATION

Although a chest CT alone is not sufficient to determine PD in stage 4 lung cancer patients on clinical trial, CT pelvis rarely demonstrates PD and may not be necessary at each follow-up time point.
CONCLUSION

Artificial intelligence can accurately predict pathological noninvasiveness in T1 size NSCLC on CT images.

CLINICAL RELEVANCE/APPLICATION

Because of the risk of recurrence, lobectomy is indicated even for small lung cancers. If we could accurately predict and classify noninvasive small lung cancers on CT images using deep learning algorithm prior to surgery, a more refined selection of candidates who would benefit from limited resection without increasing the risk of recurrence would be possible.

CH282-SD- TUB4

Inter-Observer Agreement in the Classification of Perifissural Nodules as Lymphnodes on Chest CT  

Participants

Juan Carlos Diaz Patino, Santiago, Chile (Abstract Co-Author) Nothing to Disclose  
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PURPOSE

Determine inter-observer agreement of chest radiologists classifying perifissural nodules (PFN) as intrapulmonary lymphnodes on chest CT.

METHOD AND MATERIALS

IRB-approved retrospective study, who approved a waiver on informed consent. All chest CT performed during a four-month period (March through July 2016) were reviewed for incidental pulmonary nodules by a senior chest radiologist who sub-classified them into three categories (typical PFN - likely intrapulmonary lymph node, atypical PFN and non-PFN) by using criteria by de Hoop et al. 120 cases were selected, studies were anonymized and reviewed by three other senior chest radiologists, who classified them using the same criteria, unaware of the patients' history. Inter-observer agreement was analyzed using Cohen's kappa coefficient. 95% CI were calculated and statistical significance was considered at p<0.05.

RESULTS

The global agreement measured by Cohen's Kappa was 0.603 (95% CI: 0.560 - 0.661). When categories were regrouped, Kappa value for classifying "typical PFN " compared to the remaining categories ("atypical PFN" and "not PFN") was 0.728 (95% CI: 0.690 - 0.754), in good range of concordance according to Altman et al. When the "not PFN" category was considered (grouping together the remaining categories), Kappa values dropped to 0.530 (95% CI 0.473 - 0.587), moderate concordance according to Altman et al.

CONCLUSION

Incidental pulmonary nodules are a frequent finding in routine chest CT and are followed according to guidelines. Some of these nodules represent intrapulmonary lymph nodes and should require no follow-up. Our results show that there is good interobserver agreement in the classification of pulmonary nodules as "typical" intrapulmonary lymph nodes. However, classifying as "atypical" lymphnode has a higher degree of variability, which might hinder its widespread use.

CLINICAL RELEVANCE/APPLICATION

The category of intrapulmonary lymph node has been incorporated in some European incidental pulmonary nodule guidelines, and recently mentioned on the Fleischner Society guidelines. To our knowledge, there are no studies analyzing inter-observer agreement in classifying nodules as intrapulmonary lymph nodes. Our results show that there is good interobserver agreement in the classification of pulmonary nodules as typical PFN, therefore highly suggestive of intrapulmonary lymph nodes and amenable to support the incorporation of this category in future guidelines.

CH283-SD- TUB5

T1 Mapping in Thoracic Neoplasms: Initial Experience  

Participants

Jordi Broncano, MD, Cordoba, Spain (Presenter) Nothing to Disclose  
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Pilar Caro, MD, Cadiz, Spain (Abstract Co-Author) Nothing to Disclose  
Paula Montesinos de la Vega, Madrid, Spain (Abstract Co-Author) Employee, Koninklijke Philips NV  
Antonio Luna, MD, PhD, Jaen, Spain (Abstract Co-Author) Consultant, Bracco Group; Speaker, General Electric Company; Speaker, Canon Medical Systems Corporation; Royalties, Springer Nature

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PURPOSE

To evaluate the feasibility and diagnostic performance of T1 mapping in the evaluation of tumoral and non-neoplastic lesions of the chest.

METHOD AND MATERIALS

31 patients (36 tumoral and non-neoplastic lesions) were prospectively included. There were 23 males and 8 females, with normal renal function and mean age of 66.1 ± 12.41 years-old. Added to a normal chest MR protocol, a modified look-locker (MOLLI) T1 mapping sequence was included native (5s(3s)3s) and post-contrast (4s(1s)3s(1s)2s) with ECG-gating at end diastole and during
one breathold (15 seconds). 0.015 mmol/kg of Gadopentetate of dimeglumine was administered, acquiring post-contrast images after 15 minutes. Two independent blinded radiologist analyze the images placing ROIs at the target lesions, fat tissue, striated muscle and descending aorta. Native and enhanced T1, R1 values, differences in native and post-contrast T1 (ΔT1) and R1 (ΔR1) values, and partition coefficient (λ). Independent Student T test ROC analysis and intraclass correlation coefficient were done applying a two-tailed alpha error of 0.05.

RESULTS

We analyzed 19 tumoral lesions (lung cancer, metastasis, solitary fibrous tumor of the pleural, malignant pleural mesothelioma and esophageal leiomioma) and 17 benign lesions (post-obstructive neumonitis, atelectasis, hamartomas, lipoma, lymphangioma, necrosis). Significant statistical differences between non tumoral and neoplastic lesions were obtained in T1 post-contrast (1112.76±878.77 vs. 495±182.37 ms; p<0.05), ΔT1 (666.12±747.5 vs. 1199.68±278.5 ms; p<0.05), R1 post-contrast (1.67±1.02 vs. 2.33±0.64 ms; p<0.05), ΔR1 (0.82±1.17 vs. 1.71±0.58 ms; p<0.05) and λ (0.21±0.74 vs. 0.73±0.25 ms; p<0.05). Non-significant differences were obtained on T1 native and post-contrast derived parameters of fat, striated muscle and blood pool. ROC analysis revealed significant higher area under the curve of ΔT1 (0.844), λ (0.738), ΔR1 (0.726) and T1 post-contrast (0.697).

CONCLUSION

T1 mapping of chest lesions is a feasible technique being post-contrast T1 derived parameters and λ the best markers for differentiating tumoral and non-neoplastic lesions.

CLINICAL RELEVANCE/APPLICATION

T1 mapping of chest lesions is a feasible technique being post-contrast T1 derived parameters and λ the best markers for differentiating tumoral and non-neoplastic lesions.

Honored Educators

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CH247-ED-TUB6 The Surgical 3DCT Anatomy of the Pulmonary Vessels for Lung Cancer: What Radiologists Should Know

Station #5

Participants

Makiko Murota, MD, Kitagun, Japan (Presenter) Nothing to Disclose
Yuka Yamamoto, MD, PhD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose
Katashi Satoh, MD, Takamatsu, Japan (Abstract Co-Author) Nothing to Disclose
Yoshiiro Nishiyama, MD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

Preoperative identification of pulmonary vessels is considered one of the key issues for successful surgical resection of lung cancer. Anatomical variants of pulmonary vessels can cause serious problems such as unexpected bleeding. The purpose of the exhibit is: 1. To describe the types of surgery for lung cancer, and utility of 3D-CT angiography (3D-CTA). 2. To recognize the basic branching patterns of the pulmonary artery (PA) and pulmonary vein (PV), and then to understand the variations of them that are the key point for surgery.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Describe the common types of surgery for lung cancer and anatomical information what are needed for each procedure -wedge resection, segmentectomy, lobectomy, pneumonectomy 3. The 3D-CTA techniques of the PA and PV for preoperative information -traditional CTA images -the separate demonstration 3DCT-PA and 3DCT-PV -visualization in the pulmonary bronchovascular pattern using CTA and 3D-bronchography 4. The basic branching patterns and the important variations for the lung cancer surgery -PA -PV 5. Take home points

CH248-ED-TUB7 Imaging Follow-Up After Radiofrequency Ablation (RFA) in Patients with Early Stage Non-Small Cell Lung Cancer (NSCLC): An Experience-Based Pictorial Review

Station #7

Participants

Alessandra Ottavianelli, MD, Rome, Italy (Presenter) Nothing to Disclose
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TEACHING POINTS

- To review, according to the time of unset, the most common CT and 18F-FDG PET/CT patterns occurring during follow-up after RFA in patients with NSCLC, through the experience of our center- To describe findings which are not expected after successful RFA and therefore labelled as "red flags" for progression of incompletely ablated tumor or recurrence

TABLE OF CONTENTS/OUTLINE
Radiological and functional patterns after RFA are classified according to the time of onset. EARLY PHASE (<=1 week) CT: ground glass opacities (GGO). INTERMEDIATE PHASE (>1 week - 2 months) CT: increasing of size, concentric rings of attenuation, peripheral enhancement; 18F-FDG PET/CT: absence of central uptake. LATE PHASE (>2 months) CT: gradual reduction of lesion size and enhancement; 18F-FDG PET/CT: gradual reduction of uptake. BENIGN ADDITIONAL FINDINGS: cavitation, scar formation, pleural thickening. "RED FLAGS" FOR RECURRENCE: CT: increase in volume and enhancement, new satellite nodule, lymphadenopathy; 18F-FDG PET/CT: increase in metabolic activity.
MSRO37

BOOST: Lung, Mediastinum and Pleura

Tuesday, Nov. 27 1:30PM - 1:40PM Room: S103CD

BQ CH CT NM OI RO

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

FDA Discussions may include off-label uses.

Participants
Meng X. Welliver, MD, Columbus, OH (Moderator) Nothing to Disclose
Tracy M. Sherertz, MD, San Francisco, CA (Moderator) Nothing to Disclose

Sub-Events

MSRO37-01 Dynamic Perfusion Area-Detector CT versus Dynamic Perfusion MR Imaging versus FDG-PET/CT: Capability for Therapeutic Outcome Prediction in Small Cell Lung Cancer Patients with Limited Disease

Tuesday, Nov. 27 1:30PM - 1:40PM Room: S103CD

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (Presenter) Research Grant, Canon Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Fuji Pharma Co, Ltd; Research Grant, Guerbet SA;
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Takamichi Murakami, MD, PhD, Osaka, Japan (Abstract Co-Author) Nothing to Disclose

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PURPOSE

To directly compare the capability for therapeutic outcome prediction among dynamics contrast-enhanced (CE-) perfusion area-detector CT (ADCT) and CE-perfusion MR imaging (MRI) assessed by same mathematical method and FDG-PET/CT in small cell lung cancer (SCLC) patients assessed as limited disease (LD).

METHOD AND MATERIALS

Forty-three consecutive pathologically diagnosed SCLC patients assessed as LD (25 male, 18 female; mean age 67 year old) underwent FDG-PET/CT, dynamic CE-perfusion ADCT and MRI, chemoradiotherapy, and follow-up examination. In each patient, therapeutic outcomes were assessed as therapeutic effect based on RECIST guideline, disease free interval and overall survival. Then, all patients were divided into two groups as follows: 1) responder (CR+PR: n=33) and 2) non-responder (SD+PD: n=10) groups. In each patient, total perfusion (TP) and tumor perfusions from pulmonary (TPP) and systemic (TPS) circulations calculated by dual-input maximum slope method from dynamic CE-perfusion ADCT and MRI data and SUVmax on PET/CT were assessed at targeted lesions. Then, final values were determined as average values from all targeted lesion, and compared between two groups by Student's t-test. To compare the capability for distinguishing two groups, all indexes as having significant difference were assessed by ROC analysis. 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

There were significant difference of all indexes except TPP determined by each method (p<0.05). Area under the curves (Azs) of TPS (ADCT: Az=0.92, MRI: Az=0.92) were significantly larger than that of SUVmax (Az=0.73, p<0.05). Disease free survivals of responder were significantly longer than that of non-responder by TP (ADCT: p=0.006, MRI: p=0.02) and TPS (ADCT: p=0.001, MRI: p=0.02). Overall survivals of responder were also significantly longer than that of non-responder by TP (ADCT: p<0.0001, MRI: p=0.0003,) and TPS (ADCT: p=0.001, MRI: p=0.001).

CONCLUSION

Dynamic CE-perfusion ADCT and MRI have better potential for predicting therapeutic outcome than FDG-PET/CT in small cell lung cancer patients with limited disease.

CLINICAL RELEVANCE/APPLICATION

Dynamic CE-perfusion ADCT and MRI have better potential to predict therapeutic outcome than FDG-PET/CT in small cell lung cancer patients with limited disease.
**MSRO37-02 Modern Treatment Patterns and Overall Survival of Non-Small Cell Lung Cancer Patients Receiving Palliative Radiation Therapy for Brain Metastases at Diagnosis**

Tuesday, Nov. 27 1:40PM - 1:50PM Room: S103CD

**Awards**
**Student Travel Stipend Award**

**Participants**
Pamela Samson, MD, Saint Louis, MO (Presenter) Nothing to Disclose
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Christopher D. Abraham, MD, Manchester, MO (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**
Non-small cell lung cancer (NSCLC) is one of the most common malignancies associated with brain metastases (BM) at diagnosis. Recent randomized trials have shown equivalent survival outcomes and improved neurocognitive outcomes with stereotactic radiosurgery (SRS) compared to whole brain radiation therapy (WBRT). We reviewed the NCDB to identify trends of RT for NSCLC patients with BM.

**METHOD AND MATERIALS**
11,299 NSCLC patients with BM at diagnosis and treated with palliative brain RT between 2010 and 2014 were identified in the NCDB. Patients receiving “stereotactic radiosurgery, NOS,” “LINAC radiosurgery,” or “gamma knife radiosurgery,” or received external-beam RT with fraction size >=6 Gy were included in the SRS cohort. The WBRT cohort included all patients receiving RT to the brain in >5 fractions. Patient characteristics were correlated with treatment received using multivariable logistic regression. Kaplan-Meier was used to compare overall survival (OS) between these two groups and Cox Proportional Hazards modeling (CPHM) to identify variables associated with OS.

**RESULTS**
9,680 (85.7%) patients were included in the WBRT group and 1,619 (14.3%) patients in the SRS group. Median dose in the WBRT was 3000 cGy and 2200 cGy in the SRS group. The frequency of SRS increased from 9.9% in 2010 to 19.6% in 2014. On MVA, variables associated with increased likelihood of receiving SRS included: increasing age (OR 1.01, 95% CI 1.01-1.02; P<0.0001), most recent year (2014) of diagnosis (OR 2.14, 1.78-2.56; P<0.0001), treatment at an academic facility (OR 3.21, 2.51-4.10; P<0.0001), private insurance (OR 2.25, 1.62-3.11), income in zip code >$63,000 (OR 1.33, 1.13-1.56; P=0.001), living >20 miles from treatment facility (OR 1.19, 1.03-1.37; P=0.016), and receipt of chemotherapy (OR: 2.48, 2.12-2.88; P<0.0001). WBRT patients had median OS of 4.1 months (95% CI, 4.0-4.3) vs. 8.9 months (8.2-9.7) for SRS patients (P<0.0001). On CPHM, factors independently associated with improved OS included receipt of SRS, chemotherapy, treatment at an academic center, and private insurance (P<0.02 for all).

**CONCLUSION**
Our analysis reveals that WBRT remains the most common palliative treatment for BM in NSCLC. SRS use is increasing and has nearly doubled between 2010 and 2014. In this study, SRS was associated with increased OS although there are biases in the selection of patients who receive SRS.

**CLINICAL RELEVANCE/APPLICATION**
SRS use for NSCLC patients with BM at the time of diagnosis is increasing, and is independently associated with improved OS.

**MSRO37-03 Quantification of Radiation Pneumonitis in Lung Cancer Patients Receiving Proton or Photon Radiotherapy Using FDG-PET/CT**

Tuesday, Nov. 27 1:50PM - 2:00PM Room: S103CD

**Awards**
**Trainee Research Prize - Fellow**

**Participants**
Pegah Jahangiri, MD, Philadelphia, PA (Presenter) Nothing to Disclose
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Charles B. Simone II, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
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**PURPOSE**
This study assessed the feasibility of FDG-PET/CT to quantify radiation-induced pneumonitis in ipsilateral and contralateral lungs of patients with locally advanced non-small cell lung cancer (NSCLC) who received proton, photon, or combined proton-photon radiotherapy (RT).
METHOD AND MATERIALS

39 consecutive patients (53.8% female, median age 67y) with predominantly stage IIIA (62%) or IIIB (31%) NSCLC underwent FDG-PET/CT before and after proton or photon RT. Regions of interest (ROIs) were drawn manually along the margins of the lung parenchyma on PET/CT images. Lung mean standardized uptake value (SUVmean), global lung glycolysis (GLG), and lung volume were measured. Partial volume correction (PVC) of PET-based parameters was then performed. To quantify tumor metabolic response to RT, metabolically active tumor volume (MTV), tumor SUV, and total lesion glycolysis (TLG) were measured. Total lesion glycolysis was then subtracted from GLG to calculate global lung parenchymal glycolysis (GLPG). Parameters of FDG-PET/CT scans before and after RT were compared using two-tailed paired t-tests.

RESULTS

Among the 9 patients who received photon RT, there was a significant increase in PVC-GLPG of ipsilateral (p <0.001) and in GLG of contralateral (p =0.036) lungs. Also, in the subset of 9 patients who received combination of proton-photon RT, there was a statistically significant increase in PVC-GLPG in only the ipsilateral lung (p <0.001). In contrast, among the 21 patients treated exclusively with proton RT, no significant increase in PVC-SUVmean (p=0.114) or in PVC-GLPG (p=0.453) were observed in ipsilateral lungs. Also, there were no significant increase in SUVmean (p=0.841) or in GLG (p=0.241) of contralateral lungs of patients who received exclusively proton RT.

CONCLUSION

We identified significant increases in PVC-SUV and PVC-GLPG in patients who received photon RT (either alone or in combination with proton RT) that were not identified in patients who received only proton RT. These observations suggest less induction of inflammatory response in both ipsilateral and contralateral lungs of patients treated with proton compared to photon or combined proton-photon RT, suggesting a mechanism by which proton therapy reduces radiation-induced pneumonitis.

CLINICAL RELEVANCE/APPLICATION

Proton RT induces less inflammatory response in both the ipsilateral and contralateral lungs of patients compared to photon or combined proton-photon RT.

MSRO37-04 Differentiating EGFR Mutation Status in Non-Small Cell Lung Cancer Using Imaging Features From PET/CT

Tuesday, Nov. 27 2:10PM - 2:20PM Room: S103CD

Participants

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PURPOSE

In this study, we investigated whether epidermal growth factor receptor (EGFR) mutation status in non-small cell lung cancer (NSCLC) can be assessed from quantitative as well as qualitative features extracted from both CT and PET.

METHOD AND MATERIALS

Eighty patients with stage II and III NSCLC and a confirmed EGFR mutation status (30 patients were positive and 50 were negative for EGFR mutation), who underwent PET/CT between January 2017 to December 2017, were included in this study. We extracted 514 quantitative features from PET/CT (257 for PET and 257 for CT) and 12 qualitative features from CT. Principal component analysis (PCA) was applied for feature selection. We selected principal components retaining 95% of the variability from all features. We then rebuilt the original features using the selected principal components and the original features were selected that correlated by at least 99% to the rebuilt features. Finally, 5 qualitative features, 24 quantitative features for CT as well as 10 quantitative features for PET were selected. A predictive model of EGFR mutation in terms of selected features using generalized linear regression with lasso regularization. The regularization parameter was selected through a 10-fold cross validation. All statistical analysis were performed in R software version 3.4.4.

RESULTS

With the total of 39 features selected which were significantly associated with EGFR mutation status, a predictive model for associating image features with EGFR positive/negative was built. We estimated the performance of the model using the area under the receiver operating characteristic curve (AUC). The result revealed an AUC=0.74.

CONCLUSION

By combing the PET-CT images together with first generation gene testing data, we investigate the relationship between image features and EGFR mutation status and built a radiogenomics model which can predict whether the patients have EGFR mutation or not from a certain number of qualitative features as well as quantitative features.

CLINICAL RELEVANCE/APPLICATION

A non-invasive method from image features to predict gene mutation status correlated with NSCLC and further advancing the role of imaging in precision medicine.

MSRO37-05 Stereotactic Body Radiotherapy for Centrally Located Non-Small Cell Lung Cancer: Single Center Experience

Tuesday, Nov. 27 2:10PM - 2:20PM Room: S103CD

Participants
Lorenzo Livi, Florence, Italy (Abstract Co-Author) Nothing to Disclose
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PURPOSE

By definition, centrally located lung tumors are identified as a lesion located within 2 cm or touching the zone of the proximal bronchial tree or tumors immediately adjacent to the mediastinal or pericardial pleura. In these cases, the use of stereotactic body radiotherapy (SBRT) is debated due to the potential risk of severe toxicity. Currently, no high-level evidence is available to support its use.

METHOD AND MATERIALS

Between 2010 and 2015, 40 patients were treated with SBRT for 45 centrally located lesions. SBRT was delivered through either a LINAC-based intensity modulated radiotherapy (IMRT) technique or a robotic technique with Cyberknife. The prescribed total dose varied between 26 and 60 Gy delivered in 1 or 8 fractions, respectively, with median BED10 of 69 Gy (range 37.5-105 Gy). Overall Survival (OS) and Progression Free Survival (PFS) were reported using Kaplan-Meier method. Treatment-related toxicity was evaluated according to CTCAE version 4.0.

RESULTS

The median age of the cohort was 62 years (48-86). The majority of treated lesions were secondary hilar or mediastinal lymphadenopathies (31/45, 69%), while unresectable primary tumors represented the remaining 14 cases (14/45, 31%). The most commonly used technique was VMAT for 21 lesions (47%), followed by Cyberknife for 14 (31%) and step and shoot IMRT for 10 targets (22%), respectively. The predominant NSCLC histology was adenocarcinoma (32/45, 71%). The median longest tumor diameter was 31 mm (range 10-60 mm). At a median follow-up of 14.5 months, OS and PFS were 86.5%, 55.6%, 49.4% and 48.6%, 24.1% and 12% at 1, 2 and 3 years, respectively. According to RECIST 1.1 criteria, a clinical benefit was achieved for 23 patients (57.5%) with a complete or partial response or stable disease in 4 (10%), 15 (37.5%) and 4 (10%) patients, respectively.

Consistent with previous experiences using the same fractionation regimen, SBRT was well tolerated, with no G3/G4 toxicities: the most severe side effect was G2 esophagitis in 5/40 patients (12.5%).

CONCLUSION

In accordance with standardized risk-dose prescriptions, the use of SBRT for centrally located NSCLC was confirmed to be a safe and effective strategy. Prospective studies are warranted to support its use with high level evidence.

CLINICAL RELEVANCE/APPLICATION

Our single-center experience adds to the limited available evidence on the feasibility and clinical benefit of SBRT for centrally located NSCLC.

MSRO37-06 Evaluation of the Tumor Response Using FDG-PET/CT Scans in Non-Small Cell Lung Cancer Patients Treated with Proton or Photon Radiotherapy

Tuesday, Nov. 27 2:20PM - 2:30PM Room: S103CD

Participants

Pegah Jahangiri, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Kamyar Pourazemi, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Charles B. Simone II, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Drew A. Torigian, MD, Philadelphia, PA (Abstract Co-Author) Co-founder, Quantitative Radiology Solutions LLC
Abass Alavi, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

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PURPOSE

Lung cancer is one of the leading causes of death worldwide. Radiation therapy (RT) is a major treatment option for lung cancer, including for unresectable locally advanced non-small cell lung cancer (LA-NSCLC). The aim of this study was to evaluate the response of the primary lung tumor to proton versus photon RT using 18F-fluorodeoxyglucose (FDG)-PET/CT in patients with LA-NSCLC.

METHOD AND MATERIALS

Thirty-nine consecutive patients who underwent FDG-PET/CT imaging pre- and post- proton or photon RT were assessed. Patients were predominantly female (53.8%) with a median age of 67 years and with predominantly stage IIIA (62%). An adaptive contrast-oriented thresholding algorithm was applied to measure metabolically active tumor volumes, uncorrected SUV, partial volume corrected SUV and total lesion glycolysis. Parameters of FDG-PET/CT scans before and after RT were compared using two-tailed paired t-tests.

RESULTS

Parameters of FDG-PET/CT scans before and after RT were compared using two-tailed paired t-tests. Corrected SUV and total lesion glycolysis.
Among the 9 patients who received photon RT and the 9 patients who received a combination of proton-photon RT, there was a significant decrease in PVC-TLG. Interestingly, among the 21 patients treated exclusively with proton RT, all tumor parameters including MTV, SUVmax, uncorrected SUVmean, PVC-SUVmean, uncorrected TLG, and PVC-TLG after treatment decreased significantly (all \( p < 0.001 \)). The decreases in PVC-TLG and tumor PVC-SUVmean were more obvious than non-PVC ones (\( \Delta \text{PVC-TLG} -357.26 \text{ cc} \) versus \( \Delta \text{TLG} -252.92 \text{ cc} \); \( \Delta \text{PVC-SUVmean} -16.2 \) versus \( \Delta \text{SUVmean} -10.19 \)).

**CONCLUSION**

Adaptive contrast-oriented thresholding algorithm is a promising method to quantify whole tumor glycolysis in LA-NSCLC, and our findings demonstrates that proton RT is as effective as photon RT metabolically in inducing tumor response of LA-NSCLC.

**CLINICAL RELEVANCE/APPLICATION**

Proton RT, which is much safer, is as effective as photon RT in treatment of LA-NSCLC.
LEARNING OBJECTIVES

1) Discuss the appropriate management of non-small cell lung cancer. 2) Discuss the appropriate management of small cell lung cancer.

ABSTRACT

Modern management of lung cancer typically involves interdisciplinary evaluation by radiologists, thoracic surgeons, medical oncologists, and radiation oncologists. This session reviews the most up-to-date multidisciplinary management of both non-small cell and small cell lung cancer through clinical cases.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Subba R. Digumarthy, MD - 2013 Honored Educator
**SSJ05**

**Science Session with Keynote: Chest (Thoracic MRI)**

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S404AB

- **CH**
- **CT**
- **MR**
- **NM**

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

**FDA** Discussions may include off-label uses.

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**Participants**

Jurgen Biederer, MD, Seenheim-Jugenheim, Germany (Moderator) Nothing to Disclose

Patricia J. Mergo, MD, Jacksonville, FL (Moderator) Nothing to Disclose

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**Sub-Events**

**SSJ05-01 Chest Invited Speaker: Beyond Morphology-Comprehensive Imaging of Pulmonary Disease with MRI**

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S404AB

Participants

Jurgen Biederer, MD, Heidelberg, Germany (Presenter) Nothing to Disclose

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**SSJ05-02 Combination of MR Free-Breathing 3D T1-Weighted Star VIBE and DWI for the Differentiation of Benign from Malignant Peripheral Pulmonary Lesions: A Comparative Study Using Routine-Dose CT**

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S404AB

Participants

Shan Dang, Xian, China (Presenter) Nothing to Disclose

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Shaoyu Wang, Shanghai, China (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**

The differentiation of benign pulmonary lesions from malignant pulmonary lesions is very difficult. High resolution CT is the most commonly used radiology methods for lung. While it is limited to children, child-bearing women and disorders requiring repeated examinations over prolonged periods because of its radiation dose. The result of our previous studies showed that: comparing with routine-dose CT, the MR T1-weighted 3D Star VIBE sequence was slightly lower in differentiating the peripheral pulmonary lesions (PPL) with morphological features. MR can provide not only the morphological information, but also functional information. The apparent diffusion coefficient (ADC) value was used widely in whole body, but this research of combining MR-DWI ADC value with morphological characteristics of PPL was rare. The purpose of this study was to evaluate the no radiation-dose MR (ADC value and T1-weighted 3D Star VIBE sequence) diagnostic efficiency in differentiating the malignant PPL from benign, with the routine-dose CT as a reference standard.

**METHOD AND MATERIALS**

Forty-seven patients (30 males and 17 females, mean age 64.1 years old; age range 48-83 years) were enrolled in this study, all the patients had undergone routine-dose CT, MR T1 Star VIBE and DWI with 3.0T MR scanner. These lesions were all diagnosed by transthoracic needle biopsy or surgery. Two radiologists observed the morphological signs of MR and CT images independently. The order of observation was MRI first, and followed by CT. Then the ADC value of lesions were measured. The logistic regression analysis was used to calculate the probability. The ROC curve was used to analyze the capabilities of morphological characteristics and DWI in distinguishing malignant PPL from benign.

**RESULTS**

There was significant difference of the ADC value between benign and malignant groups (p=0.001). The cut-off ADC value was 1197×10^-6 mm^2/s. Combined MR T1 Star VIBE with ADC value can distinguish PPL better than only routine-dose CT, ADC value and T1 Star VIBE alone.

**CONCLUSION**

The ADC value could differentiate the peripheral pulmonary lesions initially, but the distinguishability was better if combing MR T1 Star VIBE morphological characteristics with ADC value.

**CLINICAL RELEVANCE/APPLICATION**

We can use MR T1-weighted 3D Star VIBE and DWI to replace routine-dose CT to distinguish PSPLs in order to avoid radiation exposure.

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**SSJ05-03 18F-Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography (PET/CT) and Diffusion-Weighted Magnetic Resonance Imaging (DWI-MRI) Diagnostic Performance in the**
Evaluation of Pulmonary Lesions: A Systematic Review and Meta-Analysis

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S404AB

Awards
Student Travel Stipend Award

Participants
Adriano Basso Dias, MD, Porto Alegre, Brazil (Presenter) Nothing to Disclose
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PURPOSE
To perform a systematic review and meta-analysis of the diagnostic performance of DWI-MRI and 18F-FDG PET/CT in the evaluation of pulmonary lesions.

METHOD AND MATERIALS
Databases of MEDLINE and Embase were searched through December 2017. Studies published in English were included when the diagnostic performances of 18F-FDG PET/CT or DWI in detecting malignant pulmonary lesions were clearly identified in the articles. Two reviewers evaluated the study quality of all selected articles using QUADAS-2 and only those that met a minimum quality score were included. Parameters of lesion quantification were analyzed separately for each imaging modality (e.g., lesion-to-spine ratio (LSR), and apparent diffusion coefficient (ADC) for DWI-MRI). Meta-analysis using a random-effects model were conducted to calculate the pooled sensitivities, specificities, positive and negative likelihood ratios (PLR and NLR), diagnostic odds ratios (DOR) and area under the curve (AUC) for PET/CT and DWI with 95% confidence intervals (95% CI).

RESULTS
The literature search yielded 1280 results, and the inclusion criteria were met by 37 studies (23 FDG PET/CT studies, 8 MRI studies and 6 studies including both methods), with a total of 4224 participants and 4463 lesions (malignant, n = 3090, 69.2%; benign, n=1362, 30.8%). Pooled sensitivity and specificity of SUVmax (n = 25) were 0.86 (95%CI, 0.82-0.90) and 0.73 (95%CI, 0.62-0.82), respectively. For DWI-MRI, LSR studies (n = 4) showed a sensitivity of 0.81 (0.71-0.88) and a specificity of 0.90 (0.79-0.95), whereas studies utilizing ADC (n = 12) had a sensitivity and specificity of 0.83 (0.77-0.88) and 0.86 (0.76-0.92), respectively. DWI-LSR yielded the greatest diagnostic odds ratio (DOR = 38, 95%CI 12-115) compared to DWI-ADC (DOR = 30, 95%CI 14-66) and SUVmax (DOR = 17, 95%CI 10-28).

CONCLUSION
Diagnostic performance of DWI-MRI is comparable to 18F-FDG PET/CT for the evaluation of potentially malignant pulmonary lesions.

CLINICAL RELEVANCE/APPLICATION
This is the first meta-analysis to compare the diagnostic performance of DWI-MRI and 18F-FDG PET/CT in the evaluation of pulmonary lesions. Our study demonstrated that the diagnostic performance of DWI-MRI is comparable or even superior to that of PET/CT, which supports the inclusion of MRI as a low-cost and radiation-free option to the diagnostic work-up of pulmonary lesions.

SS305-04 Chemical Exchange Saturation Transfer (CEST) Imaging versus Diffusion-Weighted Imaging (DWI) versus FDG-PET/CT: Capability for Diagnosis of Solitary Pulmonary Nodule

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S404AB

Participants
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PURPOSE
To directly and prospectively compare the capability for diagnosis of solitary pulmonary nodules (SPNs) among chemical exchange saturation transfer (CEST) imaging, diffusion-weighted imaging (DWI) and 18F-FDG PET/CT.
To directly and prospectively compare the capability for diagnosis of solitary pulmonary nodules (SPNs) among chemical exchange saturation transfer (CEST) imaging, diffusion-weighted imaging (DWI), and FDG-PET/CT.

METHOD AND MATERIALS

113 consecutive patients (69 male and 44 female; mean age 71 year old) with 122 SPNs underwent CEST imaging and DWI at a 3T MR system, FDG-PET/CT, and pathological and/or follow-up examinations. According to final diagnoses, all SPNs were divided into malignant (n=76) and benign (n=46) SPNs. 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, apparent diffusion coefficient (ADC) 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. In addition, ROC analyses were performed to compare diagnostic performance among all indexes as well as combined methods. Finally, sensitivity, specificity and accuracy were compared among all methods by McNemar’s test.

RESULTS

MTRasym, ADC and SUVmax had significant difference between malignant and benign SPNs (p<0.05). Multivariate regression analyses identified MTRasym (Odds ratio [OR]: 0.54), ADC (OR: 47.6) and SUVmax (OR: 0.47) as significant differentiators (p<0.05). ROC analyses showed area under the curve (Az) of MTRasym (Az=0.77, p<0.05). Sensitivity (SE) and accuracy (AC) of MTRasym (SE: 82.8 [101/122] %, AC: 82.8 [101/122] %) and combined methods (SE: 85.5 [65/76] %, AC: 85.2 [104/122] %) were significantly higher than those of ADC (SE: 69.7 [53/76] %, p<0.05; AC: 77.9 [95/122] %, p<0.05) and SUVmax (SE: 64.5 [49/76] %, p<0.05; AC: 71.3 [87/122] %, p<0.05).

CONCLUSION

CEST imaging has a better potential and can improve diagnostic performance of SPNs, when compared with DWI and FDG-PET/CT.

CLINICAL RELEVANCE/APPLICATION

CEST imaging has a better potential and can improve diagnostic performance of SPNs, when compared with DWI and FDG-PET/CT.

Participants
Shi Y. Deng, Guangzhou, China (Presenter) Nothing to Disclose
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PURPOSE

To determine the diagnostic performance of apparent diffusion coefficient (ADC) histogram analysis derived from both largest cross-sectional (2D-ROI) and whole tumor region of interest(3D-VOI) in differentiating benign from malignant solitary pulmonary lesions(SPLs).

METHOD AND MATERIALS

Sixty-nine patients with pathologically confirmed lung lesions (benign: malignant = 23:46) were included in the study. All patients underwent 3.0T diffusion-weighted imaging (DWI) with 2 b values of 0 and 600s/mm2. The histogram metrics including minimum, mean, maximum, 10th, 25th, 50th, 75th and 90th percentiles, skewness, and kurtosis were calculated from the largest cross-section and whole tumor ROI, respectively. Inter-class correlation characteristic(ICC) was used to assess inter-observer reliability. Histogram metrics were analyzed using Mann-Whitney U-test. The diagnostic performance was evaluated using receiver-operating characteristic (ROC) analysis.

RESULTS

Minimum, mean, maximum and 10th,25th,50th,75th,90th percentile ADCs with two groups were significantly lower (all P<0.05), except for the maximum and 25th percentile ADCs in whole-volume group (P=0.128, P=0.221) in malignant lesions compared with benign ones. The 75th and 50th percentile ADCs in two ROI setting group respectively achieved the highest AUC (single-slice: whole-volume=0.891:0.894) with cutoff value of 1.57×10-3 mm²/s and 1.41×10-3 mm²/s in differentiating solitary pulmonary lesions. ICC for the whole-volume ROIs(0.76~0.97) was better the largest-slice ROIs(0.59~0.91).

CONCLUSION

Both single-slice and whole-volume ADCs are helpful for distinguishing malignant from benign lung lesions. Whole-volume ADC histogram analysis could have greater diagnostic properties and repeatability.

CLINICAL RELEVANCE/APPLICATION

In conclusion, ADC histogram is helpful for distinguishing malignant from benign lung lesions, and the 75th percentile ADC derived from 2D-ROI and 3D-VOI could provide better information in characterizing in SPLs, with no statistical difference. Moreover, placing ROIs in the largest lesion would be more suitable for clinical practice considering about saving time.

Participants
Joseph G. Mammappallil, MD,PhD, Durham, NC (Presenter) Nothing to Disclose
Iraq-Afghanistan War Lung Injury (WLI) describes new onset respiratory symptoms occurring in deployed soldiers to the Middle East that can ultimately lead to constrictive bronchiolitis. This study sought to determine if 19F MRI could identify patients with WLI.

METHOD AND MATERIALS

Three soldiers who presented to local VA clinics were evaluated for reactive airways disease, post deployment dyspnea, and decreased respiratory fitness. All subjects had a full pulmonary function evaluation. Inspiratory and expiratory imaging with HRCT was also obtained for each subject. For 19F MRI studies, each subject inhaled a gaseous mixture of 79% PFP mixed with 21% O2 mixture over the course of several minutes in a protocol consisting of three tidal breaths followed by a 6 second breath-hold at total lung capacity during which a 3D imaging of the lung airspaces was obtained. The image data was analyzed to generate regional wash-in and wash-out time constants (seconds) throughout the lung airspaces. Finally, the fraction of slow filling compartments was calculated as the number of volume elements exhibiting a wash-in time constant of > 100 seconds divided by the total number of lung airspace elements in the imaged [FVR1>100].

RESULTS

Two subjects were non-smokers and the third is a current smoker (11 pack-years). All three subjects were exposed to aerosolized contaminants during deployment in Iraq/Afghanistan. Spirometry for all subjects were normal FEV1% predicted (81, 109, 86), FEV1/FVC (72, 75, 73). Expiratory CT imaging was normal for subject 1, while the 2nd and 3rd subjects had mild basilar or lobular areas of air trapping. Imaging with 19F for each subject was as follows: FVR1>100 = 17.5%, 37.8%, and 24.5% for the three subjects respectfully. While the first subject’s FVR1>100 was close to values seen in subjects with normal lung function the second and third subjects more resembled patients diagnosed with COPD (25->60%).

CONCLUSION

19F MRI demonstrated delayed regional filling of PFP gas in two subjects with suspected WLI when compared to data from normal subjects.

CLINICAL RELEVANCE/APPLICATION

19F MRI has the potential to detect airway abnormalities at earlier time points than current techniques. This may ultimately lead to better diagnosis of challenging airway abnormalities such as WLI and perhaps a tool for evaluation of interventions.
SSJ17
Science Session with Keynote: Nuclear Medicine (Chest/Breast Oncology Nuclear Imaging)
Tuesday, Nov. 27 3:00PM - 4:00PM Room: S504CD

Participants
Peter S. Conti, MD, PhD, Los Angeles, CA (Moderator) Nothing to Disclose
Andrew C. Homb, MD, Rochester, MN (Moderator) Nothing to Disclose

Sub-Events
SSJ17-01 Nuclear Medicine Keynote Speaker: Radiomics in Lung Cancer
Tuesday, Nov. 27 3:00PM - 3:10PM Room: S504CD

Participants
Lawrence H. Schwartz, MD, New York, NY (Presenter) Committee member, Celgene Corporation Committee member, Novartis AG Committee member, ICON plc Committee member, Bioclinica, Inc

SSJ17-02 An Updated and Validated PET/CT Volumetric Prognostic Index for Non-Small Cell Lung Cancer
Tuesday, Nov. 27 3:10PM - 3:20PM Room: S504CD

Participants
Joshua H. Finkle, MD, Chicago, IL (Presenter) Nothing to Disclose
Bill C. Penney, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Yonglin Pu, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE
Whole-body metabolic tumor volume (MTVWB) and TNM staging are independent prognostic factors for overall survival (OS) in non-small cell lung cancer (NSCLC). We aimed to update and validate the PET/CT volumetric prognostic index (PVP index) using the new 8th edition TNM staging system to evaluate its prognostic power versus TNM staging and MTVWB alone.

METHOD AND MATERIALS
This study was a retrospective analysis of 949 non-small cell lung cancer (NSCLC) patients diagnosed between 2004 and 2014. Clinical TNM stage, MTVWB, age and gender, tumor histology type at the initial staging PET/CT exam, as well as treatment history and long-term survival data were obtained. Patients were randomly assigned to modeling or validation group. Univariate and multivariate Cox regression analyses were performed to compare PVP index, TNM stage, and MTVWB in the validation group.

RESULTS
The updated PVP index included the 3 variables TNM stage, and MTVWB and age. Univariate Cox models showed significant association of PVP index with overall survival (OS) in patients with NSCLC (with Hazard ratio HR= 2.88 in the validation group, p<0.001). The C-statistic of the PVP index (C-statistic = 0.71 in the validation group) was significantly greater than that of 8th edition TNM staging (C-statistic = 0.68, p=0.029 ), MTVWB (C-statistic = 0.68, p=0.001), and patient age (C-statistic = 0.53, p<0.001). Multivariate Cox regression analyses demonstrated significant association of PVP index with OS (with HR= 2.80, p<0.001) after adjusting patient’s gender and tumor histology.

CONCLUSION
The updated PVP index provides a quantitative risk assessment for NSCLC patients using 8th edition TNM staging, MTVWB, and age. The index provides a simple and practical way for the care team to incorporate the independent prognostic value of both the TNM stage and MTVWB. This approach can further improve the accuracy of overall survival prognosis.

CLINICAL RELEVANCE/APPLICATION
The PVP index combines the prognostic power of the TNM stage, whole-body metabolic tumor volume and age, offering prognostic accuracy superior to whole-body metabolic tumor volume or TNM stage alone.

SSJ17-03 Prospective Comparison of 18F-FDG PET/MRI and 18F-FDG PET/CT for Thoracic Staging of Non-Small Cell Lung Cancer
Tuesday, Nov. 27 3:20PM - 3:30PM Room: S504CD

Participants
Lino Sawicki, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Julian Kirchner, Dusseldorf, Germany (Presenter) Nothing to Disclose
Benedikt M. Schaarschmidt, MD, Essen, Germany (Abstract Co-Author) Stockholder, Bayer AG; Stockholder, General Electric Company; Stockholder, Siemens AG; Stockholder, Teva Pharmaceutical Industries Ltd
Ken Hermann, Essen, Germany (Abstract Co-Author) Co-founder, SurgicEye GmbH; Stockholder, SurgicEye GmbH; Consultant, Sofie
PURPOSE
To compare the diagnostic performance of 18F-FDG PET/MRI and 18F-FDG PET/CT for primary and locoregional lymph node staging in non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS
In this prospective study a total of 84 patients (51 men, 33 women, mean age 62.5 ± 9.1 years) with histopathologically confirmed NSCLC underwent 18F-FDG PET/CT followed by 18F-FDG PET/MRI in a single injection protocol. Two readers independently assessed T and N staging in separate sessions according to the seventh edition of the American Joint Committee on Cancer staging manual for 18F-FDG PET/CT and 18F-FDG PET/MRI, respectively. Histopathology as reference standard was available for N staging in all 84 patients and for T staging in 39 patients. Differences in staging accuracy were assessed by McNemars chi2 test. The maximum standardized uptake value (SUVmax) and longitudinal diameters of primary tumors were correlated using Pearson's coefficients.

RESULTS
T stage was categorized concordantly in 18F-FDG PET/MRI and 18F-FDG PET/CT in 38 of 39 (97.4%) patients. Herein, 18F-FDG PET/CT and 18F-FDG PET/MRI correctly determined the T-stage in 92.3% and 89.7% of patients, respectively. N-stage was categorized concordantly in 83 of 84 patients (98.8%). 18F-FDG PET/CT correctly determined the N stage in 78 of 84 patients (92.9%), while 18F-FDG PET/MRI correctly determined the N stage in 77 of 84 patients (91.7%). Differences between 18F-FDG PET/CT and 18F-FDG PET/MRI in T and N staging accuracy were not statistically significant (p > 0.5, each). Tumor size and SUVmax measurements derived from both imaging modalities exhibited excellent correlation (r=0.963 and r=0.901, respectively).

CONCLUSION
18F-FDG PET/MRI and 18F-FDG PET/CT showed an equivalently high diagnostic performance for T and N staging in patients suffering from NSCLC.

CLINICAL RELEVANCE/APPLICATION
PET/MRI as a dose-saving alternative to PET/CT proved coequal to the current gold standard for thoracic staging of NSCLC. Thus, clinicians might use PET/MRI instead of PET/CT for this purpose. However, considering the longer examination times and higher expenses of PET/MRI, a general recommendation in favor of PET/MRI cannot be drawn from this study.

PURPOSE
To evaluate the relationship between 18F-FDG PET/CT image characteristics and pathological types and gene mutations of primary lung cancer in untreated lung cancer patients with bone metastases.

METHOD AND MATERIALS
A total of 213 untreated lung cancer patients with bone metastases were enrolled in this study. All patients underwent 18F-FDG PET/CT examination, pathological and gene mutation examination of primary lung cancer. Spearman's correlation test was performed to evaluate the association between primary tumors and bone metastases. Single factor analysis of variance was performed to compare groups.

RESULTS
(1)A total of 213 cases were evaluated. The mean SUVmax of primary lung cancer was 7.9±4.7; that of bone metastases was 8.2±4.3. The SUVmax of primary lesions had a significantly positive correlation with the SUVmax of bone metastases (r = 0.622; p = 0.000). Osteolytic metastasis was the most common type. (2)The SUVmax of primary lung lesions with different pathological types were statistically different (all P = 0.000): squamous cell carcinoma > small cell carcinoma > adenocarcinoma. Their SUVmax were 11.7±4.3, 9.3±4.1, and 6.7±4.6, respectively. (3)In non-small cell lung cancer (NSCLC), the gene mutation rates of epidermal growth factor receptor (EGFR), K-ras and anaplastic lymphoma kinase (ALK) were 35.7%, 10.1% and 3.8%, respectively. There was no statistical difference in SUVmax of primary lung cancer between gene mutation type and wild type (P>0.05).

CONCLUSION
The SUVmax of primary lung lesions with different pathological types were statistically different. Squamous cell carcinoma was the highest, and adenocarcinoma was the lowest. The SUVmax of primary lung cancer had a significantly positive correlation with the SUVmax of bone metastases. In NSCLC, the mutation rate of EGFR is the highest. There was no statistical difference in SUVmax of primary lung cancer between gene mutation type and wild type.

CLINICAL RELEVANCE/APPLICATION
The SUVmax of primary lung cancer is suggestive of its pathological type. But the SUVmax of primary lung cancer is not helpful to predict the gene mutations in NSCLC.
Comparison between PET and MRI-pCM showed moderate to strong correlation for the comparison of all radiomic features ($-0.66 < \rho < 0.54$). Correlation of radiomic features of both modalities to hormone receptor status is shown in Table 1.

Selected radiomic features of MRI-pCM showed moderate correlation to T-stage ($-0.64 < \rho < 0.57$) and to N-stage ($-0.52 < \rho < 0.54$). Correlation of radiomic features of both modalities to hormone receptor status is shown in Table 1.

RESULTS

Association of features between the different modalities was compared (Spearman $\rho$).

METHOD AND MATERIALS

A total of 38 patients (37 females and one male, mean age 57 ± 10 years; range 31-78 years) with newly diagnosed, histopathologically proven breast cancer were prospectively enrolled in this trial. All PET/MRI examinations were assessed for local tumor burden and metastatic spread in two separate reading sessions: (1) One-step algorithm comprising supine whole-body 18F-FDG PET/MRI, (2) Two-step algorithm comprising a dedicated prone 18F-FDG breast PET/MRI and supine whole-body 18F-FDG PET/MRI.

RESULTS

On a patient-based analysis the two-step algorithm correctly identified 37 out of 38 patients with breast carcinoma (97%), while 5 patients were missed by the one-step 18F-FDG PET/MRI algorithm (33/38; 87% correct identification; $p=0.37$). On a lesion-based analysis 56 breast cancer lesions were detected in the two-step algorithm and 44 breast cancer lesions could be correctly identified in the one-step 18F-FDG PET/MRI (79%), resulting in statistically significant differences between the two algorithms ($p=0.0015$). For axillary lymph node evaluation sensitivity, specificity and accuracy was 93%, 95% and 94%, respectively. Furthermore, distant metastases could be detected in 7 patients with both modalities.

CONCLUSION

The results demonstrate the necessity and superiority of a two-step 18F-FDG PET/MRI algorithm, comprising dedicated prone breast imaging and supine whole-body imaging, when compared to the one-step algorithm for local and whole-body staging in breast cancer patients.

CLINICAL RELEVANCE/APPLICATION

Two-step 18F-FDG PET/MRI comprising dedicated breast and whole-body imaging enables high-quality local and whole-body staging in patients with breast cancer.

Multimodal Radiomic Imaging: Comparison of PET and MRI-pCM Heterogeneity in Breast Cancer

Participants

Bert-Ram Sah, MD, London, United Kingdom (Presenter) Nothing to Disclose

METHOD AND MATERIALS

This study investigated the value of pre-treatment F-18-Fluorodeoxyglucose (FDG)-positron-emission-tomography (PET) radiomics in comparison to T1-weighted-post-contrast-magnetic-resonance-imaging (MRI-pCM) radiomics in patients with breast cancer.

RESULTS

Selected radiomic features of PET showed moderate correlation to T-stage ($-0.52 < p < 0.54$) and weak correlation to N-stage ($-0.35 < p < 0.38$). Selected radiomic features of MRI-pCM showed moderate correlation to T-stage ($-0.64 < p < 0.57$) and to N-stage ($-0.52 < p < 0.54$). Correlation of radiomic features of both modalities to hormone receptor status is shown in Table 1. Comparison between PET and MRI-pCM showed moderate to strong correlation for the comparison of all radiomic features ($-0.66 < \rho < 0.64$).
\( p < 0.68 \) (Figure 1), whereas the correlation for the comparison of a respective radiomic parameter was only weak to moderate \( (0.22 < p < 0.56) \) (1st diagonal in Figure 1).

CONCLUSION
Radiomics in a multimodality approach might be a complementary tool for non-invasive pre-therapeutic characterization of breast cancer.

CLINICAL RELEVANCE/APPLICATION
Combining radiomic features from different imaging modalities may help in non-invasive specification of breast cancer.
SSJ21

**Physics (Diagnostic X-Ray)**

Tuesday, Nov. 27 3:00PM - 4:00PM Room: N229

**METIS: Next-Generation Performance Informatics Platform for Value-Based Clinical Imaging Practice**

Participants
Ehsan Samei, PhD, Durham, NC (Moderator) Research Grant, General Electric Company; Research Grant, Siemens AG; Advisory Board, medInt Holdings, LLC; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc
Wei Zhao, PhD, Stony Brook, NY (Moderator) Nothing to Disclose

Sub-Events

**SSJ21-01**

**METIS: Next-Generation Performance Informatics Platform for Value-Based Clinical Imaging Practice**

Tuesday, Nov. 27 3:00PM - 3:10PM Room: N229

Participants
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Joshua Wilson, PhD, Durham, NC (Abstract Co-Author) License agreement, Sun Nuclear Corporation
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Yakun Zhang, MS, Durham, NC (Abstract Co-Author) Nothing to Disclose
Steve D. Mann, PhD, Durham, NC (Abstract Co-Author) Consultant, Micro C Imaging
Jeffrey Nelson, Durham, NC (Abstract Co-Author) Nothing to Disclose
Jered R. Wells, 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

For information about this presentation, contact:
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**PURPOSE**

To develop a new performance informatics platform, called ‘METrology for Imaging Systems (METIS), that enables both radiation safety and image quality monitoring for prospective and retrospective assessments of dose and quality

**METHOD AND MATERIALS**

METIS has been developed with multi-year input and pilot trials at a large academic medical center. This data-centric platform integrates a multi-infrastructure workflow for collecting patient data and clinical images from the PACS, imaging workstations (CT, Mammography, Radiography, and Fluoroscopy), and electric health record system (Epic). Dose and image quality metrics are implemented from previously validate algorithms in a modality context-specific fashion. Device-, protocol-, and size-specific reference levels are established with supervised machine learning technologies. High-dimensional data analysis is performed to provide multi-dimensional visualizations to aid users in evaluating clinical performance and highlighting inconsistencies. All metrics and image data are managed in a MySQL-MongoDB hybrid database.

**RESULTS**

METIS was deployed in clinical operation since 2016. Dose data from 460,000 CT, 350,000 Mammography, 300,000 Radiography, and 10,000 Fluoroscopy exams are recorded. Over 500 dose reference lines are created for CT outlier identification. Over 60,000 chest radiographs are automatically evaluated to simulate radiologists’ perceptual evaluation process. 1000 adult and 1000 pediatric CT scans are sampled from contrast and non-contrast enhanced CT chest/abdomen/pelvis exams to build the dose-quality metrics by using measured image noise, spatial resolution, contrast, and dose. A web-based dashboard with high-dimensional data visualization is developed to provide a holistic performance view, consolidating large-scale diverse clinical and operational data into a single graphics.

**CONCLUSION**

METIS offers the first strategy for combined dose and image quality monitoring. Adding quality-dose metrics and advanced prospective and retrospective data analysis, it provides opportunities for assessing and addressing the aggregate aspects of clinical imaging practice to ensure rigorous patient safety and consistent imaging quality.

**CLINICAL RELEVANCE/APPLICATION**

METIS fulfills an unmet need for a prospective and retrospective dose monitoring, along with image quality and device performance assessment, to ensure rigorous patient safety and consistent image quality.

**SSJ21-02**

**Signal and Noise Performance of the Apodized-Aperture Pixel (AAP) X-Ray Detector Design to Increase Detective Quantum Efficiency (DQE)**

Participants
Aiping Ding, Durham, NC (Presenter) Nothing to Disclose
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**PURPOSE**

To develop a new performance informatics platform, called ‘METrology for Imaging Systems (METIS), that enables both radiation safety and image quality monitoring for prospective and retrospective assessments of dose and quality

**METHOD AND MATERIALS**

METIS has been developed with multi-year input and pilot trials at a large academic medical center. This data-centric platform integrates a multi-infrastructure workflow for collecting patient data and clinical images from the PACS, imaging workstations (CT, Mammography, Radiography, and Fluoroscopy), and electric health record system (Epic). Dose and image quality metrics are implemented from previously validate algorithms in a modality context-specific fashion. Device-, protocol-, and size-specific reference levels are established with supervised machine learning technologies. High-dimensional data analysis is performed to provide multi-dimensional visualizations to aid users in evaluating clinical performance and highlighting inconsistencies. All metrics and image data are managed in a MySQL-MongoDB hybrid database.

**RESULTS**

METIS was deployed in clinical operation since 2016. Dose data from 460,000 CT, 350,000 Mammography, 300,000 Radiography, and 10,000 Fluoroscopy exams are recorded. Over 500 dose reference lines are created for CT outlier identification. Over 60,000 chest radiographs are automatically evaluated to simulate radiologists’ perceptual evaluation process. 1000 adult and 1000 pediatric CT scans are sampled from contrast and non-contrast enhanced CT chest/abdomen/pelvis exams to build the dose-quality metrics by using measured image noise, spatial resolution, contrast, and dose. A web-based dashboard with high-dimensional data visualization is developed to provide a holistic performance view, consolidating large-scale diverse clinical and operational data into a single graphics.

**CONCLUSION**

METIS offers the first strategy for combined dose and image quality monitoring. Adding quality-dose metrics and advanced prospective and retrospective data analysis, it provides opportunities for assessing and addressing the aggregate aspects of clinical imaging practice to ensure rigorous patient safety and consistent imaging quality.

**CLINICAL RELEVANCE/APPLICATION**

METIS fulfills an unmet need for a prospective and retrospective dose monitoring, along with image quality and device performance assessment, to ensure rigorous patient safety and consistent image quality.
**SSJ21-03**  Validation and Performance Evaluation of a Remote and Automated QC Program for Digital Radiography

Tuesday, Nov. 27 3:10PM - 3:20PM Room: N229

Participants
Tomi Nano, London, ON (Presenter) Nothing to Disclose
Ian A. Cunningham, PhD, London, ON (Abstract Co-Author) Founder, DQE Instruments Inc

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**PURPOSE**
Recent studies from screening programs have shown significantly higher detection rates attributed to higher detector performance.

X-ray detector performance, in terms of signal-to-noise ratio (SNR) for a given amount of radiation, is quantified by the detective quantum efficiency (DQE). Current clinical detectors have low DQE (<30%) at high-frequencies which are important for visualization of small image features. We have developed a novel x-ray detector design, called Apodized-Aperture Pixel (AAP), that could achieve high DQE at high-frequencies. The purpose of this research is to determine AAP performance in the presence of correlated or uncorrelated noise due to x-ray interactions or converter blur.

**METHOD AND MATERIALS**
Conventional x-ray detectors have the same element and pixel size. AAP design separates physical elements from image pixels by using micro-elements (0.01-0.025mm) to produce current clinical pixel sizes (0.07-0.2mm). Conventional and AAP designs were modeled with cascaded system analysis including x-ray interactions, converter blur, collection efficiency and readout noise. DQE was measured to evaluate proof-of-concept experiments with radiography and mammography detectors. Simulations of sinusoidal patterns and demonstration x-ray images were acquired for visual comparison.

**RESULTS**
Excellent agreement was found between theoretical and experimental results. AAP design provides 1.5x greater MTF at high frequencies than conventional design. For cases when detector DQE is dominated by converter blur (ie. pixel size is smaller than converter blur), x-ray reabsorption or element size, high-frequency DQE of the AAP design was 1.5x greater, 1.8x greater and 2.5x greater respectively compared to conventional design.

**CONCLUSION**
Compared to conventional design at high-frequencies, the AAP design has greater MTF from use of a micro-elements and greater DQE due to reduced noise aliasing. MTF and DQE improvement is greatest when x-ray reabsorption and converter blur effects are minimal. Simulations and x-ray images with the AAP design (Fig. 1) show increased contrast and reduced aliasing artifacts. The AAP design can achieve a flat-DQE that approaches an 'ideal detector' which was not previously possible.

**Clinical Relevance/Application**
The Apodized-Aperture Pixel (AAP) x-ray detector design can increase high frequency MTF by 1.5x and DQE by 2.5x with the implication that this may help increase cancer detection rates.

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**SSJ21-04**  Assessment of Scatter Emitting From the Exit Window of Interventional X-Ray Tubes

Tuesday, Nov. 27 3:20PM - 3:30PM Room: N229

Participants
Zahra Razi, Gainesville, FL (Presenter) Nothing to Disclose
Hilde Bosmans, PhD, Leuven, Belgium (Abstract Co-Author) Co-founder, Qaelum NV Research Grant, Siemens AG
Patricia Mora, MS, San Jose, Costa Rica (Abstract Co-Author) Nothing to Disclose
Guozhi Zhang, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
Douglas E. Pfeiffer, MS, Boulder, CO (Abstract Co-Author) Nothing to Disclose
Harry Delis, PhD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Manuel M. Areola, PhD, Gainesville, FL (Abstract Co-Author) Research Grant, Canon Medical Systems Corporation

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**PURPOSE**
This study evaluates the performance viability of the Remote QC program as well as comparing the performance of ATIA with other established image quality assessment tools.

**CONCLUSION**
The easy-to-use ATIA provides results that are in agreement with those obtained by established methods. The results show the great applicability of the Remote QC program in monitoring trends. The results also show that however, caution needs to be used as not to damage the QC phantom and avoid using different image filtering, the consistent results will be still reproducible upon using the same phantom and acquisition protocol.

**Clinical Relevance/Application**
Insufficient qualified medical physics support in some parts of the world may lead to an ineffective quality control program for digital radiography systems. To mitigate this situation a remote QC program package (ATIA) including a simple, yet data-rich phantom and software tool was developed in order to quantitative image assessment which remotely informs the medical physicists of issues in trend analysis.
10 criteria; visualization of lung fields, vasculature, trachea, proximal bronchi, retrocardiac lung, diaphragm, costophrenic angles, (CNT) x-ray source array. Three thoracic radiologists evaluated the images. Readers scored the imaging on a scale of 1-5 based on patients with various lung pathologies. The primary goal of our study was to compare the stationary digital chest tomosynthesis (s-DCT) system to portable CXR in the evaluation of ICU patients are often too unstable to move for CT imaging. In these cases, portable chest radiographs (CXR) are used to assess pathology. Tomosynthesis can provide additional diagnostic information, but is not readily available at the bedside. The primary goal of our study was to compare the stationary digital chest tomosynthesis (s-DCT) system to portable CXR in the evaluation of patients with various lung pathologies.

METHOD AND MATERIALS

Patients undergoing clinically indicated chest CT were recruited to have a portable CXR and s-DCT scan, with our carbon nanotube (CNT) x-ray source array. Three thoracic radiologists evaluated the images. Readers scored the imaging on a scale of 1-5 based on 10 criteria; visualization of lung fields, vasculature, trachea, proximal bronchi, retrocardiac lung, diaphragm, costophrenic angles,
ribs, spine, and hardware. Readers were asked to rate their confidence in interpreting the scans on a scale of 1-7. Furthermore, readers evaluated whether s-DCT gave them more information than CXR. A t-test for independent means was used to analyze the data.

RESULTS
A total of twenty-two patients were successfully imaged. The average age was 64.7 +/- 8.5 years. All readers gave s-DCT statistically higher scores when evaluating vasculature, proximal bronchi, and the spine (p: <0.00026). Readers 1 and 2 rated the ribs higher on s-DCT (p: <0.00001). Reader 2 gave statistically higher scores to s-DCT for the trachea, retrocardiac lung, and costophrenic angles (p: <0.0033). Reader 3 gave CXR higher scores for visualization of the diaphragm (p: 0.018). Confidence scores were not statistically different between techniques for readers 1 and 3. Reader 2 gave higher confidence scores to s-DCT (p: <0.00001). Readers 1 and 3 stated that s-DCT gave them information that CXR did not 36% and 41% of the time. While reader 2 indicated that s-DCT gave additional information 95% of the time.

CONCLUSION
Portable stationary-DCT in the ICU setting should be possible with our CNT s-DCT system. Tomosynthesis imaging improves visualization of thoracic structures compared to portable CXR. Reader confidence in s-DCT can be comparable or higher to CXR, and in a significant number of cases s-DCT gives information that is not provided by CXR.

CLINICAL RELEVANCE/APPLICATION
Stationary digital chest tomosynthesis is a potentially superior alternative to portable chest x-ray for patients in the ICU setting that cannot undergo CT examination.

VIRTUAL DUAL-ENERGY (VDE) IMAGING: SEPARATION OF BONES FROM SOFT TISSUE IN CHEST RADIOGRAPHS (CXRs) BY MEANS OF DEEP RESIDUAL LEARNING (DRL)

Tuesday, Nov. 27 3:50PM - 4:00PM Room: N229

Participants
Amin Zarshenas, MSc, Chicago, IL (Presenter) Nothing to Disclose
Yihao Wang, BSc,BEng, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Junchi Liu, MS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Ziyuan Dai, BS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kenji Suzuki, PhD, Chicago, IL (Abstract Co-Author) Royalties, General Electric Company; Royalties, Hologic, Inc; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Canon Medical Systems Corporation; Royalties, Mitsubishi Corporation; Royalties, AlgoMedica, Inc

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PURPOSE
Lung nodules that overlap ribs and/or clavicles in CXRs can be difficult to be detected by radiologists, as well as by computer-aided detection (CAD) systems. Our purpose was to develop a new VDE imaging technique to separate ribs and clavicles from lung nodules and soft-tissue in CXRs by means of our newly developed DRL.

METHOD AND MATERIALS
We developed a novel DRL model employing our neural network convolution (NNC) framework in a residual convolutional manner to convert a standard CXR to an image that looks like a dual-energy (DE) bone image; thus, term VDE imaging. Our model consisted of 2 convolutional layers and 9 residual blocks, resulting in a deep 20-layer network. Each residual block contained two convolutional layers with batch normalization, and a shortcut connection, passing information from finer to coarser image features. Our DRL model was trained in an image-based fashion to learn the relationship between input CXRs and the corresponding “teaching” DE bone images. We used a large database of 118 CXRs with nodules with corresponding “gold-standard” DE images acquired with a DE imaging system (FCR 9501 ES, Fuji Medical Systems, CT). We trained and evaluated our model with a nested 2-fold cross validation protocol. Once trained, our technology no longer required DE images, and it provided VDE bone images where soft tissue was substantially attenuated, while bony structures were preserved. This image was then subtracted from the corresponding CXR to provide a VDE soft-tissue image from which bones were removed. We performed quantitative evaluation of our results by using the structural similarity (SSIM) image-quality index.

RESULTS
Our VDE technology was able to separate ribs and clavicles from lung nodules and soft-tissue structures very accurately in 118 CXRs and provided bone and soft-tissue images. Comparing to a state-of-the-art bone-suppression technique, our new VDE soft-tissue images had higher (t-test; P<.01) similarity (SSIM from 0.90 to 0.93) to the “gold-standard” DE soft-tissue images.

CONCLUSION
Our new DRL model converted CXRs to VDE soft-tissue images, where bones were separated from soft-tissue accurately, which offered the improved conspicuity of lung nodules and vessels.

CLINICAL RELEVANCE/APPLICATION
VDE technology requiring only a “single” CXR without requiring specialized equipment or additional radiation dose would be beneficial to radiologists as well as CAD in detection of lung nodules in CXRs.
RC401A
Classic Dusts: Asbestos, Silica, and Coal
Participants
Jeffrey P. Kanne, MD, Madison, WI (Presenter) Research Consultant, PAREXEL International Corporation;
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jkanne@uwhealth.org
LEARNING OBJECTIVES
1) State the radiographic and CT findings of silicosis, CWP, and asbestos-related lung disease. 2) Always consider beryllium exposure when faced with an interstitial lung disease with features of sarcoidosis. 3) Describe the importance of expiratory imaging in the identification of small airway disease. 4) Identify clues to exposure history when interpreting HRCTs for interstitial lung disease.

ABSTRACT
Despite increased safety measures, workers remain at risk for occupational exposures. Silicosis, coal workers' pneumoconiosis, and asbestos-related lung disease continue to affect workers because of ongoing exposures in the workplace, long latency between exposure and disease, and changes in mining techniques. Immune-mediated diseases such as chronic hypersensitivity pneumonitis and chronic beryllium disease may also result from workplace exposure. Airway-centered occupational lung diseases are often the subtlest and may require expiratory imaging for recognition. This session will review these categories of occupational lung disease and conclude with a case-based session that emphasizes specific findings that may alert the interpreting radiologist to the possibility of occupational lung disease when faced with an unknown HRCT for interstitial lung disease.

Sub-Events
RC401B Occupational Lung Disease: The Other Guys (Beryllium, Hard Metal, Aluminum, Siderosis)
Participants
Sudhakar N. Pipavath, MD, Mercer Island, WA (Presenter) Adjudicator, Gilead Sciences, Inc
For information about this presentation, contact:
sudhakar.pipavath@gilead.com
LEARNING OBJECTIVES
View learning objectives under main course title.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Jeffrey P. Kanne, MD - 2012 Honored Educator
Jeffrey P. Kanne, MD - 2013 Honored Educator
Sudhakar N. Pipavath, MD - 2013 Honored Educator
Sudhakar N. Pipavath, MD - 2015 Honored Educator

RC401C Airway Related Interstitial Lung Disease and Emerging Occupational Lung Disease
Participants
Christian W. Cox, MD, Rochester, MN (Presenter) Nothing to Disclose
LEARNING OBJECTIVES

View learning objectives under main course title.

RC401D HRCT Patterns of Occupational Lung Disease: Case-Based

Participants
Cristopher A. Meyer, MD, Madison, WI (Presenter) Investor, Elucent Medical; Consultant, NIOSH Certified B-reader

LEARNING OBJECTIVES

View learning objectives under main course title.
ED003-WE

Chest Wednesday Case of the Day

Wednesday, Nov. 28 7:00AM - 11:59PM Room: Case of Day, Learning Center

AMA PRA Category 1 Credit ™: .50

Participants
Rakesh D. Shah, MD, Manhasset, NY (Presenter) Nothing to Disclose
Pamela J. Lombardi, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Clinton E. Jokerst, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Daniel B. Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Nikhil Goyal, MD, Staten Island, NY (Abstract Co-Author) Nothing to Disclose
Timur Kotlyar, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher Kyrriakos, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Ross P. Frederick, MD, Phoenix, AZ (Abstract Co-Author) Nothing to Disclose
Lauren K. Groner, DO, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) To analyze interesting chest cases. 2) To understand appropriate differential diagnosis. 3) To understand the clinical significance of the diagnosis presented.
RC501

Lung Cancer Screening Diagnosis Live (Interactive Session)

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

CH  CT

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

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

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LEARNING OBJECTIVES
1) Confirm compliance with screening guidelines, including patient eligibility, scanning protocols, radiation dose, CMS requirements, and National Lung Screening Registry. 2) Incorporate shared decision making and smoking cessation in the lung screening visit. 3) Assign Lung-RADS categories to nodules encountered at baseline and annual screening CT. 4) Evaluate atypical screening findings. 5) Manage incidental findings, including COPD, coronary artery calcification, and potential extrapulmonary malignancies.

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

Sub-Events

RC501A Logistics of Screening

Participants
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LEARNING OBJECTIVES
1) Confirm compliance with screening guidelines, including patient eligibility, scanning protocols, radiation dose, CMS requirements, and National Lung Screening Registry.

RC501B Shared Decision Making and Smoking Cessation

Participants
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RC501C Nodule Assessment and Lung-RADS Categories

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

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Mylene T. Truong, MD - 2015 Honored Educator
Mylene T. Truong, MD - 2018 Honored Educator

RC501D Interesting Cases Encountered in a Screening Program

Participants
Brett M. Elicker, MD, San Francisco, CA (Presenter) Nothing to Disclose

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LEARNING OBJECTIVES
1) Describe the role of imaging in the multi-disciplinary approach to suspected lung cancer. 2) Compare the different management options in suspected lung nodules detected on lung cancer screening CT. 3) Summarize how to appropriately use Lung-RADS when interpreting lung cancer screening CTs.
Incidental Findings on the Low-Dose CT

Carol C. Wu, MD, Bellaire, TX (Presenter) Author, Reed Elsevier

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LEARNING OBJECTIVES

1) To discuss the prevalence and significance of incidental findings on LDCT. 2) To review the latest evidence-based management recommendations for various incidental findings on LDCT.
PURPOSE
Determine which CT findings are predictive of arterial injury and need for intervention in the setting of hepatic trauma.

METHOD AND MATERIALS
From June 2011 to April 2017, 42 trauma patients (30 male, 12 female; mean age 36.1; age range 16-82) underwent contrast-enhanced CT angiography (CTA) and subsequent conventional hepatic angiography within 24 hours at two level 1 trauma centers. Hepatic injuries on CTA were graded based on the American Association for the Surgery of Trauma (AAST) liver injury scale. Scans were assessed for the presence and extent of contrast extravasation, hemoperitoneum, and lacerations. Hepatic angiograms were reviewed for evidence of arterial injury, including contrast extravasation and pseudoaneurysm. The chi-squared test was used to evaluate the univariate association between the tested parameters. A p value of less than 0.05 was considered to be statistically significant.

RESULTS
There were 3 (7%) AAST grade 1, 9 (21%) grade 2, 15 (36%) grade 3, 14 (34%) grade 4, and 1 (2%) grade 5 injuries. Twenty one (50%) patients had arterial extravasation, 41 (98%) had parenchymal laceration, and 39 (93%) had hemoperitoneum on CT. The AAST liver injury scale was significantly associated with angiographic evidence of arterial injury ($x^2$ 10.8, p=0.029); 46.7% (7/15) of grade 3 injuries and 57.1% (8/14) of grade 4 injuries demonstrated this finding. High AAST grade liver injuries (3-5) were also significantly associated with angiographic evidence of arterial injury when compared with low grade injuries (1-2); 0% (0/12) of low grade and 50% (15/30) of high grade injuries demonstrated arterial injury on angiography ($x^2$ 9.3, p=0.002). In addition, extravasation > 1 cm on CTA demonstrated a significant association with arterial injury on angiography; 57.1% (8/14) versus 25% (7/28) when CTA extravasation > 1 cm was not present ($x^2$ 4.2, p=0.040).
CONCLUSION
High grade injuries per the AAST liver injury scale and presence of contrast extravasation > 1 cm on CTA are associated with positive angiographic findings in the setting of hepatic trauma. This study also suggests that low grade injuries (1-2) have a very low likelihood of arterial injury on angiography.

CLINICAL RELEVANCE/APPLICATION
CT based predictors of arterial injury in the setting of hepatic trauma would help clinicians manage patients and diagnostic radiologists make appropriate recommendations.

PURPOSE
Contrast Enhanced CT (CECT) is the gold standard for the detection of renal injuries in blunt abdominal trauma (BAT). However its disadvantages include radiation exposure and the risks associated with iodinated contrast media. Contrast enhanced ultrasound (CEUS) provides an alternative tool for the detection and grading of renal injuries. This study was done to find the sensitivity of detection of renal injuries and to compare the AAST grading on CECT and CEUS

METHOD AND MATERIALS
Consecutive hemodynamically stable patients with BAT with CECT showing solid abdominal organ injuries were recruited in this ethically approved study. These patients underwent CEUS by a radiologist blinded to the findings of CECT and the injuries were identified and graded on both CECT and CEUS using the American Association for the Surgery of Trauma(AAST) scales. The sensitivity and specificity of detection on CEUS was obtained with CECT as the gold standard and the agreement between the grading on CECT and CEUS was analysed using kappa statistics. The injuries were further classified as high grade (AAST grades IV & above) and low grade (AAST grades I to III) and agreement between grading on CECT and CEUS was analysed

RESULTS
Among the 105 patients included as a part of a larger study, there were 22 renal injuries in the 210 kidneys assessed. CEUS detected 19 out of the 22 injuries and these injuries were graded on AAST scales and compared. The sensitivity, specificity, PPV and NPV of detection of renal injuries on CEUS using CECT as the gold standard was 86.4%, 100%, 100% and 98.4% respectively. On comparing the grading on CEUS and CECT, there was no significant agreement with a kappa value of 0.46 (>0.75 significant). On combining the grades as low grade and high grade injuries on both modalities, there is poor agreement between the grading with a kappa value of 0.46. The reason for the discrepancy is because US contrast agents are purely intravascular and do not get excreted through the renal pelvicalyceal system. Hence, the patients with PCS injuries were downgraded as grade III on CEUS

CONCLUSION
Though CEUS has a reasonable accuracy for detection of renal injuries but is poor for grading them and hence cannot be used to triage management.

CLINICAL RELEVANCE/APPLICATION
While CEUS is accurate in detecting renal injuries, it is unreliable as an alternative modality to CECT in grading renal injuries and in suggesting further management.

Awards
Student Travel Stipend Award

Participants
Nicholas Wilson, MD , Boston, MA (Presenter) Nothing to Disclose
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PURPOSE
To assess the utility of MDCT findings in predicting patient outcomes after liver injury.

METHOD AND MATERIALS
This retrospective study was IRB approved and HIPAA compliant. Informed consent was waived. Patients >= 16 years old who sustained blunt or penetrating trauma and found to have liver laceration from 5/1/2005 - 2/28/2017 were included. During this interval, 169 patients met inclusion criteria (123 male, 46 female; mean age of 34; age range 16-80 years old; 61 blunt trauma, 108 penetrating trauma). Liver injury was graded in blinded, consensus fashion by two abdominal fellowship trained radiologists (9 and 13 years-experience) using the AAST liver injury scale. Additional CT variables recorded in blinded fashion were contained vascular injury and active extravasation. Length of stay, treatment (interventional radiology or operative), and peri-operative transfusion were recorded from the electronic medical record. Multivariate linear regression was performed to determine crude and adjusted parameter estimate for length of stay. Logistic regression models were run and crude and adjusted odds ratio were calculated to estimate association between categorical variables.

RESULTS
41/128 (24.3%) patients who sustained hepatic injury have concomitant hepatic vascular injury; 23/61 (38%) in the setting of penetrating trauma and 18/108 (17%) in the setting of blunt trauma. Hospital length of stay was increased by 9.0 days for hepatic vascular injury regardless of mechanism, and by 6.0 days for those with high AAST grade (grades 4-6) as compared to referents. Patients with high grade AAST liver lacerations (grades 4-6) and patients with hepatic vascular injuries were more likely to require treatment (interventional radiology or operative) compared to referents, OR 4.74, 95% CI 2.21-10.16, p<0.0001 and OR 7.0, 95% CI 2.96-16.54, p<0.0001, respectively.

CONCLUSION
There is a high incidence of hepatic vascular injury in patients with liver laceration (24.3%). High grade hepatic laceration and the presence of hepatic vascular injury is predictive of longer lengths of stay and need for treatment.

CLINICAL RELEVANCE/APPLICATION
Hepatic vascular injury in patients who sustained blunt or penetrating liver trauma is predictive of patient outcomes.

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minor/moderate (grades I-III) vs. severe (grades IV-V) injuries. The primary outcomes were operative management and in-hospital mortality.

RESULTS
A total of 81 cases were included. The mean age of the cohort was 31.5 ± 12.2 years and 26.9% were female. Overall, grade I-III injuries in 86.4% (n=70) and grade IV-V injuries in 13.6% (n=11) were observed. The most common associated injuries involved chest wall (n=44; 54.4%), lung (n=42; 51.8%), lower ribs (n=32; 39.5%). Overall, 17.3% (n=14) and 82.7% (n=67) were subjected to operative and non-operative management, respectively. There was no correlation between CT scoring of liver injuries and surgical management (p=0.196). CT signs of active bleeding was noted in 20 patients (25%) and 30% (n=6) of these patients underwent operative treatment. The remaining 10% (n=2) of patients with active bleeding were embolized per interventional radiology (IR). One patient had IR intervention for a concomitant abdominal injury and one was treated surgically for a splenic injury. A total of 8 cases (13%) without CT-verified active bleeding (n=60) required surgery. There was no statistically relevant correlation between CT-based active liver hemorrhage and subsequent operative treatment (p=0.102). The overall mortality of the study population was 2.5% (n=2).

CONCLUSION
The majority of the population-based liver injuries were minor or moderate and CT-scoring of liver injuries did not determine subsequent surgical management. There was no correlation between CT signs of active bleeding and operative treatment decision. Further prospective studies are warranted.

CLINICAL RELEVANCE/APPLICATION
To improve our clinical practices we need to analyze our previous performance using existing injury scoring criteria and imaging characteristics regarding clinical outcome and decision making.

RCS08-07 Treatment Decisions in Blunt Splenic Trauma: Insights from a UK Trauma Centre
Wednesday, Nov. 28 10:10AM - 10:20AM Room: S406B

RESULTS
257 patients included. Median age 27(3-90). 178 were male and 49 female. 15 patients had isolated splenic injuries and 212 had >2 organ system injuries. 220 had a CT scan on presentation. CT findings included splenic contrast extravasation(n=44), pseudoaneurysms(n=24), splenic lacerations(n=196, 30 full thickness and 23 involved the splenic hilum), perisplenic haematoma(n=105) and haemoperitoneum(n=65). For initial treatment, 17 had splenectomy, 32 had SE and 178 were managed conservatively. 5 had delayed SE following failure of conservative management. A total of 12 patients had proximal SE and 25 had distal SE. The 4 Attendings were in most agreement on the presence of active bleeding on CT (89%), Fleiss' Kappa 0.696. For chosen method of treatment, the overall inter-observer agreement was 84% (range 83-93%) and Fleiss' Kappa was 0.614. For haemodynamically stable patients with active bleeding on CT with either perisplenic haematoma or haemoperitoneum, all Attendings opted for SE with a view to distal embolization for splenic preservation.

CONCLUSION
Both clinical and imaging findings are invaluable in guiding management of blunt splenic trauma. In the presence of splenic injury and active bleeding on CT imaging even with a stable patient, splenic artery angiogram with a view to embolization is recommended.

CLINICAL RELEVANCE/APPLICATION
In the presence of splenic injury and active bleeding on CT imaging even with a stable patient, splenic artery angiogram with a view to embolization is recommended.
Segmented Pelvic Hematoma Volumes, Intravenous Contrast Extravasation Volumes, and Extravasation Rate Are All Independently Predictive of Major Arterial Injury After Pelvic Fracture: Analysis of a Prospective Cohort

Wednesday, Nov. 28 11:00AM - 11:10AM Room: S406B

Participants
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The predictive value of hematoma volumes for major arterial injury after pelvic fractures is known. Area measurements of contrast extravasation (CE) and area rate of change between phases are also important. A model using hematoma volume and contrast extravasation volume on multiphase CT is derived.

METHOD AND MATERIALS
Patients with CT in the trauma bay were screened prospectively for pelvic ring disruptions between July 2016-Oct 2017. Patients were excluded if CT was performed: after a) laparotomy or angiography, b) at another institution, or c) without IV contrast. Hematoma volumes (HMVs) were measured in all remaining patients. Patients with HMV < 50 mL were not considered at risk for arterial injury requiring intervention and were excluded a priori. Included patients were additionally assessed for: binder, Tile grade, comminution, fracture gap (> 5 mm), obturator greater sciatic fracture, atherosclerosis, multiple/bilateral foci of arterial blush, arterial blush volume, and difference in CE volume between phases (bleeding rate). Variables with p<0.05 on univariate analysis (tests for proportions, Chi squared test for trend, comparison of means) were included in logistic regression with backward elimination to determine independent predictors and derive a parsimonious predictive model.

RESULTS
241 patients had pelvic ring disruptions on CT. 121 had non-negligible hematoma volumes (>50 mL). 19 patients underwent catheter embolization for pelvic arterial bleeding. In univariate analysis, predictor variables included hematoma vol (p < 0.0001), Tile grade (p = 0.002), multiple/bilateral foci of extravasation (p = 0.049), arterial blush vol (p < 0.0001), PVP blush vol (p = 0.004), and bleeding rate: PVP-art (p = 0.001). In logistic regression, hematoma vol (OR 1.007 Δ per mL), arterial CE vol (OR 194.3 Δ per mL), PVP CE vol (OR 0.015 Δ per mL), bleeding rate (OR 61.7 Δ per mL), and Tile C vertical instability (OR 6.2) remained as independent predictors.

CONCLUSION
Hematoma vol, CE vol on art and PVP phase, and bleeding rate between phases are independent predictors of major arterial hemorrhage after pelvic fracture. The generalizability of the model is under evaluation using a dataset from a second high-volume level I trauma center.

CLINICAL RELEVANCE/APPLICATION
Volumetric measurements of hematoma, arterial and PVP CE, and rate of change of CE between phases can potentially improve prediction of major arterial injury after pelvic fractures.

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LEARNING OBJECTIVES

1) Describe common imaging findings of tracheobronchial injury. 2) Classify parenchymal injuries of the lung. 3) Discuss rib fracture patterns and pre-operative planning for chest reconstructive surgery.

PURPOSE

There is controversy regarding the administration of oral and rectal contrast in CT protocols to detect bowel injury in the context of penetrating torso trauma. Given the lack of published societal guidelines, our goal was to survey trauma radiologists across North America and abroad to determine consensus on CT protocols for penetrating trauma.

METHOD AND MATERIALS

With IRB approval, an anonymous 10-question online survey was distributed via email to 589 radiologists in the American Society of Emergency Radiology (ASER) member database. The survey was open for a 4-week period in February 2018. A commercially available website that allows subscribers to create and analyze survey results was used for analysis.

RESULTS

We received 124 responses (21% response rate) with majority from U.S. institutions (82%), followed by Europe (7%), Canada (6%), Asia (3%) and Australia/New Zealand (2%). Seventy-four percent of respondents indicated they do not routinely administer oral contrast in penetrating trauma and 68% do not administer rectal contrast. The decision to administer intraluminal contrast is made by the referring physician at 52% of institutions, the attending radiologist at 18% and a resident or fellow at 20%. Most centers do not use software to assess trajectory of penetrating trauma (90%). There is in-house attending level coverage at 54% of institutions. When asked if trauma scans are reviewed before removing the patient from the table, 41% of respondents answered 'No' and of those who answered 'Yes,' 12% said they are reviewed by an attending, 33% by a resident, and 4% by a fellow.

CONCLUSION

The majority of major trauma centers do not routinely administer oral or rectal contrast in cases of penetrating torso trauma and the decision is often made by the referring physician.

CLINICAL RELEVANCE/APPLICATION

There is international consensus that the added benefit of intraluminal contrast to detect bowel injury in CT protocols for penetrating trauma is outweighed by the delay in patient management.

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PURPOSE

To assess the utility of CT findings with clinical parameters to predict clinical outcomes in trauma.
To assess the utility of CT findings with clinical parameters to predict clinical outcomes in trauma.

METHOD AND MATERIALS

IRB-approved retrospective study of all adults who sustained blunt/penetrating trauma in a Level 1 trauma center in 2015. Clinical parameters: admission blood pressure (SBP), heart rate, Glasgow Coma Scale (GCS), hemoglobin, hematocrit (HCT) and lactate. A blinded radiologist assessed CT for colon, kidney, liver, spleen, bony pelvic ring, lung parenchyma, and/or rib injuries. Outcomes: admission to ICU, length of stay (LOS) in the ICU, life-saving procedures (conventional angiography/intervention, surgery) and total LOS in the hospital. Multivariate linear and logistic regression models were employed and covariate-adjusted parameter estimates and odds ratios (OR) with 95% confidence intervals (CI) were computed.

RESULTS

Among 723 patients, 162 were excluded due to missing lab data, resulting in 561 patients (72% males, age 39 ± 18 years). 168 patients were admitted to the ICU. Liver (OR 15.9 [4.8-52.5]), spleen (OR 15.9 [4-62.8]), pelvis (OR 3.4 [1.5-7.5]), lung (OR 3.3 [1.5-7.1]) and rib (OR 4.1 [2.4-7.3]) injuries in addition to age, GCS and lactate predicted admission to the ICU. Among these, the LOS in the ICU was 6 (3-11) days. Only pelvic injury (2.4, p < 0.05) was associated with longer LOS in the ICU. 31 patients had life-saving procedure. Colon (OR 37.3 [7.4-189.3]), liver (OR 3.9 [1.2-12.3]), spleen (OR 8.5 [2.3-31.0]) and pelvis (OR 4.8 [1.7-13.7]) injuries, in addition to lactate, predicted undergoing procedures. Total LOS in the hospital was 2 (1-5) days. Kidney (3.6, p = 0.02), liver (2.9, p = 0.03), spleen (3.5, p = 0.02), pelvis (7.2, p < 0.01), lung (3.8, p < 0.01) and rib (2.2, p < 0.01) injuries in addition to age, GCS, HCT and lactate were associated with longer LOS.

CONCLUSION

Liver, spleen, pelvis, lung and rib injuries are predictive of ICU admission, among which only pelvic injury predicts longer LOS in the ICU. Colon, liver, spleen and pelvis injuries are predictive of life-saving procedure. Kidney, liver, spleen, pelvis, lung and rib are predictive of increased LOS in the hospital. These are independent of age, SBP, GCS, HCT or lactate.

CLINICAL RELEVANCE/APPLICATION

Radiologists can demonstrate value by developing strong predictive models of interest to clinicians and administrators alike.

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RC520A  
**Fundamentals of Imaging of Liver Cancer in Radiation Oncology**

Participants  
Michael I. Lock, MD,FRCPC, London, ON (Presenter) Speaker, sanofi-aventis Group

**LEARNING OBJECTIVES**

1) Provide a step-by-step method to distinguish recurrence from normal radiation changes. 2) Appraise new research to better select MRI sequences to localize tumors. 3) Provide an image review of common errors in imaging post radiation.

**ABSTRACT**

Imaging changes after treatment with radiation can be difficult and misleading. Recent evidence provides insight into better timing of imaging, appropriate MRI sequences (these sequences often differ from sequences used by radiologists) and imaging features that are associated with a higher risk of recurrence.

RC520B  
**Fundamentals of Imaging of Lung Cancer in Radiation Oncology**

Participants  
Candice A. Johnstone, MD, Milwaukee, WI (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Define the most appropriate uses for the use of PET-CT in lung cancer. 2) Identify situations when imaging is sufficient for mediastinal staging. 3) Describe new imaging techniques and their application to lung cancer treatment.

RC520C  
**Fundamentals of Imaging of Gynecologic Cancer in Radiation Oncology**

Participants  
Eric Leung, MD, FRCP, Toronto, ON (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review imaging modalities for staging, planning and response of gynaecological cancer treatments with radiation therapy. 2) To review imaging techniques in three-dimensional based brachytherapy for locally advanced gynaecological cancers. 3) To review imaging techniques for stereotactic radiation therapy of gynaecological cancers. 4) To review functional imaging techniques for gynaecological cancers and radiation treatment.

RC520D  
**Fundamentals of Imaging of CNS Tumors in Radiation Oncology**

Participants  
Hui-Kuo G. Shu, MD, PhD, Atlanta, GA (Presenter) Speakers Bureau, Varian Medical Systems, Inc; Stockholder, Medtronic plc; Stockholder, Apple Inc; Stockholder, ICON plc; Stockholder, Raytheon

**LEARNING OBJECTIVES**

1) List the imaging modalities most often used by the radiation oncologist in the management of CNS tumors. 2) Explain how specific CNS imaging techniques are utilized to assess the extent of disease prior to initiation of radiation therapy (upfront staging). 3) Describe various imaging evaluations of CNS tumors after radiation therapy for longitudinal response assessment with attention to interpretation of specific results.
ABSTRACT
Radiation therapy (RT) is critical for the overall management of many central nervous system (CNS) tumors. Advances in radiation treatment planning, with techniques such as intensity modulated radiation therapy, volumetric modulated arc therapy, and stereotactic radiosurgery, now allow the delivery of highly conformal doses with very high precision. These techniques rely on high-resolution 3-dimensional anatomic imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) scans to accurately and reliably define CNS targets and avoidance structures. The integration of cross sectional imaging into CNS radiation oncology has directly translated into improvements in the therapeutic window of RT, and the union between radiation oncology and imaging is only expected to grow stronger. In addition to standard imaging such as CT and MRI scans, advanced imaging techniques including diffusion/perfusion/spectroscopic MRIs and positron emission tomography (PET) scans with novel tracers are being used to provide additional insight into CNS tumor biology and behavior beyond anatomy. Together, standard and advanced imaging modalities hold significant potential to improve future RT delivery and response assessment. In this talk, we will discuss the current utilization of standard/advanced imaging for CNS malignancies from a radiation oncology perspective as well as discuss the implications of novel MRI and PET modalities currently under investigation.
LEARNING OBJECTIVES

1) Review the unique biomechanical and imaging presentation of the developing pediatric spine. 2) Review key features of pediatric spine trauma. 3) Present a brief introduction into congenital versus acquired spine disorders.

ABSTRACT

The normal development and variations of the pediatric spinal column will be discussed, age specific biomechanical properties and resultant variable patterns of accidental and non-accidental injury will be reviewed. In addition, a brief introduction will be given on differentiating acquired from congenital spine and spinal cord pathologies using a case based approach.

LEARNING OBJECTIVES

1) Describe the imaging findings of several pediatric pulmonary disorders. 2) Differentiate between disorders with similar findings. 3) Recommend appropriate management based on the imaging features.

ABSTRACT

Congenital and acquired pediatric pulmonary cases will be presented. Discussion will include: 1) description of the imaging features for each condition, 2) tips for differentiating between conditions with similar imaging findings, 3) up-to-date recommendations for management and follow-up for each condition.

ABSTRACT

A series of pediatric musculoskeletal cases will be presented to illustrate: 1) normal variants that can be confused with pathology. 2) MR imaging spectrum of chronic non bacterial osteomyelitis (CNO). 3) Neoplasms that can mimic infections and viceversa.
**SSK05**

**Science Session with Keynote: Chest (Artificial Intelligence/Deep Learning)**

Wednesday, Nov. 28 10:30AM - 12:00PM  Room: N227B

AMAI CH

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

Participants
Bram Van Ginneken, PhD, Nijmegen, Netherlands (Moderator) Stockholder, Thirona BV; Co-founder, Thirona BV; Research Grant, Varian Medical Systems, Inc; Research Grant, Canon Medical Systems Corporation
Carol C. Wu, MD, Bellaire, TX (Moderator) Author, Reed Elsevier

Sub-Events

**SSK05-01  Chest Keynote Speaker: AI and Machine Learning in Thoracic Imaging**

Participants
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**SSK05-02  Application of Deep Learning for Risk Stratification of Pulmonary Nodules**

Wednesday, Nov. 28 10:40AM - 10:50AM  Room: N227B

Participants
Seyoun Park, Baltimore, MD (Presenter) Nothing to Disclose
Linda C. Chu, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Cheng Ting Lin, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Alan Yuille, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Elliot K. Fishman, MD, Baltimore, MD (Abstract Co-Author) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc

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PURPOSE

The low dose CT (LDCT) screening criteria used in National Lung Screening Trial (NLST) has a 26.6% false positive rate at baseline. Even when updated more stringent Lung RADS criteria was retrospectively applied to the NLST data, the false positive rate remained at 12.8%. Deep learning, a form of artificial intelligence, has the potential to improve risk stratification of pulmonary nodules. The purpose of this study is compare the performance of deep learning vs. radiologists in the risk stratification of pulmonary nodules.

METHOD AND MATERIALS

264 patients with one solid nodule reported in NLST database up to 20mm (mean±standard deviation: 7.5±3.4mm) in size (223 benign, 41 malignant) were retrospectively selected from the NLST baseline LDCT (T0). All malignant nodules were confirmed pathologically and benign nodules were diagnosed based on pathology or clinical follow-up by NLST investigators. The nodules were semi-automatically segmented using our in-house software. 3D deep convolutional networks (CNN) was used for the deep learning classification of malignancy based on 64x64x64 input patch bounding intramodular and perinodular areas. 4-fold cross-validation was performed. Data augmentation by scaling and rotating was used to increase the number of training dataset. Two radiologists who were blinded to the diagnosis reviewed the cases independently and scored the nodules based on Lung RADS criteria. Scores 1 and 2 were considered negative and scores >= 3 were considered positive.

RESULTS

The selected cohort was 62.0±5.1 year-old-patients at T0 (150 male and 114 female). The average accuracy, sensitivity, and specificity of the review of radiologists were 0.67, 0.73, and 0.67, respectively. 4-fold cross validation result of deep learning was 0.88, 0.90, and 0.88 in the same terms of accuracy, sensitivity, and specificity. Especially, the false positive rate showed significant improvement from 0.33 to 0.12, which represents to reduce false positive cases from 73 to 27, using CNN.

CONCLUSION

Deep learning achieved improved sensitivity, specificity, and accuracy in risk stratification of pulmonary nodules compared with radiologists.

CLINICAL RELEVANCE/APPLICATION

Deep learning can improve the accuracy in risk stratification of pulmonary nodules compared with radiologists. This has the potential of achieving earlier cancer detection and reducing unnecessary work up in the lung screening population.
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SSK05-03  **Deep Learning with Convolutional Neural Network for the Differentiation of Pathologic Grades in Lung Adenocarcinomas**

**Wednesday, Nov. 28 10:50AM - 11:00AM Room: N227B**

**Participants**
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**PURPOSE**
To investigate the diagnostic performance of a deep learning method with a convolutional neural network (CNN) for the differentiation of pathologic grades in lung adenocarcinomas (ADs) manifesting as solitary lung nodules.

**METHOD AND MATERIALS**
This clinical retrospective study comprised preoperative CT image sets of lung ADs pathologically confirmed to be one of three grades (grade A, patterns with low metastatic potential [AIS, MIA, and lepidic-predominant]; grade B, patterns with intermediate metastatic potential [acinar and papillary]; and grade C, patterns with high metastatic potential [solid and micropapillary]). Supervised training was performed using 26,321 CT images (2390 sets) obtained between 2014 and 2016 (a total of 1066 image sets; 278, 716, and 70 nodules for grades A, B, and C, respectively; 609 enhanced and 457 non-enhanced). Image sets were augmented (rotated, parallel-shifted, strongly enlarged, and horizontal flipped images were generated from the original images) by a factor of 4 in images from grade A tumors and by a factor of 8 from grade C tumors. A CNN composed of 151 convolutional, two maximum pooling, and one fully connected layers was tested using independent 1268 image sets (762 enhanced and 506 non-enhanced) obtained between 2007 and 2013 (578 men and 690 women; mean age, 62.7 years ± 10.1; mean mass size, 23.5 mm ± 14.4; 400, 709, and 159 lung ADs of grades A, B, and C, respectively). Accuracy in categorizing lung ADs using the CNN model and the area under the ROC curve (AUC) for differentiating grades A vs. B+C, grade A vs. B, grade A vs. C, and grade B vs. C were calculated.

**RESULTS**
For the differentiation of grades A vs. B+C, diagnostic accuracy was 79.1% and AUC was 0.77 in the test data. For differentiating grades A vs. B, A vs. C, and B vs. C, diagnostic accuracies were 73.4%, 76.8%, 70.1% and AUCs were 0.77, 0.91, and 0.62, respectively.

**CONCLUSION**
Deep learning with CNN demonstrated high diagnostic performance in differentiating the pathologic grade of lung ADs.

**CLINICAL RELEVANCE/APPLICATION**
The CNN model can be useful in differentiating the pathologic grade of lung ADs, however, further study is warranted to correlate patients’ prognoses with the output of CNN.

SSK05-04  **Deep Machine Learning for Automatic Analysis of Chest X-Rays: Effect of Clinically Relevant Pathology Class Label Definition**

**Wednesday, Nov. 28 11:00AM - 11:10AM Room: N227B**

**Participants**
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**PURPOSE**
To quantitatively analyze the effect of radiologically relevant pathology class label definition on deep machine learning results for automatic analysis of chest x-rays.

**METHOD AND MATERIALS**
With >100,000 frontal-view chest radiographs, the ChestX-ray14 data (Wang et al, 2017) is currently the largest publicly available annotated dataset for automatic chest x-ray analysis. Annotations consist of one or more of 14 thoracic pathology labels, e.g. Consolidation (C), Infiltration (I), Pneumonia (P) and 11 others. As radiologists cannot distinguish between C, I and P based on imaging findings alone, the stratification of these ‘opacity’ entities into separate classes suggests a non-existent crispness of reported pathology class labels. To circumvent this key limitation of the ChestX-ray14 dataset and to investigate its effect on machine learning performance, we resampled data belonging to the 3 ‘opacity’ and ‘no findings’ classes, resulting in a 2-class classification problem with 63,000 chest x-rays. Images were resized to 10242 without preserving aspect ratio. Ensuring strict training/test (80%/20%) data separation, we fine-tuned a pre-trained ResNet-34 convolutional neural network with batch normalization, cross-entropy loss function, and last layer sigmoid activation. We also performed classification for all 14 individual pathology labels using the full dataset. Diagnostic accuracy was quantified using Area Under the receiver operating characteristics (AUC).
Evaluating the Use of a Deep Learning Algorithm for Radiology Quality Assurance in Out-Patient Chest X-Ray Reporting

Wednesday, Nov. 28 11:10AM - 11:20AM Room: N227B

Participants
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PURPOSE
To evaluate the accuracy of a deep learning algorithm - 1. To assist with screening of chest X-rays in the wellness check/primary care setting with predominantly normal X-rays 2. To help optimize the quality assurance (QA) process by selecting X-rays for review

METHOD AND MATERIALS
For this retrospective study, we used 3945 de-identified chest X-rays with the accompanying radiologist reports, randomly selected from the natural distribution of scans from adult patients attending OPD for a wellness check at 5 urban centers. Language processing algorithms were used to extract an initial ground truth of either 'normal' or 'abnormal' from the report impressions. A commercial deep learning-based chest X-ray screening system was then evaluated versus this ground truth. X-rays with a discordance between the original radiology report and the algorithm output were re-read by a panel of 3 radiologists. The majority opinion of the 3 radiologists was used as a new ground truth, to evaluate accuracy on this discordant set.

RESULTS
3274 of 3945 (82.9%) X-rays were normal, based on the original radiology report. Algorithm accuracy on the original dataset was 80%, with an AUC of 0.8, sensitivity of 0.63 and specificity of 0.83 on the detection of abnormal X-rays. Of the 789 discordant X-rays, 405 were read by the panel of 3 radiologists. On this discordant dataset, the 3 radiologist-consensus agreed with the algorithm results in 64.9% of the cases, and with the original radiology report in the remaining 35.1%.

CONCLUSION
Among the discordant scans, the consensus ground truth was closer to the algorithm results than to the original report. Deep learning algorithms can effectively select chest X-rays for review during radiology quality control

CLINICAL RELEVANCE/APPLICATION
Artificial intelligence algorithms can be used for automated selection of chest X-rays for review during the radiology QA process, potentially increasing its effectiveness.
Deep Learning-Based Automatic Detection Algorithm for the Detection of Major Thoracic Abnormalities on Chest Radiographs

Wednesday, Nov. 28 11:30AM - 11:40AM Room: N227B

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PURPOSE

To develop a deep learning-based automatic detection (DLAD) algorithm for major thoracic abnormalities including nodule/mass, tuberculosis (TB), pneumonia and pneumothorax on chest radiographs (CRs) using a large-scale CR dataset and evaluate its diagnostic performance.

METHOD AND MATERIALS

We collected a total of 89,832 CRs comprising 54,221 normal CRs and 35,641 abnormal CRs with major thoracic abnormalities including malignant pulmonary nodules/masses, pulmonary TB, pneumonia and pneumothorax. Thereafter, all CRs were randomly split into three datasets; training dataset (n=84,072; 53,393 normal and 30,679 abnormal CRs), validation dataset (n=750; 300 normal and 450 abnormal CRs), and test dataset (n=750; 300 normal and 450 abnormal CRs). DLAD was designed using deep convolutional network consisting of 27 layers and 12 residual connections, and trained with 71,376 label-only CRs and 12,696 annotated CRs for which 15 thoracic radiologists marked the locations of the individual abnormalities. Diagnostic performance of the DLAD was investigated using receiver-operating characteristic (ROC) curve analysis for per-CR classification performance and jackknife alternative free-response receiver-operating characteristic (JAFROC) curve analysis for per-lesion detection performance. All CRs in the validation and test datasets were annotated by 5 out of 15 thoracic radiologists, and the final determination of the location of each abnormality was made by majority decision.

RESULTS

In the test dataset, DLAD showed an area under the ROC curve (AUC) of 0.9811 for per-CR classification performance and an area under the JAFROC curve of 0.9656 for per-lesion detection performance. The AUCs and JAFROCs of each disease category were 0.9674 and 0.9494 for malignant pulmonary nodule/mass, 0.9902 and 0.9742 for tuberculosis, 0.9854 and 0.9740 for pneumonia, and 0.9937 and 0.9800 for pneumothorax, respectively.

CONCLUSION

Our deep learning-based automatic detection algorithm demonstrated excellent, cutting-edge performances both in terms of differentiating normal and abnormal CRs and localizing individual abnormalities on CRs.
Assess the efficacy of deep learning in determining endotracheal tube (ETT) position on chest radiographs.

**PURPOSE**

Chest radiograph is the most commonly performed imaging; changes, or lack thereof, of radiographic findings have tremendous implications on patient care. We compared accuracy of machine learning (ML) algorithm (Qure AI) and thoracic radiologists for assessing stability or change in findings over serial chest radiographs.

**METHOD AND MATERIALS**

We parsed the publicly available, de-identified, frontal-view chest radiographs from the NIH to identify 300 baseline and follow-up radiographs from 150 adult patients both with and without change in radiographic findings. Two thoracic radiologists reviewed all 300 radiographs to establish ground truth for radiographic findings [such as pleural effusions (EF), lung opacities (LO), hilar prominence (HP), and cardiomegaly (CM)]. All radiographs were processed with Qure AI ML to generate prediction scores and heat maps for each finding. Then, two different thoracic (test R1 and R2) radiologists independently recorded their findings, unaware of the ground truth and ML findings. Data were analyzed to determine accuracy and area under curve with free-choice receiver operating characteristics (FROC) analyses.

**RESULTS**

Respective percentage changes in findings on follow-up radiographs for EF, CM, HP and LO were 15% (21/138), 9% (13/150), 5% (8/150), 25% (33/132) for ground truth; 20% (28/138), 13% (20/150), 12% (18/150), 27% (36/132) for R1; 19% (26/138), 7% (11/150), 4% (7/150), 25% (33/132) for R2; and 20% (28/138), 23% (34/150), 23% (34/150), 40% (53/132) for ML. The AUC of ML algorithm for detecting lack of change in findings were 0.867 (EF), 0.904 (C), 0.872 (HP), 0.742 (LO). Accuracy of ML for detecting change in radiographic findings was also high with corresponding AUC of 0.804 (EF), 0.923 (C), 0.839 (HP), 0.758 (LO). Although both test radiologists had AUC similar to ML for stable radiographic findings, their AUC [0.867-0.878 (EF), 0.815-0.904 (CM), 0.635-0.872 (HP), 0.742-0.854 (LO)] for change in findings were lower compared to corresponding AUC for ML.

**CONCLUSION**

ML algorithm can accurately predict stability and change in radiographic findings on follow-up radiographs. Its accuracy varies across different types of findings, and is highest for cardiomegaly and lowest for lung opacities.

**CLINICAL RELEVANCE/APPLICATION**

ML can enable stratification of chest radiographs on basis of change or stability of findings, thus expediting interpretation of radiographs with important changes.

**Honored Educators**

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

**SSK05-09**

**Assessment of Endotracheal Tube Position on Chest Radiographs using Deep Learning**

**Wednesday, Nov. 28 11:50AM - 12:00PM Room: N227B**

**Participants**

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**PURPOSE**

Assess the efficacy of deep learning in determining endotracheal tube (ETT) position on chest radiographs.

**METHOD AND MATERIALS**

23,079 de-identified frontal chest radiographs with an ETT were split into 12 categories, which included bronchial insertion, and distance from the carina at 1.0cm intervals (e.g. 0.0-0.9cm, 1.0-1.9cm...) and lastly >=10cm. Ground truth ETT position was determined by two board certified radiologists (original author and a second radiologist for QA confirmation). Images were split into...
training (80%, 18467 images), validation (10%, 2306 images), and test (10%, 2306 images). The ETT was re-measured on 100 random images from the test data to assess inter-observer variability. The pretrained Inception V3 convolutional neural network was utilized to a) predict ETT distance from the carina in cm and b) categorize images as low ETT (< 2cm of carina), satisfactory (2-7cm above carina), or high (>= 7cm above carina). Image normalization and auto-cropping about the carina was performed prior to model training. Real-time data augmentation was employed, and an ensemble of 10 Inception V3 models was used in the final classification. Receiver operating characteristic (ROC), area-under-the-curves (AUC), sensitivity and specificity on test data were used to assess the models.

RESULTS

The predicted ETT distance from carina had a mean difference of 0.79cm (±0.56) from the ground truth, and the two radiologists had a mean difference of 0.44cm (±0.44). On the test data, the AUC was 0.97 (95%CI: 0.96-0.98) for differentiating ETT<2cm from carina from all others. The AUC was 0.96 (95%CI: 0.95-0.98) for differentiating high ETT>=7cm from all others. 4 bronchial insertions and ETT 0-0.9cm from carina were missed of 385 true positives (sensitivity: 99.0%). There were 86 false positives of 1921 true negative cases (specificity: 95.5%). However, threshold cases near a category were sometimes missed; for example, 43 cases of 1-1.9cm above carina were misclassified as >=2cm above carina, usually as 2-3cm above carina. Similarly, threshold cases of 6-6.9cm were predicted as 7-7.9cm above carina or vice-versa. The sensitivity of the model drops to 87.8% when including these threshold cases as misclassified.

CONCLUSION

Deep learning shows promise in assessing ETT position and predicts position within 1cm in most cases.

CLINICAL RELEVANCE/APPLICATION

Automatic identification of ETT position may reduce time to identification of critical placement.
Differences of CT Bone Density, Pulmonary Function, and Bone Mineral Density According to Smoking Status and Amount in Healthy Men

**Method and Materials**

This cross-sectional study used data from the *** cohort included in the *** Genome Epidemiology Study. Participants diagnosed with chronic obstructive lung disease (forced expiratory volume in one second [FEV1]/forced vital capacity [FVC]<0.70) were excluded. Finally, a total of 1034 men who underwent chest CT, BMD, PFT were included in this study. The CT attenuation value of T4, T7, T10, and L1 vertebral bodies (VD) was measured in each chest CT to obtain CTBD value. BMD, PFT, and CTBD were compared between smoking status (non-, ex-, and current smokers) and the number of pack-year (PY) of smoking (G1, PY<15; G2, 15<=PY<30; G3, PY>=30). The correlation between BMD and CTBD was also evaluated.

**Results**

CTBD of current smokers was significantly lower than non-smokers and ex-smokers (203±50 vs. 194±47 vs. 193±48 at T4; 158±42 vs. 149±41 vs. 149±39 at L1; all P<0.01). BMD was also significantly lower in current smokers than in non-smokers and ex-smokers (1.24±0.2 vs. 1.23±0.2 vs. 1.18±0.2, P=0.005), and there was significantly more osteoporosis patients in current smokers than in non-smokers and ex-smokers (P=0.01). FEV1 and FEV1/FVC of current smokers were significantly lower than those of non-smokers and ex-smokers. According to the number of PY of smoking, G3 of CTBD at all vertebral body levels was significantly lower than G2 and G1 (all P<0.03), although there was no significant difference in BMD between the groups. FEV1 was significantly lower in G3 than G1 and G2 (P<0.001). There were significant correlations between BMD and CTBD in non-, ex-, and current smokers (r, 0.433-0.652, range).

**Conclusion**

CT bone density were significantly different between smoking status and according to smoking amount. PFT was also significantly different. CT bone density was significantly correlated with BMD.

**Clinical Relevance/Application**

This study demonstrated the effect of smoking status and amount on bone quality by measuring CT bone density, which may be helpful in detecting BMD in normal subjects.

Hepatocellular Metastasis in the Thorax

**Method and Materials**

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Purpose

This project analyzes the imaging features and time period for metastatic manifestation of Hepatocellular Carcinoma (HCC) in the thorax and correlates the findings with intra-abdominal tumor staging based on CT or MR findings. The goal was to establish follow-up recommendations for patients with HCC and to estimate the time period of thoracic metastasis to guide thoracic CT re-staging for HCC patients. Assessing time period and patterns for metastasis in the thorax helps reduce unnecessary short-term surveillance scans and helps to provide a guideline for the time line during which intervention to prolong survival could take place.

Method and Materials

A retrospective review of 310 HCC patient using records from October 2010 to August 2014 was conducted. The patient’s first Abdomen CT or MRI with signs of HCC was found, and the date and the characteristics of the hepatic nodules were noted. Initial CT or MR imaging study of the abdomen was also reviewed to determine the abdominal extent of the disease. Signs of thoracic metastasis on staging or surveillance chest CT scan were recorded.

Results

27 patients had metastasis as lymphadenopathy, bone lesions, and enlarged lung nodules. Initial staging or surveillance CT scans led to detection of extrhepatic metastasis in 8.7% of patients with HCC. The most common thoracic metastasis was pulmonary nodules, 10.9% of those with metastasis. Other patterns of metastasis include lymphadenopathy (44%) and bony metastasis (14.8%). The average time period for thoracic metastasis since the initial diagnosis of HCC was 722 days and the median time for thoracic metastasis since the initial diagnosis of HCC was 335 days.

Conclusion

Staging and surveillance chest CT for HCC was shown to reliably detect thoracic metastasis given that surveillance imaging helped with metastasis discovery in 8.7% of patients with HCC. The appropriate time period for subsequent thoracic surveillance should be within 1-2 years of initial diagnosis.

Clinical Relevance/Application

Currently there are no recommendations for imaging surveillance for thoracic HCC metastasis. Given the substantial number of patients developing thoracic metastasis and various metastatic patterns, it is valid to include chest CT studies as a part of follow-up imaging protocol for HCC. Further analysis of these patients based their intra-abdominal staging and prior treatment will help determine appropriate time interval for surveillance scan.

CH287-SD-WEA4 Interstitial Lung Abnormalities in Stage IV Non-Small Cell Lung Cancer Patients: A Validation Study for the Association with Poor Clinical Outcome

Station #4

Participants

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Purpose

The presence of interstitial lung abnormalities (ILA) at diagnosis of stage IV non-small cell lung cancer (NSCLC) patients have previously shown to be associated with shorter survival. The present study aimed to validate the association in a larger cohort of treatment-naïve stage IV NSCLC patients.

Method and Materials

This study included 484 patients (205 males and 279 females, median age: 62) with stage IV NSCLC. ILA was scored on the baseline chest CT scans at diagnosis prior to therapy using 3-point scale (0=no ILA, 1=equivocal for ILA, 2=ILA) using a sequential reading method by 3 readers as published previously. Clinical characteristics and overall survival (OS) were compared in patients with ILA (score 2) vs. those without ILA (score 0 or 1).

Results

ILA was present (score 2) on baseline CT in 19 of the 484 patients (3.9%, 95%CI: 2.4 - 6.1%). Patients with baseline ILA were older (median age: 69 vs. 62 years, Wilcoxon p=0.0008) and were more commonly male (68.4% (13/19) vs. 41.3% (192/465); Fisher p=0.03) compared to those without ILA. Other variables including race, smoking history, and histology were not significantly associated with baseline ILA. Patients with baseline ILA had significantly shorter overall survival compared to those without (median OS: 9.95 months [95%CI: 5.88-15.5] vs. 16.95 months [95%CI: 14.65-18.7]; Log-rank p=0.0002). In multivariable analyses, baseline ILA remained significant as a marker for shorter overall survival (HR=2.09; Cox p=0.004), after adjusting for age (>70 years using the 75th percentile; HR=1.48; Cox p=0.001), male gender (HR=1.22; Cox p=0.055) and smoking (never vs. current/former smoker; HR=0.79; Cox p=0.051).

Conclusion

The presence of ILA at diagnosis of stage IV NSCLC was significantly associated with shorter survival, validating ILA as an independent marker for poor outcome.
CLINICAL RELEVANCE/APPLICATION

Recognition of ILA on chest CT at diagnosis of stage IV NSCLC is important, because ILA can serve as a marker for shorter survival and may contribute to patient monitoring and management.

CH288-SD-WEA5 The Value of Clot Volume in Risk Stratification of Acute Pulmonary Embolism Based on a 3-Dimensional Technique

Station #5

Participants
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PURPOSE

To investigate the value of clot volume in risk stratification of acute pulmonary embolism (APE) by a 3-dimensional technique.

METHOD AND MATERIALS

One hundred and thirty-nine APE patients were enrolled from March 2015 to July 2016 and divided into high-risk, intermediate-risk and light-risk group according to 2014 ESC guideline. The clot volume was measured using an automated program, clot burden was assessed using semi-quantitative scores (Qanadli and Mastora), and signs of right ventricular dysfunction (RVD) were evaluated. Spearman rank coefficient was used to analyze the correlation among clot volume, semi-quantitative scores and signs of RVD. One-way ANOVA and Mann-Whitney U nonparametric test were used to compare the above indexes among three groups. Receptor operation characteristics (ROCs) curve was used to compare the AUC of the above indexes. Uni- and multivariate analyses were used to identify the independent predictors of life-threaten APE.

RESULTS

Strong positive correlations were noted between clot volume and Qanadli (r=0.831, p<0.001) and Mastora (r=0.844, p<0.001), intermediate positive correlations were noted between clot volume and signs of RVD. Clot volume, semi-quantitative scores, signs of RVD showed significantly different in three groups (p<0.05). ROC showed clot volume has the highest AUC area of determination between high risk and intermediate risk (AUC=0.968), and intermediate risk and low risk (AUC=0.971). Only increase in clot volume was independently associated with life-threaten APE in Univariate analysis (OR=1.859, 95%CI:1.368-2.527, p<0.001) and in multivariate analysis (OR=2.379, 95%CI:1.216-4.653, p<0.001).

CONCLUSION

Clot volume obtained by computerized software is strongly correlated with traditional semi-quantitative CT scores, and is the independent factor of life-threaten APE patients.

CLINICAL RELEVANCE/APPLICATION

Acute pulmonary embolism (APE) is a common disease with high mortality, morbidity and hospitalization, ranking the third cause of death among all cardiovascular diseases. High-risk APE is confirmed to be in the presence of shock or persistent arterial hypotension. Multi-detector computed tomographic pulmonary angiography (CTPA) has been the first-line diagnostic technique in APE patients. However, semi-quantified method has limitations. The value of clot volume obtained by computer-aided detection in predicting the degree of risk of APE is faster, easier and more subjective.

CH289-SD-WEA6 Deep Learning Reconstruction in Thoracic CT: Comparison of Image Quality with Iterative Reconstruction Methods

Station #6

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PURPOSE

To evaluate whether deep learning reconstruction (DLR) based on convolutional neural network will improve image quality in thoracic CT compared to two clinically established iterative reconstruction methods (IR).

METHOD AND MATERIALS

48 projection datasets from subsequent patients who underwent CT of the chest (120 kV, 50 mA, 0.5 s rotation time, 0.5*80 detector rows; Canon Aquilion Genesis) were reconstructed in 5 series: hybrid-iterative IR (AIDR) and forward-projection based IR (FIRST), both with body and lung settings, and DLR. All images were reconstructed with 1 mm slice thickness and presented as 5 on 1 (random order, no image annotation) on a 4K monitor. By using forced ranking, 2 readers (23, 10 years on staff) evaluated the series in the categories: (C1) lung, (C2) noise texture lung, (C3) mediastinum, (C4) noise texture mediastinum, (C5) artifacts, and (C6) overall appeal. The readers also graded image quality in C6 on a Likert scale (1=excellent, 10=low quality). Inter-reader agreement was calculated for all categories. Image noise (SD in ROI) was measured within the aorta and in air. All values were statistically analyzed.
RESULTS

DLR was unanimously preferred (rank 1) over all other reconstructions by both readers in all patients and in all categories (p<0.001) except for artifacts (C5) where DLR ranked 2nd behind AIDR body. The mean rank of AIDR body/DLR in (C5) for reader 1 and 2 was 2.19/1.70 and 2.25/1.67 respectively, p>0.05. The mean ranking/Likert score in category (C6) for AIDR body, lung, FIRST body, lung and DLR for reader 1 and 2 was 3.85/6.17, 3.29/5.76, 4.81/7.12, 2.13/3.80 and 1.00/1.88, and 3.90/5.25, 2.92/4.25, 5.00/6.88, 2.17/3.31 and 1.00/2.00, respectively, p<0.001. Inter-reader agreement for forced ranking was k=0.90, for the Likert score k=0.78. Noise in the aorta was lowest (12.2 HU) and in air second highest (22.2 HU) on DLR, p<0.01.

CONCLUSION

Deep learning reconstruction provides superior subjective image quality in thoracic CT for lungs and mediastinum when compared to both clinically established iterative methods. DLR holds promise to eliminate the need for separate reconstructions for lungs and soft tissues.

CLINICAL RELEVANCE/APPLICATION

Deep learning reconstruction carries the potential to become the future standard-of-care reconstruction in thoracic CT.

TEACHING POINTS

1. To review the development and methods of computed tomography (CT) quantitative analysis tools
2. To demonstrate the role of quantitative analysis in the diagnosis and management of diffuse lung disease
3. To explain pitfalls in quantitative analysis interpretation

TABLE OF CONTENTS/OUTLINE

The complexity of diffuse lung diseases and variability of their imaging evaluation reinforces the clinical need for quantitative analysis tools. Computer-Aided Lung Informatics for Pathology Evaluation and Rating (CALIPER), one of the novel image analysis tools for characterizing and quantifying lung parenchymal diseases such as emphysema and interstitial lung diseases on high resolution CT, has been shown to be useful in prognostication and management of diffuse lung diseases. In this exhibit, we will review the development of machine learned texture analysis tools and discuss the application of such quantitative analysis in diagnosis, prognostication, and management of various diffuse lung diseases such as emphysema, interstitial lung disease, and lymphangioleiomyomatosis. Pitfalls of interpretation and potential solutions will be explored, including artifacts secondary to erroneous extraction of non-parenchymal structures and respiratory inconsistency.
Clinical Usefulness of Combined Use of Ultra-High-Resolution CT and Iterative Reconstruction in CT Virtual Bronchoscopy

Station #1

Participants
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PURPOSE
A state-of-the-art combination of ultra-high-resolution CT (UHRCT) scanner (Aquilion Precision, Canon) with 0.25 mm x 160 slice collimation, 1024-matrix size, and full iterative reconstruction (IR) algorithm (FIRST) can simultaneously improve spatial resolution and reduce noise in CT images. We assessed the clinical usefulness of this combination for CT virtual bronchoscopy (VB).

METHOD AND MATERIALS
We retrospectively enrolled consecutive 21 patients (13 men, mean age: 68±14 years) who underwent chest CT by UHRCT; reconstructed VB images with the following modes: 1) 512 matrix, 0.5-mm thickness, and hybrid IR (AIDR 3D); 2) 1024 matrix, 0.25-mm thickness, and hybrid IR (AIDR 3D enhanced); 3) 1024 matrix, 0.25-mm thickness, and FIRST for each patient. Using a dedicated workstation, two readers by consensus determined the maximal order of recognizable bronchial bifurcation in the segment 1+2 of the left lung and segment 10 of the right lung in those three modes. The two readers independently graded the subjective image quality (IQ) of the airway surface using a 5-point scale (1, poor; 5, excellent). The maximal bifurcation order and IQ grades at the most distal bifurcation recognizable in the three modes for each observer were compared using Kruskal-Wallis test. Inter-reader agreement of the IQ grades was assessed using κ-statistics.

RESULTS
Both in the left S1+2 and right S10, the maximal bifurcation order increased from the mode one (8.2±1.3 and 11.5±1.7, respectively) to two (9.3±1.3 and 12.5±1.7) to three (10.2±1.5 and 13.3±1.6) and mean IQ grades improved from the mode one (1.5±0.6 and 1.7±0.5, respectively) to two (2.8±0.5 and 2.8±0.4) to three (3.5±0.5 and 3.4±0.6). For the maximal bifurcation order and IQ grades, significant differences were found between the modes one and three (P<0.05). The IQ grade in the left S1+2 was significantly better with the mode three than the mode two. The inter-reader agreement of the IQ grades was substantial to excellent (κ: 0.77-0.83).

CONCLUSION
Combined use of UHRCT and FIRST is useful for improving delineation of more distal bronchial bifurcation on VB images.

CLINICAL RELEVANCE/APPLICATION
Combined use of ultra-high-resolution CT and full iterative reconstruction can offer higher-quality virtual bronchoscopy images, which may improve clinical management for peripheral pulmonary lesions.

Lung Nodule Detection Performance Using a Deep Convolutional Neural Network Model Using Wide Detector Spectral Ct Monochromatic Imaging? A Preliminary Phantom Study

Station #2

Participants
Li Long, Shenzhen, China (Presenter) Nothing to Disclose
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Luo Dehong, Beijing, China (Abstract Co-Author) Nothing to Disclose
The aim of this study was to evaluate the clinical value of the Deep bone suppression imaging (deepBSI) in detecting pulmonary nodules. The deepBSI program and DES used in this study provided similar detection rates for lung nodules which located in the upper and middle lung field. DTS imaging exhibited greater sensitivity than deepBSI and DES radiography for nodules located in the upper lung field, comparing to DR, the nodule detection rates of deepBSI, DES and DTS were the highest respectively. When the nodule was located in the lower lung field, there was no statistical difference between DR and DES (P>0.05). The specificity for DR, deepBSI, DES and DTS was 79.70%, 81.20%, 78.95% and 85.71% respectively. When the nodule was located in the upper lung field, there was no statistical difference between deepBSI and DES (P>0.05). The sensitivity for DR, deepBSI, DES and DTS was 84.52% and 91.61% respectively, the performance of deepBSI, DES and DTS was significantly better than DR respectively (P < 0.05), there was no statistical difference between deepBSI and DES (P>0.05). The specificity for DR, deepBSI, DES and DTS was 79.70%, 81.20%, 78.95% and 85.71% respectively. When the nodule was located in the lower lung field, there was no statistical difference between DR and DES (P>0.05). When the nodule was located in the upper lung field, comparing to DR, the nodule detection rates of deepBSI, DES and DTS were the highest respectively.

Lung nodule detection rate and evaluation performance can be maintained well among monochromatic imaging reconstructions.

CONCLUSION

Lung nodule detection rate and evaluation performance can be maintained well among monochromatic imaging reconstructions. Using wide detector spectral CT monochromatic imaging, lung nodule detection rate, sensitivity and specificity performance was found the best by using 50kev.

CLINICAL RELEVANCE/APPLICATION

Monochromatic imaging reconstructions with good results of CAD detection may be an alternative for patient chest CT scan.

RESULTS

Nodules detected by CAD system compared with true nodules and Youden index of eleven groups were shown in the following table. While in the group of A2(50kev), true nodules detected by CAD system was 14. Sensitivity, specificity and Youden index were 87.5%, 85% and 0.730. Average diameter of nodules were 7.37-10.42mm, average volume of nodules were 0.38-0.71mm3, CT value of nodules were -381.71-321.58HU, and malignant probabilities of nodules were 61%-85%. Results revealed high intracranial correlation coefficients for measurement (ICCs: 0.980, 0.915, 0.940, 0.995, P<0.05). Lung nodule detection rate and evaluation performance can be maintained well among monochromatic imaging reconstructions.

CONCLUSION

Lung nodule detection rate and evaluation performance can be maintained well among monochromatic imaging reconstructions. Using wide detector spectral CT monochromatic imaging, lung nodule detection rate, sensitivity and specificity performance was found the best by using 50kev.

CLINICAL RELEVANCE/APPLICATION

Monochromatic imaging reconstructions with good results of CAD detection may be an alternative for patient chest CT scan.

evaluation of Deep Bone Suppression Imaging (deepBSI) for Lung Nodule Detection: A Comparative Study

Method and Materials

The study adopted chest simulation phantom with 16 homogeneous simulated nodules with different sizes and densities. The scans were conducted by GE 256 MDCT scanner (Revolution CT) using GSI mode. Noise Index was set as 20. Monochromatic image data sets were reconstructed as 40-140kev (10kev interval) named A1-A11 group. Other parameters were the same with detector coverage: 80mm, pitch: 0.992, rotation speed: 0.5 s/r, scan slice and interval thickness: 5mm. All the scan images were reconstructed as standard algorithm with thickness of 1.25mm. Nodule detections were automatically performed on an artificial intelligence CAD system using DCNN model. To determine the utility of IR method for improving nodule detection capability, sensitivity and specificity of the CAD system were compared among all scans. The measurements of the nodules were evaluated and compared. Statistical analyses were performed using the intraclass correlation coefficients (ICC).

RESULTS

Nodules detected by CAD system compared with true nodules and Youden index of eleven groups were shown in the following table. While in the group of A2(50kev), true nodules detected by CAD system was 14. Sensitivity, specificity and Youden index were 87.5%, 85% and 0.730. Average diameter of nodules were 7.37-10.42mm, average volume of nodules were 0.38-0.71mm3, CT value of nodules were -381.71-321.58HU, and malignant probabilities of nodules were 61%-85%. Results revealed high intracranial correlation coefficients for measurement (ICCs: 0.980, 0.915, 0.940, 0.995, P<0.05). Lung nodule detection rate and evaluation performance can be maintained well among monochromatic imaging reconstructions.

CONCLUSION

Lung nodule detection rate and evaluation performance can be maintained well among monochromatic imaging reconstructions. Using wide detector spectral CT monochromatic imaging, lung nodule detection rate, sensitivity and specificity performance was found the best by using 50kev.

CLINICAL RELEVANCE/APPLICATION

Monochromatic imaging reconstructions with good results of CAD detection may be an alternative for patient chest CT scan.
Pleural Irregularities Compared to CT Quantitative and Semi-Quantitative Analysis

METHOD AND MATERIALS
Thirty-seven patients affected by IIM were enrolled and underwent a thoracic ultrasound exam (US). In 53 anterior and posterior bilateral intercostal spaces, we evaluated the US irregularities of the pleural profile. We assigned a score for each space, according to a 3 points scale (0=regular, 1=mild irregularities between 3 mm and 5 mm, 2=irregularities > 5 mm) and summed the score in each space to obtain the total score (PIs). A CT was performed and quantified by a thoracic radiologist using a semi-quantitative score of parenchymal abnormalities (Warrick's score (WS)). In 21 patients a quantitative analysis of interstitial lung involvement was obtained by a volumetric texture and local volumetric histogram feature-based analysis software (CALIPER). Interstitial lung involvement was evaluated as a percent of interstitial lung abnormalities (ILD%): combination of percent of areas of ground glass, reticulation and honeycombing. Analysis of the vascular involvement was obtained as percent of pulmonary vessel volume (PVRS %).

RESULTS
Twelve out of 37 patients had a WS=0. In the 25/37 patients who had a positive CT scan a good correlation between PIs and WS was demonstrated (r=0.65; p<0.001). From the analysis of ROC curve, a cut-off of PIs<19 was found, that might be able to identify all patients without CT abnormalities (sensitivity 100%). A high correlation between WS and ILD% (r=0.802; p<0.001), WS and PVRS % (r=0.746; p<0.001), ILD% and PIs (r=0.777; p<0.001) and PVRS% and PIs (r=0.738; p<0.001) was demonstrated.

CONCLUSION
The good correlation between PIs and WS may lead to a possible role of US as a first level exam to evaluate lung involvement in IIM patients. The high correlation between WS and ILD% may define the role of CALIPER, as an instrument to quantify lung involvement in IIM patients.

CLINICAL RELEVANCE/APPLICATION
The US evaluation of pleural irregularities is a new promising technique to screen lung involvement in connective tissue interstitial lung disease such as IIM. Automatic software may be useful to evaluate the interstitial lung involvement in a reproducible and easy way.

CH294-SD- WEBS Hemodynamic Status of Main Pulmonary Artery in Pulmonary Hypertension

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Shi, Shanghai, China (Presenter) Nothing to Disclose
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PURPOSE
To retrospectively study the morphological and hemodynamic changes of main pulmonary artery (MPA) in patient with pulmonary arterial hypertension (PAH).

METHOD AND MATERIALS
38 patients (21 women; 43.1 years±17.7) who were suspected of having PAH underwent both computed tomography angiography (CTA) and right heart catheterization (RHC).Based on RHC, 31 patients were diagnosed with PAH (mean pulmonary artery pressure [MPAP], >25mmHg) and the remaining 7 subjects were treated as normal controls. Then the PAH patients were divided into three groups by their clinical severity:mild, moderate and severe. A combined CTA and computational fluid dynamics (CFD) approach was used to construct patient-specific pulmonary models and simulate blood flow at steady-state. Hemodynamic parameters, including MPA wall shear stress (MPA-WSS) and velocity (vMPA), were generated in each patient locally. Morphological parameters such as diameter of MPA, left (LPA) and right (RPA) pulmonary artery were also measured. All the parameters will be compared between the PAH cohort and the normal cohort, and evaluated the difference in the three PAH groups. The association between two variables was assessed by a Pearson correlation coefficient (r) and a Wilcoxon ranked-sum test was used to determine if parameter means were significantly different.
RESULTS
Compared with controls, PAH cohort demonstrated smaller MPA-WSS (0.19 + 0.08 vs 0.54 + 0.23 Pa, P<0.001) and vMPA (6.07 + 1.44 vs 15.57 + 5.5 cm/s, P<0.001). However, PAH patients always had larger diameter in MPA (3.6 + 0.32 vs 2.79 + 0.27 cm, P<0.001), LPA (2.54 + 0.32 vs 2.11 + 0.25 cm, P<0.001) and RPA (2.7 + 0.33 vs 2.27 + 0.35 cm, P<0.001). Additional, MPA-WSS showed a significant negative correlation with MPAP (r = -0.71, P < 0.01), pulmonary vascular resistance (PVR) (r = -0.62, P < 0.01) and MPAP diameter (r = -0.65, P < 0.01). Conversely, vMPA had a strong positive correlation with MPA-WSS (r = 0.79, P < 0.01). With the aggravation of PAH, MPA-WSS decreased from 0.24 Pa in mild group to 0.17 in moderate group, then to 0.15 in severe group. However, the correlation was not strong between the MPA and MPA-WSS when we just consider the PAH patients (r = -0.43, r = 0.017).

CONCLUSION
MPA-WSS and vMPA decreased in PAH patients and significantly associated with MPAP, PVR and the deformation of MPA.

CLINICAL RELEVANCE/APPLICATION
Hemodynamic changes of MPA may play a role in the pathogenesis and progression of PAH.

Participants
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PURPOSE
To develop and validate a deep learning-based automatic detection (DLAD) algorithm for active pulmonary tuberculosis (TB) on chest radiographs (CRs).

METHOD AND MATERIALS
For the development of DLAD, 54,221 normal CRs and 6,768 CRs with active pulmonary TB were retrospectively collected from a single institution and labeled by 13 board-certified radiologists. DLAD was developed with a 27-layer deep convolutional neural network, and its performance was validated using 6 external validation datasets (4 datasets from 4 institutions and 2 datasets from the US National Library of Medicine). Finally, to compare the performances of DLAD and physicians, an observer performance test was conducted by 15 physicians (5 non-radiology physicians, 5 board-certified radiologists, and 5 thoracic radiologists) using one of the external validation datasets. Diagnostic performance was measured using area under the receiver operating characteristic (ROC) curves for image-wise classification and with area under the alternative free-response ROC curves for lesion-wise localization. Sensitivities and specificities of DLAD were calculated using two cutoffs [high sensitivity (98%) and high specificity (98%)] obtained from the results of in-house validation.

RESULTS
DLAD demonstrated an image-wise classification performance of 0.977-1.000 and localization performance of 0.973-1.000 in the 6 external validation datasets. Sensitivities and specificities for image-wise classification were 94.3-100% and 91.1-100% using the high sensitivity cutoff and 84.1-99.0% and 99.1-100% using the high specificity cutoff. DLAD showed significantly higher performance in both classification (0.993 vs. 0.746-0.971 according to physician groups, all Ps <0.05) and localization (0.993 vs. 0.664-0.925 according to physician groups, all Ps <0.05) compared to physicians.

CONCLUSION
DLAD showed excellent and consistent performance in the detection of active pulmonary TB on CRs, outperforming physicians.

CLINICAL RELEVANCE/APPLICATION
DLAD can classify CRs with active pulmonary TB and localize lesions at an expert’s level, and thus may play a key role in the diagnosis and screening of active pulmonary TB.

Participants
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TEACHING POINTS
The purpose of this exhibit is to make radiologists and clinicians aware of the updates made in the second version (2017) of the Fleischner Society guidelines for management of incidental pulmonary nodules. The original paper was initially released in 2005 with a separate guideline for sub-solid nodules issued in 2013. This exhibit aims to highlight the changes made as well as make radiologists aware of the current guidelines.

TABLE OF CONTENTS/OUTLINE

Introduction and History Recommendations for Managing incidentally discovered pulmonary nodules • General recommendations • Recommendations for solid lung nodules & solitary sub-solid nodules Risk factors for Malignancy: General Considerations • Nodule size, morphology, location, multiplicity, & growth rate • Emphysema and Fibrosis • Age, sex, race, & family history • Tobacco & other inhaled carcinogens • Risk estimation and risk models • Invasive diagnostic and therapeutic procedures Additional Considerations • Apical Scarring • Peri-fissural Nodules • Incidentally detected lung nodules on incomplete thoracic CT scans • Partial thoracic CT scans for nodule follow-up Conclusions Advances in Knowledge Implications for Patient Care

Participants
Andrea V. Pavani, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
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Julia Capobianco, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Viviane B. Antunes, MD, MS, Sao Paulo, Brazil (Presenter) Nothing to Disclose
Gustavo S. Meirelles, MD,PhD, Sao Paulo, Brazil (Abstract Co-Author) Partner, Ambra Saude; Stockholder, Fleury SA; Advisory Board, Boehringer Ingelheim GmbH;

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TEACHING POINTS
- Practical Implications of the New TNM.
- Show examples of tomographic images in patients with lung cancer and its staging.

TABLE OF CONTENTS/OUTLINE
- Explain the changes in the new TNM (Eighth Edition).
- To show in a practical way the main points of the new TNM.
- Show the importance of staging correctly with the new TNM to make the correct treatment and also to predict.
- We will be using cases material from our Radiology Department to describe and illustrate the lung cancer staging.
- Conclusion and "take home messages".
These conditions. Malignant pleural disease can manifest as an isolated pleural effusion, a pleural effusion with uneven pleural thickening or more rarely by presence of isolated small pleural nodules, which is named dry pleural dissemination.

LEARNING OBJECTIVES

1) Identify CT features of benign solitary pulmonary nodules.
2) List morphologic features of solitary nodules that suggest malignancy.
3) Review current recommendations for management of incidentally-detected small lung nodules.
4) Recognize common mechanisms of intrathoracic metastatic spread with focus on pulmonary metastases.
5) Familiarize with pertinent imaging features and patterns of metastatic disease on CT.
6) Illustrate how to narrow the differential diagnosis regarding the primary site of malignancy.
7) Assess utility of imaging findings for diagnosis, prognosis and directing therapy of metastatic disease.
8) Describe intrathoracic calcification by location and identify those with characteristic morphology.
9) Identify signs of malignant pleural disease on CT examinations.

ABSTRACT

Solitary pulmonary nodules are among the most common diagnostic problems facing radiologists who interpret chest CT examinations. This component of the course will review technical considerations of CT of lung nodules, the characteristics of benign nodules and those CT features of SPNs that are concerning for malignancy. The evidence-based approach to small nodules detected incidentally on chest CT examinations will be reviewed, with a focus on the 2017 Fleischner Society guidelines for management of these lesions. Metastatic disease to the thorax is commonly encountered in clinical practice and can have a wide range of imaging manifestations. CT is typically used to detect the abnormality, guide diagnostic procedures and therapy, as well as assess treatment response. This presentation will review cases that illustrate main pathological mechanisms of metastatic spread to the chest, and imaging patterns on CT, characteristic for specific categories of primary malignancies, with focus on pulmonary metastases. Prognostic implications and available therapeutic options will be reviewed. Intrathoracic calcification is most often the result of prior granulomatous infection. Other intrathoracic calcifications will be presented by location: solitary pulmonary nodule, multiple pulmonary nodules, diffuse parenchymal involvement, lymph node and pleura. The differential diagnosis includes malignant, metastatic, occupational, and idiopathic causes often with subtle differences in morphology that can be used to correctly diagnose these conditions. Malignant pleural disease can manifest as an isolated pleural effusion, a pleural effusion with uneven pleural thickening or more rarely by presence of isolated small pleural nodules, which is named dry pleural dissemination.

Participants
Diana Litmanovich, MD, Haifa, Israel (Director) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify CT features of benign solitary pulmonary nodules.
2) List morphologic features of solitary nodules that suggest malignancy.
3) Review current recommendations for management of incidentally-detected small lung nodules.
4) Recognize common mechanisms of intrathoracic metastatic spread with focus on pulmonary metastases.
5) Familiarize with pertinent imaging features and patterns of metastatic disease on CT.
6) Illustrate how to narrow the differential diagnosis regarding the primary site of malignancy.
7) Assess utility of imaging findings for diagnosis, prognosis and directing therapy of metastatic disease.
8) Describe intrathoracic calcification by location and identify those with characteristic morphology.
9) Identify signs of malignant pleural disease on CT examinations.

ABSTRACT

Solitary pulmonary nodules are among the most common diagnostic problems facing radiologists who interpret chest CT examinations. This component of the course will review technical considerations of CT of lung nodules, the characteristics of benign nodules and those CT features of SPNs that are concerning for malignancy. The evidence-based approach to small nodules detected incidentally on chest CT examinations will be reviewed, with a focus on the 2017 Fleischner Society guidelines for management of these lesions. Metastatic disease to the thorax is commonly encountered in clinical practice and can have a wide range of imaging manifestations. CT is typically used to detect the abnormality, guide diagnostic procedures and therapy, as well as assess treatment response. This presentation will review cases that illustrate main pathological mechanisms of metastatic spread to the chest, and imaging patterns on CT, characteristic for specific categories of primary malignancies, with focus on pulmonary metastases. Prognostic implications and available therapeutic options will be reviewed. Intrathoracic calcification is most often the result of prior granulomatous infection. Other intrathoracic calcifications will be presented by location: solitary pulmonary nodule, multiple pulmonary nodules, diffuse parenchymal involvement, lymph node and pleura. The differential diagnosis includes malignant, metabolic, occupational, and idiopathic causes often with subtle differences in morphology that can be used to correctly diagnose these conditions. Malignant pleural disease can manifest as an isolated pleural effusion, a pleural effusion with uneven pleural thickening or more rarely by presence of isolated small pleural nodules, which is named dry pleural dissemination.
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MSCT41B Many Faces of Metastatic Diseases to the Chest

Participants
Maya Galperin-Aizenberg, MD, Philadelphia, PA (Presenter) Nothing to Disclose

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LEARNING OBJECTIVES
1) Identify CT features of benign solitary pulmonary nodules. 2) List morphologic features of solitary nodules that suggest malignancy. 3) Review current recommendations for management of incidentally-detected small lung nodules. 4) Recognize common mechanisms of intrathoracic metastatic spread with focus on pulmonary metastases. 5) Familiarize with pertinent imaging features and patterns of metastatic disease on CT. 6) Illustrate how to narrow the differential diagnosis regarding the primary site of malignancy. 7) Assess utility of imaging findings for diagnosis, prognosis and directing therapy of metastatic disease. 8) Describe intrathoracic calcification by location and identify those with characteristic morphology. 9) Identify signs of malignant pleural disease on CT examinations.

ABSTRACT
Solitary pulmonary nodules are among the most common diagnostic problems facing radiologists who interpret chest CT examinations. This component of the course will review technical considerations of CT of lung nodules, the characteristics of benign nodules and those CT features of SPNs that are concerning for malignancy. The evidence-based approach to small nodules detected incidentally on chest CT examinations will be reviewed, with a focus on the 2017 Fleischner Society guidelines for management of these lesions. Metastatic disease to the thorax is commonly encountered in clinical practice and can have a wide range of imaging manifestations. CT is typically used to detect the abnormality, guide diagnostic procedures and therapy, as well as assess treatment response. This presentation will review cases that illustrate main pathological mechanisms of metastatic spread to the chest, and imaging patterns on CT, characteristic for specific categories of primary malignancies, with focus on pulmonary metastases. Prognostic implications and available therapeutic options will be reviewed. Intrathoracic calcification is most often the result of prior granulomatous infection. Other intrathoracic calcifications will be presented by location: solitary pulmonary nodule, multiple pulmonary nodules, diffuse parenchymal involvement, lymph node and pleura. The differential diagnosis includes malignant, metabolic, occupational, and idiopathic causes often with subtle differences in morphology that can be used to correctly diagnose these conditions. Malignant pleural disease can manifest as an isolated pleural effusion, a pleural effusion with uneven pleural thickening or more rarely by presence of isolated small pleural nodules, which is named dry pleural dissemination.

MSCT41C Many Faces of Thoracic Calcifications

Participants
Cristopher A. Meyer, MD, Madison, WI (Presenter) Investor, Elucent Medical; Consultant, NIOSH Certified B-reader

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LEARNING OBJECTIVES
1) Identify the cause of diffuse lung parenchymal calcification based on morphology and distribution. 2) Describe the differential diagnosis for calcified mediastinal lymph nodes. 3) Be familiar with the entities of pleural plaque and pseudo-plaque in occupational exposure.

MSCT41D Many Faces of Pleural Disease

Participants
Marie-Pierre Revel, Paris, France (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify CT features of benign solitary pulmonary nodules. 2) List morphologic features of solitary nodules that suggest malignancy. 3) Review current recommendations for management of incidentally-detected small lung nodules. 4) Recognize common mechanisms of intrathoracic metastatic spread with focus on pulmonary metastases. 5) Familiarize with pertinent imaging features and patterns of metastatic disease on CT. 6) Illustrate how to narrow the differential diagnosis regarding the primary site of malignancy. 7) Assess utility of imaging findings for diagnosis, prognosis and directing therapy of metastatic disease. 8) Describe intrathoracic calcification by location and identify those with characteristic morphology. 9) Identify signs of malignant pleural disease on CT examinations.
**Purpose**

To develop a new interventional oncologic technique, namely 'image-guided intratumoral radiofrequency hyperthermia (RFH)-enhanced local HSV-TK/GCV-mediated suicide gene therapy of lung cancers' and investigate its associated bio-molecular mechanisms.

**Method and Materials**

Human lung cancer cells (A549) transduced with Luciferase/mCherry/lentivirus for in-vitro confirmation, and 24 nude rats with the same orthotopic lung cancers for in-vivo validation were divided into four study groups with different treatments of (i) combination therapy with intratumoral HSV-TK/GCV gene therapy followed by RFH at 41-42 °C for 30 minutes; (ii) HSV-TK/GCV gene therapy alone; (iii) RFH alone; (iv) PBS as a control. In in-vivo experiments, bioluminescence assay, confocal microscopy and flow cytometry were used to determine the viability and apoptosis of cells, while in the in-vivo experiments molecular optical/x-ray imaging was used to evaluate the changes of bioluminescent signals among different groups over 2 weeks. To investigate the potential mechanisms of apoptosis, IHC staining and WB were used for detecting the expression of Bcl-2/Bax, as well as increased expression of Bax, Caspase-3, HSP-70, IL-2 and CD94.

**Results**

Of in-vitro experiments, compared with gene therapy alone, RFH alone or PBS, combination therapy induced the lowest cell viability (P<0.01), the highest cell apoptosis (P<0.001), and a significant decrease of relative bioluminescence signal (P<0.01). Of in-vivo experiments, optical imaging detected a significantly decreased bioluminescence signal of the tumor with combination therapy (P<0.05). Regarding to the mechanisms, both WB analysis and IHC staining displayed the significantly decreased expression of Bcl-2, as well as increased expression of Bax, Caspase-3, HSP-70, IL-2 and CD94 in cancer tissues of combination therapy, compare to other control treatments.

**Conclusion**

This study validated the feasibility of image-guided interventional RFH-enhanced direct suicide gene therapy of orthotopic lung cancers, which is activated through the mechanisms of augmenting Bax/Bcl-2/caspase-3-depended apoptosis and the HSP-70/IL-2 depended immune regulation pathway.

**Clinical Relevance/Application**

This alternative technique may open new avenues for effective treatment of lung cancers via integrating image-guided interventional oncology, RF technology, and direct gene therapy.
Impact of Availability of PET-CT Imaging on Diagnostic Accuracy and Biopsy Safety of CT-Guided Percutaneous Needle Biopsy (PNB) of Suspected Lung Cancer

Wednesday, Nov. 28 3:10PM - 3:20PM Room: S404CD

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Sisa Grubnic, MD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
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Teresa Jacob, MBBS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Joanna Moser, MBChB, FRCS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Ioannis Vlahos, MRCP, FRCS, London, United Kingdom (Abstract Co-Author) Research Consultant, Siemens AG Research Consultant, General Electric Company

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PURPOSE
To determine whether the availability of PET-CT improves diagnostic yield and safety in lung cancer PNB.

METHOD AND MATERIALS
PNB diagnostic rates over 3yrs for 3 thoracic radiologists (6-17yr practice) were retrospectively reviewed. Radiologists review PET-CT, if available, prior to PNB, to target the maximum activity tissue (PET-CT-MA). The availability of PET-CT pre or post PNB was recorded, and whether PNB was ultimately taken from the PET-CT-MA (whether PET-CT pre- or post PNB). The number of needle passes, complications and biopsy results were recorded. The influence of lesion morphology on results was assessed.

RESULTS
353 PNBs were performed in 350 patients (median lesion size 30mm, 7-120mm). 178 PNB (50.4%) had PET-CT pre-PNB, in 102 (28.9%) cases PET-CT was post-PNB. In 73 (20.7%) PET-CT was never performed. Overall PNB success was 83.9% (95.8% malignant). 88.8% of 178 PNB with PET-CT pre-PNB were diagnostic, versus 78.9% of 175 PNB without PET-CT upfront (p<0.01 Fisher exact test).Correct targeting to PET-CT-MA was present in 87.1% of 278 cases with PET-CT. 88.8% of 242 PNB targeting the PET-CT-MA were successful, but only 52.8% of 36 PNB not targeting PET-CT-MA (p<0.0001). PET-CT pre-PNB had higher rates of PET-CT-MA targeting compared to PET-CT post PNB (91.0% v 80.0%, p=0.01). More patients with PET-CT pre-PNB (n=162) had diagnostic PNB than patients with PET-CT pre-PNB (n=16) but incorrect localization (90.1% v 75%). Similarly, more patients with no PET-CT pre-PNB (n=80) but ultimately correct localization had successful PNB compared to patients with no PET-CT pre-PNB (n=20) and ultimately incorrect localization (86.3% v 35%, p<0.0001). Patients with a PET-CT pre-PNB underwent fewer PNB passes (mean 2.6 v 3.1, p=0.0001 Mann Whitney U). Serious complications were less common in PET-CT pre-PNB group (4.5% v 10.9%, p<0.05). Pre-PNB PET-CT performance improvement applied to all 3 radiologists and was greatest for masses and infiltrative abnormalities.

CONCLUSION
PNB localisation to the PET-CT-MA is associated with higher diagnostic biopsy rates and appears to account for improved performance, less needle passes and complications when available pre-biopsy.

CLINICAL RELEVANCE/APPLICATION
Prospective studies are required to confirm the results that suggest PET-CT should be available prior to biopsy particularly for larger masses or infiltrative lesions.

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

Diagnostic Success and Complication Rate of Ultrasound-Guided Percutaneous Needle Biopsy of Thoracic Lesions: Study of 147 Cases

Wednesday, Nov. 28 3:20PM - 3:30PM Room: S404CD

Participants
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PURPOSE
The goal of this study was to assess the diagnostic yield and safety profile of US-guided biopsy in the diagnosis of thoracic lesions, including lesions located in the chest wall, mediastinal and lung parenchyma.

METHOD AND MATERIALS
A total of 147 US-guided percutaneous needle biopsies of thoracic lesions performed in 146 consecutive patients (66±7y, 83M, 63F)
were analyzed, including lesions originating from the lung (67/147), chest wall (54/147), mediastinum (14/147) and pleura (12/147), obtained with FNA and/or CNB (FNA/CNB). Lesions varied in size from 1.5cm to 16cm. The overall diagnostic yield and complication rate of US-guided biopsy as well as the influence of lesion location and size, biopsy technique (FNA or CNB) and number of specimens on diagnostic yield and complication were calculated. Fisher's exact test, Chi-square test and logistic regression were used for statistical analysis. Results with p<0.05 were considered to be statistically significant and yield was summarized as proportion with 95% CI.

RESULTS

The overall diagnostic yield of US-guided needle biopsy was 88%. Biopsy of lesions located in the chest wall were diagnostic in 91% of cases, compared to 88% for lung lesions and 75% for pleural lesions and 93% for mediastinal lesions, although this was not statistically significant (p = 0.45). The diagnostic yield of FNA was similar to that of CNB (89% and 86% respectively) and the number of specimens obtained for either FNA or CNB did not affect yield ( p = 0.10). Complications occurred in 4/147(3%) cases, including pneumothorax in two and mild hemoptysis in one patient. In all cases patients were treated conservatively with no cases requiring intervention. Complications were not statistically associated with any of the covariates analyzed.

CONCLUSION

US-guided biopsy has high yield for the diagnosis of thoracic lesions, including lesions located in the mediastinum and lung parenchyma. Tissue diagnosis sufficient to direct specific management is often obtained. The safety profile of US-guided thoracic biopsy is excellent with very low complication rates.

CLINICAL RELEVANCE/APPLICATION

Imaging-guided percutaneous biopsy is a safe minimally invasive technique used for the diagnosis of thoracic lesions and usually considered the initial modality to obtain tissue diagnosis.

SSM05-04 Artificial Intelligence Based Aortic Diameter Quantification on Routine Unenhanced Chest CT

Wednesday, Nov. 28 3:30PM - 3:40PM Room: S404CD

Awards

Student Travel Stipend Award

Participants

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PURPOSE

To validate a supervised machine learning algorithm to quantify thoracic aortic diameters on non-ECG synchronized, non-contrast material enhanced chest CT.

METHOD AND MATERIALS

A novel deep learning based radiology assistant was applied to a training dataset of manually annotated chest CTs. Aortic measurements were made by a single observer off of volumetric datasets utilizing double-oblique short axis measurements at 7 levels, as defined by the American Heart Association (sinuses of Valsalva, sino-tubular junction, mid ascending aorta, proximal aortic arch, mid aortic arch, proximal descending thoracic aorta, mid descending aorta). A deep convolutional image-to-image learning model was used to learn the mapping between the input CT volume and the ground truth aorta mask. The algorithm was then applied to a test set of 72 cases, and aortic diameters between manual measurements and the machine learning algorithm were compared.

RESULTS

The overall correlation between manual and machine learning measurements was r=0.86. The best correlation between manual and machine learning measurements was in the mid descending aorta (r=0.875). The model predictions resulted in an area under the curve of 0.877 when applying a threshold of 38 mm to detect an abnormally enlarged mid ascending aorta, with peak performance of the model set at cutoff 39 mm (indicating a small bias in the model) and resulting in sensitivity and specificity of 77% and 89%, respectively.

CONCLUSION

A machine learning algorithm may be able to automatically provide reliable quantitative measures of thoracic aortic diameters and flag abnormal values.

CLINICAL RELEVANCE/APPLICATION

Automated aortic measurements could enrich radiology reports for epidemiologic studies, save time for the interpreting clinician, and ensure that abnormally dilated aortas are not missed.
Volume-Helical-Shuttle Mode with Low Contrast Dose and Low Tube Voltage in CT Pulmonary Angiography for Critically Ill Patients

Wednesday, Nov. 28 3:40PM - 3:50PM Room: S404CD

Participants
Xiaoxia Chen, MMed, Xianyang City, China (Presenter) Nothing to Disclose
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PURPOSE
To explore the value of using volume-helical-shuttle (VHS) mode with low contrast dose and low kVp in CT pulmonary artery (CTPA) imaging for critically ill patients.

METHOD AND MATERIALS
38 critically ill patients for CTPA were in the study group (Group A), and other 38 cases of conventional CTPA served as the control group (Group B). Group A used the VHS mode: tube voltage 80kVp, smart mA, noise index (NI) 25HU, pitch 1.375:1, rotation speed 0.5s for 4 passes with scan started 6s after the contrast injection. Contrast dose of 25mL (350mgI/ml) at 4mL/s flow rate was used. Images were reconstructed using 60%ASiR and the best images were selected from the 4 passes for analysis. Group B used tube voltage 120kVp, smart mA for NI of 12HU, pitch 1.375:1, rotating speed 0.8s and contrast dose of 60ml, and images were reconstructed with 40%ASiR. The CT values and SD values of vessels and the vertical spinal muscles were measured to calculate SNR and CNR for vessels. Artifacts near superior vena cava was graded with 5 being the worst. The attenuation difference between the right inferior pulmonary artery and right inferior pulmonary vein was calculated. Two experienced physicians also evaluated image quality double blindly using a 5-point scoring system. Measurements in both groups were statistically compared.

RESULTS
The total radiation dose in VHS mode (Group A) was the same as the conventional CTPA (P>0.05), but the contrast dose in Group A was reduced by 58% compared with Group B. The target vessel CT and SD values in Group A were both higher than group B (P<0.05), resulting in similar SNR and CNR values in both groups (P>0.05), except that the CNR values of MPA and RPA in group B were higher (P<0.05); There was no difference in the subjective score of image quality between the two groups (P>0.05). However, Group A was better in both the attenuation difference and superior vena cava artifacts (P<0.05).

CONCLUSION
CTPA using VHS mode at low kVp works for critically ill patients who were unable to cooperate. Compared with the conventional CTPA, the proposed method provides more satisfactory image results with the same total radiation dose and 58% contrast dose reduction.

CLINICAL RELEVANCE/APPLICATION
For critically ill patients, this method can reduce contrast dose, make multi-phase diagnosis, overcome difficulties that patients cannot cooperate well and ensure the success rate of examination.

Real-Time Patient Specific Scan Initiation for Pulmonary Embolism CTA: Impact on Image Quality

Wednesday, Nov. 28 3:50PM - 4:00PM Room: S404CD

Participants
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Daniel Boll, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Real-time modulation of scan initiation based on patient specific hemodynamics may allow for optimal timing of contrast enhancement in the pulmonary arteries in evaluation of pulmonary embolism (PE), reducing the number of non-diagnostic scans. The purpose of this study is to assess image quality for PE chest CTA using a modulated scan initiation delay based on patient specific hemodynamics.

METHOD AND MATERIALS
This was a HIPAA compliant, IRB approved quality improvement project. Fluoroscopic administration of contrast was used for all PE chest CTA exams. A new modulated scan initiation delay software was evaluated in 30 patients (cohort 1) scanned on a dual-source 192 detector CT (Siemens FORCE, Forchheim, Germany) from 01/2018-04/2018. 30 patients (cohort 2, matched to cohort 1 for BMI and age) with exams performed using a fixed scan initiation delay of 5 seconds (sec) were identified from 10/2016-12/2017. Subjective image quality was graded on a 4-point Likert-scale (1=excellent, 2=good, 3=fair and 4=inadequate). Objective image quality was determined by measuring the Hounsfield (HU) values in the main pulmonary artery, the bilateral lower lobe segmental and subsegmental arteries (150 arterial segments/cohort). HU values and standard deviations were compared for both cohorts.
RESULTS

Average patient age was 54.5 vs 54.3 years for cohorts 1 and 2 respectively. Average BMI was 32.9 kg/m\(^2\) for both cohorts. There was a statistically significant difference in scan initiation delay of 11±3.6 sec (range 7.8 to 27.8 sec) for cohort 1 vs the set delay of 5 sec for cohort 2 (P<0.01). Subjective image quality for cohort 1 was graded as excellent or good in 22 patients, fair in 5 and inadequate in 3 patients; for cohort 2 it was graded as excellent or good in 20 patients, fair in 4 and inadequate in 6 patients. Average HU values were higher for cohort 1 vs cohort 2 in segmental (382 vs 349 HU right/387 vs 359 HU left) and subsegmental arteries (371 vs 327 HU right/382 vs 330 HU left). A total of 20/150 segments in cohort 1 and 31/150 segments in cohort 2 were non-diagnostic (HU<250; 7.4\% reduction).

CONCLUSION

Real time, patient specific modulated scan initiation delay achieved higher image quality than a set delay for PE chest CTA.

CLINICAL RELEVANCE/APPLICATION

A real-time patient specific scan initiation can improve subjective image quality for PE chest CTA exams and reduce the total number of non-diagnostic pulmonary artery segments.
SSM06

Chest (Diffuse Lung Disease)

Wednesday, Nov. 28 3:00PM - 4:00PM Room: S402AB

CH CT

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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John P. Lichtenberger III, MD, Bethesda, MD (Moderator) Nothing to Disclose

Sub-Events

SSM06-01 Imaging Manifestations of IgG4-Related Disease in the Thorax: Association Between CT Findings and IgG4 Antibody Levels

Wednesday, Nov. 28 3:00PM - 3:10PM Room: S402AB

Awards
Student Travel Stipend Award

Participants
Dania Daye, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose
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PURPOSE

IgG4-related disease (RD) is an immune-mediated fibro-inflammatory disease that can affect the respiratory system. The goal of this study is to investigate the association between thoracic imaging manifestations of IgG4-RD, IgG4 antibody levels and pulmonary symptoms.

METHOD AND MATERIALS

In this IRB-approved retrospective study, 62 patients with a pathology-proven diagnosis of IgG4-RD and thoracic CT imaging were identified. Images were reviewed by two thoracic radiologists. IgG4 antibody levels, pulmonary symptoms and patient demographics were collected. Wilcoxon rank-sum test was used to assess for differences of the mean IgG4 levels between patients with and without thoracic imaging manifestations of disease. Fischer's exact test was performed to assess for independent association between IgG4 levels and the presence of imaging findings. Spearman correlation analysis was used to assess the correlation between the number of imaging findings and IgG4 levels. Univariate logistic regression analysis was performed to assess for independent contribution of IgG4 levels and pulmonary symptoms in predicting the presence of imaging manifestation on CT.

RESULTS

Of the 62 patients enrolled, 36 patients (58%) had imaging findings attributable to IgG4-RD. Patients with imaging findings had significantly higher IgG4 antibody levels (897±218 mg/dL vs. 87±17 mg/dL in those without imaging findings) (p<0.01). Airway involvement was a common imaging finding, present in 19/36 (52.8%) patients. Patients with bronchial wall thickening (p<0.01), mosaic lung attenuation (p=0.01), and saber sheath trachea (p=0.03) had significantly higher serum IgG4 levels compared to those without airway involvement. IgG4 levels and pulmonary symptoms were independent predictors of presence of thoracic imaging manifestations on regression analysis (p=0.02 and 0.01 respectively). Overall, there was a positive correlation between the number of thoracic manifestations on CT and serum IgG4 levels (r=0.60, P<0.01).

CONCLUSION

Airway involvement is a common manifestation of IgG4-RD. High IgG4 levels and pulmonary symptoms are independently associated with presence of findings on chest CT in patients with IgG4-RD.

CLINICAL RELEVANCE/APPLICATION

Elevated IgG4 antibody levels and the presence of pulmonary symptoms should prompt thoracic imaging to identify lung involvement and direct management decisions in patients with IgG4-RD.

Eric P. Wilson, MD, St. Louis, MO (Moderator) Nothing to Disclose

Participants
Jonathan H. Chung, MD, Chicago, IL (Moderator) Royalties, Reed Elsevier; Consultant, Boehringer Ingelheim GmbH; Consultant, F. Hoffmann-La Roche Ltd; Consultant, Applied Clinical Intelligence LLC; Consultant, Veracyte, Inc; Speakers Bureau, Boehringer Ingelheim GmbH; Speakers Bureau, F. Hoffmann-La Roche Ltd
John P. Lichtenberger III, MD, Bethesda, MD (Moderator) Nothing to Disclose

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PURPOSE

IgG4-related disease (RD) is an immune-mediated fibro-inflammatory disease that can affect the respiratory system. The goal of this study is to investigate the association between thoracic imaging manifestations of IgG4-RD, IgG4 antibody levels and pulmonary symptoms.

METHOD AND MATERIALS

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CONCLUSION

Airway involvement is a common manifestation of IgG4-RD. High IgG4 levels and pulmonary symptoms are independently associated with presence of findings on chest CT in patients with IgG4-RD.

CLINICAL RELEVANCE/APPLICATION

Elevated IgG4 antibody levels and the presence of pulmonary symptoms should prompt thoracic imaging to identify lung involvement and direct management decisions in patients with IgG4-RD.
Chest CT Analysis for Prediction of Treatment Response in Organizing Pneumonia: A 20-year Retrospective Cohort Study

Participants
Younghoon Cho, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
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Se Jin Jang, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the CT imaging features associated with poor clinical outcome after steroid treatment (Tx) in patients diagnosed with organizing pneumonia (OP).

METHOD AND MATERIALS
The study retrospectively enrolled 166 patients (M:F=55:111; mean age, 57.2; mean FVC, 65.9; mean DLco, 58.5) with the pathologically proven OP, which included 131 cases of cryptogenic OP (COP) and 35 cases of connective tissue disease-related OP (CTD). Baseline chest CTs prior to Tx were semi-quantitatively analyzed by two thoracic radiologists in consensus. Lesion extent (consolidation, GGO, reticulation, and total), dominant lesion pattern, dominant distribution, and presence of bronchiectasis (BE), lymph nodes, pleural or pericardial effusions, and reverse halo were evaluated. Uni- and multivariate logistic regression analyses were performed to identify variables associated with poor clinical outcomes including failure to achieve complete response (non-CR) and relapse after Tx.

RESULTS
CR was achieved in 40 (24%) patients and relapse was detected in 53 (31%) patients. While BE was detected in 30% of patients with CR, 65% of patients with non-CR were found to have BE on baseline chest CT. Average extent of consolidation for CR and non-CR group was 14.1% and 15.2%, respectively. Presence of BE (hazard ratio (HR), 4.38) and extent of consolidation greater than 10% of the lung (con>10%) (HR, 2.46) were significantly associated with higher non-CR rate (all, p < 0.01). CTD-OP was also found to have higher non-CR rate (HR, 4.19) than COP. On multivariate logistic regression analysis adjusted for age and sex, BE, con>10%, and CTD-OP all remained as significant predictors. For the prediction of relapse, significant associations were found with con>10% (HR, 2.66), total extent > 25% (HR, 2.77), and CTD-OP (HR, 6.79). After adjusted for age and sex, con>10 % and CTD-OP were found be significant predictors of relapse.

CONCLUSION
In patients diagnosed with OP, patients with BE and greater extent of consolidation on baseline chest CT were less likely to achieve CR, and the latter was also associated with higher rate of relapse after treatment. Additionally, CTD-OP was found to have worse treatment outcome than COP.

CLINICAL RELEVANCE/APPLICATION
Patients with underlying CTD, bronchiectasis, and greater extent of consolidation at the time of diagnosis were found to have worse treatment outcome in OP, and therefore should be monitored with extra vigilance.

Identification of CT Patterns for Disease Progression in CTs of Patients with Idiopathic Pulmonary Fibrosis - An Unsupervised Machine-Learning Approach

Participants
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Markus Holzer, Vienna, Austria (Abstract Co-Author) Founder, contextflow GmbH
Georg Langs, Vienna, Austria (Presenter) Nothing to Disclose

PURPOSE
To identify CT patterns which can be used as markers of disease progression in patients with idiopathic pulmonary fibrosis (IPF) using an unsupervised machine-learning approach.

METHOD AND MATERIALS
695 CT scans from 106 IPF patients (1-4 per patient) were investigated in the study. All CT studies were automatically segmented into super-voxels and gray-level co-occurrence features at the centroid positions were extracted. Twenty clusters of these super-voxels proved to be stable across the population in the feature space. The volume of each cluster relative to the entire lung was used as the signature of a lung. To identify prognostic markers in these signatures, we trained a random-forest classifier to predict for any pair of scans for one patient (scans A and B) if A was acquired prior to B or vice versa (overall 230 pairs). The classifier determined which features were most informative regarding the classification. To determine whether the signature was predictive and stable, a four-fold cross-validation was performed on the data set. The classifier was trained on 3/4 of the patients, and predicted an A/B sequence on the remaining 1/4 of these patients. To study the distribution of predictive information in the lung, we split the volume into upper-, middle-, and lower third, and performed the evaluation for each of them individually.
RESULTS
The random forest identified four distinct clusters as predictive for the temporal course. In the four-fold cross-validation experiment, using all lung data, the classifier correctly determined the sequence of scans for 80.35% of the cases. Using only cluster information in one of three parts of the lung reduces the accuracy, but reveals that the middle segment results in highest accuracy (76.52%) compared to upper (73.04%) and lower (72.61%) segments. Three clusters where among the top four most predictive clusters in all folds, and one cluster was in the top four for three of four folds.

CONCLUSION
The described approach identified four patterns that were markers of disease progression in lung CT data of IPF patients. The information contributed by individual clusters differs depending on their location in the lung.

CLINICAL RELEVANCE/APPLICATION
Data-driven identification of imaging markers enables the exploitation of complex patterns for the detection and quantification of progression.

SSM06-04 Interstitial Lung Abnormalities in Stage IV Non-Small Cell Lung Cancer Patients: A Validation Study for the Association with Poor Clinical Outcome

Wednesday, Nov. 28 3:30PM - 3:40PM Room: S402AB

RESULTS
The random forest identified four distinct clusters as predictive for the temporal course. In the four-fold cross-validation experiment, using all lung data, the classifier correctly determined the sequence of scans for 80.35% of the cases. Using only cluster information in one of three parts of the lung reduces the accuracy, but reveals that the middle segment results in highest accuracy (76.52%) compared to upper (73.04%) and lower (72.61%) segments. Three clusters where among the top four most predictive clusters in all folds, and one cluster was in the top four for three of four folds.

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CLINICAL RELEVANCE/APPLICATION
Data-driven identification of imaging markers enables the exploitation of complex patterns for the detection and quantification of progression.

SSM06-04 Interstitial Lung Abnormalities in Stage IV Non-Small Cell Lung Cancer Patients: A Validation Study for the Association with Poor Clinical Outcome

Wednesday, Nov. 28 3:30PM - 3:40PM Room: S402AB

RESULTS
The presence of interstitial lung abnormalities (ILA) at diagnosis of stage IV non-small cell lung cancer (NSCLC) patients have previously shown to be associated with shorter survival. The present study aimed to validate the association in a larger cohort of treatment-naïve stage IV NSCLC patients.

METHOD AND MATERIALS
This study included 484 patients (205 males and 279 females, median age: 62) with stage IV NSCLC. ILA was scored on the baseline chest CT scans at diagnosis prior to therapy using a 3-point scale (0=no ILA, 1=equivocal for ILA, 2=ILA) using a sequential reading method by 3 readers as published previously. Clinical characteristics and overall survival (OS) were compared in patients with ILA (score 2) vs. those without ILA (score 0 or 1).

RESULTS
ILA was present (score 2) on baseline CT in 19 of the 484 patients (3.9%, 95%CI: 2.4 - 6.1 %). Patients with baseline ILA were older (median age: 69 vs. 62 years, Wilcoxon p=0.0008) and were more commonly male (68.4% (13/19) vs. 41.3% (192/465); Fisher p=0.03) compared to those without ILA. Other variables including race, smoking history, and histology were not significantly associated with baseline ILA. Patients with baseline ILA had significantly shorter overall survival compared to those without (median OS: 9.95 months [95%CI: 5.88-15.5] vs. 16.95 months [95%CI: 14.65-18.7]; Log-rank p=0.0002). In multivariable analyses, baseline ILA remained significant as a marker for shorter overall survival (HR=2.09; Cox p=0.004), after adjusting for age (>70 years using the 75th percentile; HR=1.48; Cox p=0.001), male gender (HR= 1.22; Cox p=0.055) and smoking (never vs. current/former smoker; HR=0.79; Cox p=0.051).

CONCLUSION
The presence of ILA at diagnosis of stage IV NSCLC was significantly associated with shorter survival, validating ILA as an independent marker for poor outcome.

CLINICAL RELEVANCE/APPLICATION
Recognition of ILA on chest CT at diagnosis of stage IV NSCLC is important, because ILA can serve as a marker for shorter survival and may contribute to patient monitoring and management.

SSM06-05 Juxta-Pleural and Acutely-Folded Bronchi: Differential CT Findings of IPF without Evidence Honeycombing From NSIP

Wednesday, Nov. 28 3:40PM - 3:50PM Room: S402AB

RESULTS
The random forest identified four distinct clusters as predictive for the temporal course. In the four-fold cross-validation experiment, using all lung data, the classifier correctly determined the sequence of scans for 80.35% of the cases. Using only cluster information in one of three parts of the lung reduces the accuracy, but reveals that the middle segment results in highest accuracy (76.52%) compared to upper (73.04%) and lower (72.61%) segments. Three clusters where among the top four most predictive clusters in all folds, and one cluster was in the top four for three of four folds.

CONCLUSION
The described approach identified four patterns that were markers of disease progression in lung CT data of IPF patients. The information contributed by individual clusters differs depending on their location in the lung.

CLINICAL RELEVANCE/APPLICATION
Data-driven identification of imaging markers enables the exploitation of complex patterns for the detection and quantification of progression.

SSM06-04 Interstitial Lung Abnormalities in Stage IV Non-Small Cell Lung Cancer Patients: A Validation Study for the Association with Poor Clinical Outcome

Wednesday, Nov. 28 3:30PM - 3:40PM Room: S402AB

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The presence of interstitial lung abnormalities (ILA) at diagnosis of stage IV non-small cell lung cancer (NSCLC) patients have previously shown to be associated with shorter survival. The present study aimed to validate the association in a larger cohort of treatment-naïve stage IV NSCLC patients.

METHOD AND MATERIALS
This study included 484 patients (205 males and 279 females, median age: 62) with stage IV NSCLC. ILA was scored on the baseline chest CT scans at diagnosis prior to therapy using a 3-point scale (0=no ILA, 1=equivocal for ILA, 2=ILA) using a sequential reading method by 3 readers as published previously. Clinical characteristics and overall survival (OS) were compared in patients with ILA (score 2) vs. those without ILA (score 0 or 1).

RESULTS
ILA was present (score 2) on baseline CT in 19 of the 484 patients (3.9%, 95%CI: 2.4 - 6.1 %). Patients with baseline ILA were older (median age: 69 vs. 62 years, Wilcoxon p=0.0008) and were more commonly male (68.4% (13/19) vs. 41.3% (192/465); Fisher p=0.03) compared to those without ILA. Other variables including race, smoking history, and histology were not significantly associated with baseline ILA. Patients with baseline ILA had significantly shorter overall survival compared to those without (median OS: 9.95 months [95%CI: 5.88-15.5] vs. 16.95 months [95%CI: 14.65-18.7]; Log-rank p=0.0002). In multivariable analyses, baseline ILA remained significant as a marker for shorter overall survival (HR=2.09; Cox p=0.004), after adjusting for age (>70 years using the 75th percentile; HR=1.48; Cox p=0.001), male gender (HR= 1.22; Cox p=0.055) and smoking (never vs. current/former smoker; HR=0.79; Cox p=0.051).

CONCLUSION
The presence of ILA at diagnosis of stage IV NSCLC was significantly associated with shorter survival, validating ILA as an independent marker for poor outcome.

CLINICAL RELEVANCE/APPLICATION
Recognition of ILA on chest CT at diagnosis of stage IV NSCLC is important, because ILA can serve as a marker for shorter survival and may contribute to patient monitoring and management.

SSM06-05 Juxta-Pleural and Acutely-Folded Bronchi: Differential CT Findings of IPF without Evidence Honeycombing From NSIP

Wednesday, Nov. 28 3:40PM - 3:50PM Room: S402AB

RESULTS
The random forest identified four distinct clusters as predictive for the temporal course. In the four-fold cross-validation experiment, using all lung data, the classifier correctly determined the sequence of scans for 80.35% of the cases. Using only cluster information in one of three parts of the lung reduces the accuracy, but reveals that the middle segment results in highest accuracy (76.52%) compared to upper (73.04%) and lower (72.61%) segments. Three clusters where among the top four most predictive clusters in all folds, and one cluster was in the top four for three of four folds.

CONCLUSION
The described approach identified four patterns that were markers of disease progression in lung CT data of IPF patients. The information contributed by individual clusters differs depending on their location in the lung.

CLINICAL RELEVANCE/APPLICATION
Data-driven identification of imaging markers enables the exploitation of complex patterns for the detection and quantification of progression.
Hyun-Ju Lee, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Gong Yong Jin, MD, PhD, Jeonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kwang Nam Jin, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ki Yeol Lee, MD, PhD, Ansan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kum Ju Chae, MD, Jeonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

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PURPOSE

To evaluate juxta-pleural and acutely-folded bronchi for the differentiation of IPF patients without honeycombng from idiopathic NSIP.

METHOD AND MATERIALS

The derivation cohort consisted of 80 consecutive patients (41 IPF and 39 NSIP: 17 probable, 10 indeterminate, 53 non-IPF CT patterns) who met following criteria in a single hospital: (a) multidisciplinary diagnosis of IPF or idiopathic NSIP with surgical biopsy from 2005 to 2017, (b) diagnostic thin-section chest CT, and (c) lack of honeycombng in case of IPF. For validation, 22 patients (14 IPF and 8 NSIP: 4 probable, 11 indeterminate, 7 non-IPF CT patterns) were included from another institution. Two radiologists for derivation cohort independently assessed the presence of juxta-pleural and acutely-folded bronchi on axial, coronal, sagittal minimum intensity projection (MinIP) images (20mm overlap, 5mm increment; MEDIP software, MEDICALIP Co., Ltd. Seoul, South Korea). Juxta-pleural bronchus was defined as bronchiectasis attached perpendicular to the pleura 1.5cm or longer in length. Acutely-folded bronchus was defined if a single bronchus folded abruptly over 90 degrees and if bronchus branched at an angle of 135 degrees or larger. Logistic regression analysis was used to identify the association of the MinIP findings with IPF. For validation, we assessed the diagnostic accuracy and interobserver agreement of 4 radiologists blinded to any clinical information using a proportion of correct diagnosis of IPF and NSIP and ROC curve before and after reviewing MinIP images.

RESULTS

Non-juxta-pleural and juxta-pleural acutely-folded bronchi (OR, 3.5 95%CI, 1.37-8.66; p=.008 and OR, 6.22, 95%CI, 1.62-23.84; p=.008, respectively), and co-existence of non-juxta-pleural acutely-folded bronchus and juxta-pleural bronchus in same patient (OR, 5.67, 95%CI, 2.03-15.85; p=.001) were significant imaging features for IPF. After reviewing MinIP images, the readers’ area under the curve mildly improved from 0.496-0.808 to 0.554-0.808 with increased proportion of correct diagnosis from 40.9-54.5% to 50.0-77.3%. Mean interobserver kappa values for juxta-pleural and acutely-folded bronchi were 0.373 and 0.475.

CONCLUSION

Juxta-pleural and acutely-folded bronchi were differential CT findings for IPF without honeycombng.

CLINICAL RELEVANCE/APPLICATION

Analysis of bronchial trajectory using MinIP images could increase an imaging confidence of IPF without honeycombng.

SSM06-06 Fibrotic Lung Disease on CT Predicts Adverse Outcomes in Patients Undergoing Transcatheter Aortic Valve Replacement

Wednesday, Nov. 28 3:50PM - 4:00PM Room: S402AB

Participants
Cheng Ting Lin, MD, Baltimore, MD (Presenter) Nothing to Disclose
Matthew Czamy, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Amira F. Hussien, MBChB, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Rani K. Hasan, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Elliot K. Fishman, MD, Baltimore, MD (Abstract Co-Author) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc
Jon Resar, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Stefan L. Zimmerman, MD, Ellicott City, MD (Abstract Co-Author) Project consultant, Siemens Healthcare; Research grant, American Heart Association;

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PURPOSE

To evaluate the relationship between CT findings of diffuse lung disease (fibrosis and emphysema) and outcomes in patients who underwent transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS

Retrospective review of pre-operative CT scans obtained from 507 patients who underwent TAVR during 2012-2017. Lung images were divided into ten contiguous axial sections spaced equally apart. The extent of fibrotic lung disease - characterized by reticular abnormality and/or honeycombng - was graded by a thoracic radiologist using a five-point scale based on the percent of lung parenchyma involved. A similar approach was used to grade the extent of emphysema. Scores from all the axial slices for each patient were summed to determine fibrosis and emphysema scores. Demographic and clinical data, including pulmonary function tests, were extracted from institutional data submitted to the national Transcatheter Valve Therapy (TVT) Registry. Outcome analyses were performed according to the Kaplan-Meier method using a combined endpoint of death and readmission as the primary outcome.

RESULTS

Complete clinical parameters and outcome data were available in 335 patients. Fibrosis was present in 91 out of 507 (18%) patients with fibrosis scores ranging from 1-34. Emphysema was seen in 33 out of 507 (6.5%) patients. Fibrosis scores between patients with and without chronic lung disease - defined according to TVT registry as FEV1 below 60% - were not statistically different (p=0.59). The presence of fibrotic lung disease on CT was significantly associated with the primary outcome (HR 1.62; 95% CI
1.09-2.40; p=0.016) after adjustment for pre-specified covariates (including FEV1, smoking status, age, and LVEF). Emphysema scores were not associated with the primary outcome. FEV1 was also an independent predictor of worse outcome (HR 0.99; 95% CI 0.984-0.998; p<0.01).

CONCLUSION
The presence of fibrotic lung disease on pre-TAVR CT scans was a significant predictor of adverse events, independent of known risk factors for mortality. Radiologists should be aware that these pulmonary findings could help identify patients who are at higher risk among those referred for TAVR.

CLINICAL RELEVANCE/APPLICATION
Visual assessment of reticular abnormality and honeycombing on pre-operative CT scans can predict adverse events in patients undergoing transcatheter aortic valve replacement.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Stefan L. Zimmerman, MD - 2012 Honored EducatorStefan L. Zimmerman, MD - 2015 Honored EducatorElliot K. Fishman, MD - 2012 Honored EducatorElliot K. Fishman, MD - 2014 Honored EducatorElliot K. Fishman, MD - 2016 Honored EducatorElliot K. Fishman, MD - 2018 Honored Educator
Case-based Review of Thoracic Radiology (Interactive Session)

Wednesday, Nov. 28 3:30PM - 5:00PM Room: S406A

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

Participants
Diana Litmanovich, MD, Haifa, Israel (Director) Nothing to Disclose

Sub-Events

MSCT42A  Thoracic Emergencies

Participants
Sanjeev Bhalla, MD, Saint Louis, MO (Presenter) Nothing to Disclose

For information about this presentation, contact:
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LEARNING OBJECTIVES
1) To use cases to highlight an approach to embolic disease. 2) To use cases to discuss the acute aortic syndromes. 3) To review other conditions which may manifest with acute chest pain.

Honored Educators

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

Sanjeev Bhalla, MD - 2014 Honored Educator
Sanjeev Bhalla, MD - 2016 Honored Educator
Sanjeev Bhalla, MD - 2017 Honored Educator
Sanjeev Bhalla, MD - 2018 Honored Educator

MSCT42B  Large Airway Disorders

Participants
Phillip M. Boiselle, MD, Boca Raton, FL (Presenter) Nothing to Disclose

For information about this presentation, contact:
pboiselle@health.fau.edu

LEARNING OBJECTIVES
1) Apply a pattern-based approach to enhance accurate detection, characterization and diagnosis of a variety of benign and malignant large airway disorders. 2) Recognize normal variants which may mimic large airways diseases. 3) Understand the importance of carefully inspecting the large airways on CT scans.

Honored Educators

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

Phillip M. Boiselle, MD - 2012 Honored Educator

MSCT42C  Cystic Lung Disease

Participants
Theresa C. McLoud, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Learn to distinguish cystic lung disease from bronchiectasis and emphysema. 2) Recognize specific features of different cystic disease entities. 3) Understand the common complications, other systemic findings and prognosis of each of the entities discussed.

MSCT42D  Adult Manifestations of Congenital Lung Disease

Participants
Diane C. Strollo, MD, Gibsonia, PA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize the spectrum of congenital lung abnormalities that may manifest in adulthood. 2) Understand developmental abnormalities of tracheobronchial tree, to include anomalous branching, such as bronchial atresia, and airway malformations such as
congenital lobar emphysema and congenital pulmonary airway malformation. 3) Review etiologies of intra- and extra-lobar sequestration and partial anomalous pulmonary venous return. 4) Discuss characteristic imaging findings and clinical management.
Controversy Session: Marginally Operable Stage I Non-small Cell Lung Cancer: Cut or Shoot (Surgery vs Radiation)?

Wednesday, Nov. 28 4:30PM - 6:00PM Room: E353C

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

Participants
Candice A. Johnstone, MD, Milwaukee, WI (Moderator) Nothing to Disclose
For information about this presentation, contact: cjohnstone@mcw.edu

Sub-Events

SPSC41A Evaluation of Suspicious Lung Nodule: Can Diagnostic Imaging Confidently Diagnose Non-small Cell Lung Cancer?

Participants
Michelle S. Ginsberg, MD, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To discuss imaging features of lung cancer and ability to accurately diagnose lung cancer. 2) To describe CT features of lepidic predominant adenocarcinoma that correlate with invasiveness on pathology.

SPSC41B Case for Surgical Resection

Participants
David W. Johnstone, Milwaukee, WI (Presenter) Nothing to Disclose
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LEARNING OBJECTIVES
1) Appraise the current data supporting surgical resection for early stage non-small cell carcinoma of the lung. 2) Understand the definitions of sublobar resection and lobectomy. 3) Compare outcomes between surgical resection and radiation therapy for early stage non-small cell carcinoma. 4) Appraise ongoing clinical trials comparing radiation to surgical resection for early stage lung cancer.

SPSC41C Case of Stereotactic Body Radiotherapy

Participants
Gregory Videtic, MD, FRCPC, Cleveland, OH (Presenter) Nothing to Disclose
For information about this presentation, contact: videtig@ccf.org

LEARNING OBJECTIVES
1) To discuss the approach to the radiographically suspicious lung nodule. 2) To discuss the management options including surgery and radiotherapy to address the suspicious nodule. 3) To discuss the evidence to support radiotherapy in the form of SBRT for the suspicious nodule.

ABSTRACT

TO discuss the clinically controversial question: ‘Marginally operable stage I NSCLC: cut or shoot (surgery vs. radiation)?’ A diagnostic radiologist will discuss the management approach for the radiographically suspicious lung nodule. A thoracic surgeon will discuss the role of surgery. A thoracic radiation oncologist will discuss the role for lung stereotactic body radiotherapy (SBRT).
ED003-TH

Chest Thursday Case of the Day

Thursday, Nov. 29 7:00AM - 11:59PM Room: Case of Day, Learning Center

AMA PRA Category 1 Credit ™: .50

Participants
Rakesh D. Shah, MD, Manhasset, NY (Presenter) Nothing to Disclose
Pamela J. Lombardi, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Clinton E. Jokerst, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Daniel B. Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Nikhil Goyal, MD, Staten Island, NY (Abstract Co-Author) Nothing to Disclose
Timur Kotlyar, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher Kyriakakos, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Ross P. Frederick, MD, Phoenix, AZ (Abstract Co-Author) Nothing to Disclose
Lauren K. Groner, DO, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) To analyze interesting chest cases. 2) To understand appropriate differential diagnosis. 3) To understand the clinical significance of the diagnosis presented.
Practical HRCT of the Lung (Interactive Session)
Thursday, Nov. 29 8:30AM - 10:00AM Room: N228

Participants
Daria Manos, MD, FRCPC, Halifax, NS (Moderator) Nothing to Disclose

For information about this presentation, contact:
daria.manos@nshealth.ca

LEARNING OBJECTIVES
1) Identify and distinguish common and important CT patterns of diffuse and interstitial lung disease. 2) Understand the clinical importance of HRCT pattern recognition, the overlap between patterns and the key imaging features to help avoid diagnostic error. 3) Use clinical context to tailor HRCT differential diagnosis. 4) Describe an approach to diffuse airspace disease detected on CT chest. 5) List 3 common causes of acute diffuse airspace disease. 6) List 3 common causes of chronic diffuse airspace disease. 7) Accurately identify the common and important features of cystic lung disease on HRCT. 8) Recognize distinguishing features from other mimics of cystic lung disease on HRCT. 9) Use clinical context and other ancillary findings to tailor HRCT differential diagnosis.

Sub-Events

RC601A  Approach to Nodular Patterns
Participants
Daria Manos, MD, FRCPC, Halifax, NS (Presenter) Nothing to Disclose

For information about this presentation, contact:
daria.manos@nshealth.ca

LEARNING OBJECTIVES
1) Identify and distinguish common and important CT patterns of diffuse and interstitial lung disease. 2) Understand the clinical importance of HRCT pattern recognition, the overlap between patterns and the key imaging features to help avoid diagnostic error. 3) Use clinical context to tailor HRCT differential diagnosis.

RC601B  Diffuse Airspace Disease: Practical Tips
Participants
Elsie Nguyen, MD, Toronto, ON (Presenter) Nothing to Disclose

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elsie.nguyen@uhn.ca

LEARNING OBJECTIVES
1) Describe an approach to diffuse airspace disease detected on CT chest. 2) List 3 common causes of acute diffuse airspace disease. 3) List 3 common causes of chronic diffuse airspace disease.

RC601C  Cystic Lung Disease: What Are You Missing?
Participants
Judith L. Babar, MBChB, Thriplow, United Kingdom (Presenter) Nothing to Disclose

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judith.babar@addenbrookes.nhs.uk

LEARNING OBJECTIVES
1) Accurately identify the common and important features of cystic lung disease on HRCT. 2) Recognize distinguishing features from other mimics of cystic lung disease on HRCT. 3) Use clinical context and other ancillary findings to tailor HRCT differential diagnosis.

RC601D  Fibrotic Lung Disease: Not Always UIP
Participants
Susan J. Copley, MD, FRCR, London, United Kingdom (Presenter) Nothing to Disclose

For information about this presentation, contact:
sue.copley1@nhs.net
LEARNING OBJECTIVES

1) Accurately identify the common and important features of fibrotic lung disease on HRCT. 2) Describe the common and important HRCT features of UIP. 3) Recognize distinguishing features of other patterns of fibrotic lung disease on HRCT.
Diseases of the Thoraco-abdominal Aorta

Thursday, Nov. 29 8:30AM - 10:00AM Room: S503AB

For information about this presentation, contact:
kate.hanneman@uhn.ca

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

RC612A Imaging of Aortic Dissection

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

For information about this presentation, contact:
kate.hanneman@uhn.ca

LEARNING OBJECTIVES

1) Discuss the epidemiology of aortic dissections. 2) Review multi-modality imaging findings in patients with acute and chronic dissections.

RC612B Imaging of Aortic Aneurysm

Participants
Iain D. Kirkpatrick, MD, Winnipeg, MB (Presenter) Speaker, Siemens AG

For information about this presentation, contact:
kirkpatrick_ian@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.

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.
RC612C  Imaging of Vasculitis

Participants
Phillip M. Young, MD, Rochester, MN (Presenter) Consultant, Arterys Inc

For information about this presentation, contact:
young.phillip@mayo.edu

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.

RC612D  Aortic Repair Complications: CT Imaging Findings You Need to Know

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

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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.

Honored Educators

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SSQ02
Cardiac (Great Vessels and Cardiopulmonary Disease)
Thursday, Nov. 29 10:30AM - 12:00PM Room: S404AB

Participants
Matthew D. Cham, MD, New York, NY (Moderator) Nothing to Disclose
Seth J. Kligerman, MD, Denver, CO (Moderator) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (Moderator) Consultant, Guerbet SA Grant, Siemens AG Grant, C. R. Bard, Inc

Sub-Events
SSQ02-01 3rd Generation Dual Source CT Pulmonary Angiographic Study at Very Low Contrast Doses: A New Frontier
Thursday, Nov. 29 10:30AM - 10:40AM Room: S404AB

Participants
Nicolò Schicchi, MD, Ancona, Italy (Presenter) Nothing to Disclose
Matteo Oliva, MD, Ancona, Italy (Abstract Co-Author) Nothing to Disclose
Corrado Tagliati, Ancona, Italy (Abstract Co-Author) Nothing to Disclose
Giacomo Agliata, MD, Saint-Denis, France (Abstract Co-Author) Nothing to Disclose
Paolo Esposito Pirani, Ancona, Italy (Abstract Co-Author) Nothing to Disclose
Andrea Giovagnoni, MD, Ancona, Italy (Abstract Co-Author) Nothing to Disclose

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PURPOSE
Pulmonary Angio-CT is the first diagnostic choice for the evaluation of pulmonary embolism and usually performed with iodinated contrast media (CM) injection. The purpose of this study is to evaluate the lower amount of iodinated CM required in order to obtain a diagnostic quality pulmonary Angio-CT with the new Dual Source CT technology.

METHOD AND MATERIALS
36 patients (16 males, 20 females; mean age 40 years) were enrolled with medium-high pre-test probability of pulmonary embolism and underwent a 3rd generation Dual Source CT (Somatom Force Siemens Healthineers) scan. Three groups of 12 patients each were randomized using 400 mgI/mL iodinated CM with different doses: group A (<5 ml), group B (<10 ml) and group C (<15 ml). The Hounsfield Unit (HU) values were sampled at predefined points of the pulmonary arteries. Each exam was also assessed qualitatively with a 5-point scale.

RESULTS
HU evaluation did not show statistically significant difference between groups A and B, while they showed statistically significant difference between group C and groups A-B (Kruskal-Wallis, p=0.025). Qualitative analysis did not find statistically significant difference between groups A, B and C (Kruskal-Wallis, p=0.12).

CONCLUSION
The new 3rd Dual Source CT technology allows for an optimization of pulmonary angio-CT study in order to obtain a diagnostic quality images with low doses of iodinated CM.

CLINICAL RELEVANCE/APPLICATION
The purpose of this study is to evaluate a reduced contrast media administration in patients with suspected pulmonary embolism in an emergency setting, especially in patients with higher risk of contrast-induced nephropathy (CIN) (i.e. nephropatic or type 2 diabetic patients).

SSQ02-02 2D-PC MRI Measurement of Pulmonary Artery Blood Flow and Left Atrial Function in Smokers: A Correlational Research
Thursday, Nov. 29 10:40AM - 10:50AM Room: S404AB

Participants
Shuangchun Ma, Dalian, China (Presenter) Nothing to Disclose
Zhiyong Li, Dalian, China (Abstract Co-Author) Nothing to Disclose
Ruyi Bao, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Chen Hui, Dalian, China (Abstract Co-Author) Nothing to Disclose
Xin Li, Dalian, China (Abstract Co-Author) Nothing to Disclose
Ailian Liu, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
PURPOSE
To investigate the correlation between main pulmonary artery blood flow and left atrium functional parameters in smokers using two-dimensional phase contrast magnetic resonance imaging (2D-PCMRI).

METHOD AND MATERIALS
Twenty-eight smokers (all men, mean age: 39.8±7.0 years) were enrolled in this study. All of them underwent main pulmonary artery 2D-PC and cardiac scan at 3.0T MR from December 2017 to March 2018. Blood flow parameters include Peak Positive Velocity (PPV) (cm/s), Peak Negative Velocity (PNV) (cm/s), Average flow (AF) (ml/beat), Average Positive Flow (APF) (ml/beat), and Average Negative Flow (ANF) (ml/beat). The correlation between main pulmonary artery blood flow and left atrial functional parameters was analyzed.

RESULTS
There is a statistically correlation between pulmonary artery PPV and left atrial active ejection fraction (LAEFa) (p=0.022, r=0.431), and left atrium total ejection fraction (LAEFt) (p=0.032, r=0.406) respectively. Similarly, there is a statistically correlation between pulmonary artery AF and left atrium maximum volume (LAVi max) (p=0.048, r=0.378), LAEFa (p=0.040, r=0.391) and LAEFT (p=0.008, r=0.488) respectively. There is a statistically correlation between APF and LAVi max (p=0.039, r=0.392), LAEFT (p=0.028, r=0.415), respectively.

CONCLUSION
There is a positive correlation between the main pulmonary artery blood flow and left atrium function in smokers.

CLINICAL RELEVANCE/APPLICATION
This correlational research of pulmonary artery blood flow and left atrium function is helpful in further to understand and reveal the effect of smoking on the cardiovascular system.

Participants
Wei-Ming Huang, MD, Taipei, Taiwan (Presenter) Nothing to Disclose
Chun-Ho Yun, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose
Wen-Jui Wu, MD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose
Chung-Lieh Hung, MD,PhD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose

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PURPOSE
Dedicated descriptions of pulmonary emboli (PE) morphology, total emboli burden, and the possible impacts on hemodynamics and diagnostic biomarkers remained largely unexplored.

METHOD AND MATERIALS
We consecutively studied subjects suffered from acute PE who visited emergency department. On arrival hemodynamics, oxygenation status, and markers of Troponin-I/D-dimer were all obtained. Contrast enhanced spiral computed tomography (CT) for pulmonary vasculature and 3-dimensional (3D) measures of emboli burden were performed (IntelliSpace Portal [ISP] 9.0 Philips Medical Systems Nederland B.V.).

RESULTS
Among 116 subjects (mean age: 70.1±16.0, 64% female) with clinical information and CT-based 3D embolism quantification available, the mean total emboli size were 8.6cm³, Qanadli scores was 7.4, 4.6, and 12.1 for right, left side and total pulmonary trunk (reference range: 0-20), respectively. Both greater total emboli mass and pulmonary emboli Qanadli score were positively associated with higher Troponin I level (r=0.23 & 0.33, both p<0.05), and marginally associated with lower on arrival oxygenation saturation (SpO2) (by blood gas, r=-0.38, p=0.05). Instead, total emboli burden within lung parenchyma was strongly inversely associated with SpO2 (r=-0.48 & -0.42, both p<0.05).

CONCLUSION
Total thromboemboli burden assessed by quantitative CT-based modality served as a useful index for stressed cardiopulmonary circulation, and possibly provide insights into oxygenation/perfusion status.

CLINICAL RELEVANCE/APPLICATION
Total thromboemboli burden assessed by quantitative CT-based modality served as a useful index for stressed cardiopulmonary circulation.
Kawasaki disease causes inflammation that is inclined to cause heart complications, such as coronary artery vasculitis, myocarditis, and heart valve problems. Our study is aimed to assessment of coronary arteries in Kawasaki disease by 3D magnetic resonance imaging.

**METHOD AND MATERIALS**

The study group consisted of 16 pediatric patients aged 2 to 10 years (males, 87.5%; mean age, 4.8 year) with Kawasaki diseases from Jan. 2017 to Mar. 2018. All patients underwent three-dimensional (3D) whole-heart magnetic resonance imaging (1.5T, Philips); using two different sequences (3D TEE sequence; 3D BTEE sequence; ). Sweep time were record and the image quality was graded (from 0 to 5).

**RESULTS**

there were six patients with enlarged left and right ventricles (37.5%), three patients with enlarged whole-heart (18.75%), two patients with double superior vena cavas and enlarged left atrium and ventricle (12.5%). The scan time of 3D TEE sequence was One minute and forty seconds to two minute and thirty seconds (1min 40s to 2 min 30s), The scan time of 3D BTEE sequence was five minute and twenty seconds to six minute and thirty seconds (5 min 20s to 6 min 30s). For the grade of imaging quality, five patients were classes as 0-2 grade (31.25%), 11 patients were 3-5 grade (68.75) by the 3D TEE sequence, and six patients were 0-2 grade (37.5%), 11 patients were 3-5 grade (62.5%) by the 3D BTEE sequence.

**CONCLUSION**

3D whole-heart coronary arteries magnetic resonance imaging could obtain similar imaging quality with less scan time, it may be an excellent method to image, evaluate, diagnose, and follow-up coronary arteries lesions in pediatric patients with Kawasaki diseases.
Cardiac function and volume parameters derived from non-dedicated whole-body MRI, such as stroke volumes and biventricular end-diastolic volumes were significantly associated with lung volumes in a patient cohort without cardiovascular disease.

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

These results suggest, that MRI could be an accurate, radiation-free, and possibly one-stop-shop screening tool, with the potential for early detection of subclinical heart disease in patients with emphysema and subclinical cardiovascular dysfunction.

SSQ02-08  Double Region of Interest Timing Bolus Technique to Perform Aortic CT Angiography with 40 mL of Contrast Medium

Thursday, Nov. 29 11:40AM - 11:50AM Room: S404AB

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PURPOSE

We developed a novel method to track the peak of the injected contrast medium by placing two regions of interest (ROI) at the timing bolus image. The purpose of this study was to compare the enhancement of the aorta when CT angiography was performed with 40 mL of contrast medium using the novel double ROI timing bolus (DRTB) technique with the enhancement using the conventional method.

METHOD AND MATERIALS

We prospectively included 21 patients from February to March 2018 who underwent repeated CT angiography of the aorta. In the prior scan, a total of body weight × 1.7 mL of contrast medium was injected for 25 s, and the scan timing was determined by the bolus tracking technique. The tube potential was 120 kVp and the table speed was set as fast as possible to acquire the entire aorta. In the DRTB method, timing bolus technique was performed using 9 mL of contrast medium at the level of the aortic root. An ROI was placed at the ascending and descending aorta, respectively. Time density curves of the two ROIs were drawn and the difference of the peak time (Tdiff) was recorded. The blood flow of the aorta was calculated by dividing the length of the thoracic aorta by Tdiff. The main scan was performed with a tube potential of 100 kVp. We injected 40 mL of contrast medium for 9 s and adjusted the table speed to follow the peak of the injected contrast bolus. We evaluated the attenuation of the aorta at the level of aortic root, arch, descending, celiac trunk, and iliac bifurcation.

RESULTS

The injected contrast medium during the main scan significantly reduced from 87 ± 11 to 40 mL (p <0.001). The attenuation of the aorta at the level of the aortic root, arch, descending, celiac trunk, and iliac bifurcation using the DRTB method were 408 ± 125, 425 ± 99, 421 ± 96, 414 ± 96, 417 ± 101 HU, respectively, which were all significantly higher than using the conventional method (341 ± 72, 370 ± 61, 362 ± 59, 349 ± 96, 362 ± 70 HU, respectively, all p <0.05).

CONCLUSION

DRTB method could dramatically reduce the contrast medium during aortic CT angiography while improving the enhancement than the conventional method.

CLINICAL RELEVANCE/APPLICATION

Aortic CT angiography using the DRTB method would reduce the risk of contrast induced nephropathy and also widen the indication of aortic CT to patients with chronic kidney disease.

SSQ02-09  Subclinical Changes in Cardiac Functional Parameters as Determined by Cardiovascular Magnetic Resonance (CMR) Imaging in Patients with Sleep Apnea and Snoring: Findings from UK Biobank

Thursday, Nov. 29 11:50AM - 12:00PM Room: S404AB

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Obstructive sleep apnea (OSA) is a common disorder that shows an increased risk for left ventricular (LV) and, more rarely, right ventricular (RV) dysfunction. Most studies to date have examined populations with manifest cardiovascular disease and have used echocardiography to analyze ventricular dysfunction, with little or no reference to ventricular volumes or myocardial mass. We hypothesized that there would be stepwise increase in LV mass and RV volumes from the unaffected, to the snoring and the OSA group.

We analyzed cardiac MRI data from 4493 UK Biobank participants free from cardiovascular disease. Participants were allocated into three cohorts: (i) with OSA; (ii) with self-reported snoring; and (ii) without OSA or snoring (n=38; 1919; and 2536 respectively). We determined ventricular volumes, ejection fraction and LV mass from balanced cine-SSFP sequences.

Trend analysis showed a stepwise increase for LV mass in both genders (p<0.001) and for LV and RV ejection fraction (EF) and stroke volume (SV) as well as LV end diastolic volume in males (p<0.02). There was no significant difference when comparing the OSA group to the unaffected group but we found a significant difference when comparing snoring to unaffected in LV mass of females (ß=1.45±0.55g; p=0.009) and in LVEF and RVEF as well as LVSV and RV end systolic volume of males (ß=0.80±0.28%; p=0.005, ß=1.17±0.28%; p<0.001, ß=1.68±0.76ml; p=0.027 and ß=-2.41±0.90ml; p=0.008) respectively.

Our study suggests that the transition from snoring to OSA is an evolving process which is associated with LV hypertrophy. The different results based on the gender in the pilot data point to a gender specific progression. Separate prospective studies are needed to further explore the direction of causality.

Sleep apnea and snoring lead to gender specific alterations in cardiac function which may require diversified prevention and treatment strategies.
SSQ04

**Chest (Radiomics)**

Thursday, Nov. 29 10:30AM - 12:00PM Room: E353A

- **BQ**
- **CH**
- **CT**
- **OI**

AMIA PRA Category 1 Credit™: 1.50
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FDI

Discussions may include off-label uses.

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SSQ04-01  **Nodule Malignancy Prediction: A Systematic Comparison of Deep Learning and Radiomics**

Thursday, Nov. 29 10:30AM - 10:40AM Room: E353A

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**PURPOSE**

Radiomics is a field of study that extracts features from medical images using data characterization algorithms. It has been applied to classify pulmonary nodule malignancy. Recent development in computer vision shows that deep learning is a powerful tool to extract image features. This paper systematically compares a deep learning (DL) method and previously established radiomics methods to extract features from chest CT scans to predict nodule malignancy.

**METHOD AND MATERIALS**

We collected CT scans of 463 patients from LIDC (a public dataset) and of 915 patients from a collaborating hospital. Each CT scan contained one nodule whose malignancy was pathology proven. The whole dataset was randomly separated into a training dataset (1154: 391 from LIDC) and a testing dataset (224: 72 from LIDC). Three methods were used to extract nodule features. (1) radiomics condition, all nodules were segmented first, and 1008 features were extracted from each nodule using PyRadiomics (van Griethuysen et al, 2017). PCA was applied to select 95.3%, 96.2%, 97.8%, 98.4% and 99.2% information from the original features. (2) DL condition, we used a 3D-CNN model and average pooling to extract 128 features based on the same segmented nodules. The same PCA method was applied to DL features. (3) radiomics&DL condition, we concatenated the features from both (1) and (2) after the PCA processing. In all 3 conditions, we trained a random forest classifier based on outputs from PCA to predict nodule malignancy. We replicated the experiment 10 times to average out randomness caused by random forest.

**RESULTS**

As shown in Table 1, (1) radiomics condition achieved classification AUCs between 0.840 and 0.845; (2) DL method's AUCs ranged from 0.841 to 0.858. (3) radiomics&DL condition (AUCs: 0.855 to 0.872) outperformed the above two conditions. Figure 1 shows ROC plot of the 98.4% situation in Replication 1.

**CONCLUSION**

Radiomics combined with DL consistently achieved significantly higher AUCs than the DL or radiomics method alone, and DL performed marginally better than radiomics at nodule malignancy prediction. This study suggests that features extracted by DL can to some extent complement information extracted by radiomics.

**CLINICAL RELEVANCE/APPLICATION**

This paper shows that deep learning methods could extract extra features from CT images to complement traditional radiomics methods to improve clinical evaluation of pulmonary nodule malignancy.

SSQ04-02  **A Novel Prediction Model for Pulmonary Nodule Diagnosis Combining Plasma Biomarkers, Radiomics, Conventional Imaging Features, and Clinical Data**
underwent surgery with the primary tumor having relapsed in 75 total cases. This cohort was randomly divided into a training
chart review, pre-treatment CT scans with clinical follow-up and outcome data was obtained for each patient. All patients
The single site study comprised 316 ES-NSCLC patients who had curative surgery and/or chemotherapy. Following retrospective
METHOD AND MATERIALS
which patients will benefit from adjuvant chemotherapy following curative resection.

ES-NSCLC has up to a 55% risk of recurrence following curative resection with a OS ranging between 35-50%. The ability to
PURPOSE
For both screening and incidental findings it is important but also challenging to classify pulmonary nodules as benign or malignant
at first presentation. The objective of this study is to develop a novel prediction model for lung cancer diagnosis combining plasma
biomarkers, radiomics, conventional imaging features and clinical data.

METHOD AND MATERIALS
We performed a retrospective study with 121 NSCLC patients and 117 controls. Specific tumor-derived autoantibodies were
analyzed in plasma of all patients. The nodules were contoured by a thoracic radiologist from chest CT images and texture features
were extracted using the PORTS radionics library. Another thoracic radiologist (blinded to the outcomes) evaluated semantic
features including size, shape, density, emphysema, etc. All plasma biomarker variables, texture features, clinical and semantic
features were input into a LASSO penalized logistic regression model. The most significant input variables for this regression are
then determined and used to generate a new logistic regression model. We performed 5-fold cross-validation for the model to
generate ROC curves. The AUC for these ROC curves was computed and the 95% confidence interval determined.

RESULTS
There were 11 plasma tumor biomarkers, 8 clinical and semantic features and 4 texture features selected by the LASSO penalized
logistic model. The cross-validated AUCs for the model with all 23 plasma tumor biomarkers, clinical and imaging variables was 90%
(CI:0.807-0.972), higher than the model with only clinical and imaging features with the AUC of 86%(CI:0.746-0.961).

CONCLUSION
Using a novel combination of plasma tumor biomarkers, radiomic texture features, conventional clinical and semantic features, our
model classifies nodules with a AUC of 90% after cross-validation, which is higher than the performance reported by other models.
The combination of these 4 sets of features outperforms each separate set of features in pulmonary nodule diagnosis.

CLINICAL RELEVANCE/APPLICATION
Combining plasma biomarkers, radiomics, conventional imaging features and clinical data has the potential to improve and facilitate
management of pulmonary nodules.

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educational content in their field of study. Learn how you can become an honored educator by visiting the website at:
https://www.rsna.org/Honored-Educator-Award/ Sudhakar N. Pipavath, MD - 2013 Honored EducatorSudhakar N. Pipavath, MD -
2015 Honored Educator

SSQ04-03 Combination of Intra- and Peri-Tumoral Radiomic Features on Baseline CT are Prognostic of
Recurrence and Overall Survival in Early Stage Non-Small Cell Lung Cancer (ES-NSCLC) Patients

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PURPOSE
ES-NSCLC has up to a 55% risk of recurrence following curative resection with a OS ranging between 35-50%. The ability to
predict aggressiveness and prognosticating survival of ES-NSCLC from pre-treatment CT scans can aid oncologists in identifying
which patients will benefit from adjuvant chemotherapy following curative resection.

METHOD AND MATERIALS
The single site study comprised 316 ES-NSCLC patients who had curative surgery and/or chemotherapy. Following retrospective
chart review, pre-treatment CT scans with clinical follow-up and outcome data was obtained for each patient. All patients
underwent surgery with the primary tumor having relapsed in 75 total cases. This cohort was randomly divided into a training


(n=60) and independent validation set (n=256). A total of 124 intratumoral (IT) and peritumoral (PT) radiomic textural features were extracted from every patient.

RESULTS

The top six most predictive features included a combination of two intratumoral (Gabor, Haralick) and four peritumoral (Laws-Laplace, Collage, Gabor) from an annular ring 0-12 mm outside the nodule. These features were also found to be relatively stable with an ICC of 0.8 calculated on the RIDER CT test-retest dataset. These features separated patients who recurred from those who did not (AUC=0.65; p<0.001) and also were prognostic of 5-year recurrence-free survival (RFS) (p<0.005) on the independent validation set (n=256).

CONCLUSION

We identified radiomic texture features from within and outside the lung nodule that are able to predict recurrence in early stage non-small cell lung cancer. These features were also found to be prognostic of 5-year RFS.

CLINICAL RELEVANCE/APPLICATION

ES-NSCLC patients who were predicted to recur based off diagnostic CT scans would be ideal candidates for treatment escalation including adjuvant chemotherapy following curative surgical resection.

SSQ04-04 CT-Based Quantitative Radiomic Features Predict Brain Metastasis in T1 Stage Lung Adenocarcinoma

Thursday, Nov. 29 11:00AM - 11:10AM Room: E353A

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PURPOSE

To retrospectively evaluate the use of computed-tomography (CT) based quantitative radiomic features (QRF) to predict brain metastasis (BM) in patients with T1 stage lung adenocarcinoma (LAD).

METHOD AND MATERIALS

Eighty patients with pathologically confirmed lung adenocarcinoma were collected. T1 stage was established by the 8th edition of the TNM staging system. All patients had brain MRI scans (BM+: 26; BM-: 54). In total, 1160 QRFs were calculated from the primary lung cancer tumor in each patient. Three machine-learning algorithms were applied sequentially to build the radiomic prediction model. Firstly, unsupervised hierarchical clustering was used to exclude highly correlated QRFs; secondly, the minimum Redundancy Maximum Relevance (mRMR) feature selection algorithm was employed to rank QRFs according to their relevance to BM and redundancy with other features; finally, the K-Nearest-Neighbor (k=5) classification algorithm was adopted to construct model by using the informative and non-redundant QRFs. The area under the receiver operating characteristic (ROC) curve (AUC) and the ten-fold cross-validation were employed to evaluate the prediction model. Yuden's Index for the ROC curve was calculated to determine the optimal sensitivity and specificity.

RESULTS

The radiomic prediction model achieved AUC (95% CI) of 0.879 (0.694, 0.959), and sensitivity and specificity of 0.808 and 0.815, respectively. The most significant QRFs to build the prediction model were LoGU (‘Uniformity of Laplacian of Gaussian Filter’) and MGE (‘Maximal Gabor Energy’), which were designed to characterize tumor homogeneity and boundary sharpness, respectively. We found that tumors with BM+ were of higher LoGU and MGE values than those with BM- (both p-values <0.001).

CONCLUSION

CT-based radiomic features could be used to predict brain metastasis in T1-stage LAD. For T1-stage LAD, solid tumor with sharp boundary were more prone to BM than those with ground glass opacity and unclear boundary.

CLINICAL RELEVANCE/APPLICATION

Radiomic features extracted from noninvasive and routinely acquired CT can be applied to help radiologists to predict brain metastasis in patients with T1 stage lung adenocarcinoma.

SSQ04-05 The Radiomics Prognostic Score (RadScore): The New Prognostic Imaging Biomarker After Stereotactic Body Radiation Therapy In Patients with Lung Cancer

Thursday, Nov. 29 11:10AM - 11:20AM Room: E353A

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PURPOSE
To develop the radiomics prognostic score (RadScore) for the patients with lung cancer treated with stereotactic body radiation therapy (SBRT) and to evaluate prognostic impact on progression free survival

METHOD AND MATERIALS
In this retrospective study approved by our institutional review board, we reviewed 241 patients who underwent SBRT for lung cancer between July 2006 and November 2016. After excluding patients who had no pathological diagnosis, no pretreatment computed tomography (CT) and clinical diagnosis of Stage III/IV, 43 patients were analyzed. The RadScore was developed using the linear predictor of multivariate Cox proportional hazard regression with LASSO (Least Absolute Shrinkage and Selection Operator) method for shrinkage of variables. The variables for the regression were the results of histogram (kurtosis and skewness) and texture analysis (gray level co-occurrence matrix) for solid part within the region of interest for the lung cancer which was placed on pre- and post-contrast-enhanced axial CT images. To reveal the impact of RadScore in the prediction of progression free survival (local / distant recurrence or death), another multivariate Cox proportional hazard regression analysis was performed.

RESULTS
Among the 132 variables by histogram and texture analysis, 2 variables by histogram analysis and 2 variables by texture analysis were selected. In the multivariate Cox regression, the RadScore was the only significant predictive factor for progression free survival (95% confidence interval of hazard ratio: 1.89-24.14, p<0.005), whereas the following variables were not significant: male (0.53-4.34, p=0.44), age (0.94-1.12, p=0.53), pathological diagnosis of adenocarcinoma (0.81-7.06, p=0.11), and clinical stages (IB: 0.59-3.96, p=0.38; IIA: 0.17-15.33, p=0.67; IIB: 0.42-56.65, p=0.21).

CONCLUSION
The RadScore was an independent prognostic factor for progression free survival in patients of post-SBRT for lung cancer.

CLINICAL RELEVANCE/APPLICATION
The RadScore was a prognostic factor for progression free survival in patients of post-SBRT for lung cancer. The RadScore have potential to become one of indications of SBRT for lung cancer.

SSQ04-06  CT-Based Quantification of Lung Disease in Cystic Fibrosis Using Radiomics

Thursday, Nov. 29 11:20AM - 11:30AM Room: E353A

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PURPOSE
To build imaging biomarkers from chest computed tomography (CT) using radiomics to evaluate the severity of lung disease in adults with cystic fibrosis (CF).

METHOD AND MATERIALS
This single-center, retrospective, observational study was approved by an institutional ethics committee and the need for patient consent was waived. One hundred and sixty-two CF outpatients referred for unenhanced chest CT during follow-up between January 2013 and December 2015 were included and randomly divided into 2 equal cohorts. After lung segmentation, 38 imaging features were extracted. Chest CT from the development cohort were used to build 5 CT scores, each with a different machine learning technique (lasso, ENET, ridge regression, decision tree and SVM). The aim was to correlate these scores with a clinical prognostic score (Nkam score). Correlations between radiomics-based CT scores and 3 prognostic scores (Nkam, Liou and CF-Able), forced expiratory volume in 1 second (FEV1) and respiratory tract exacerbations were evaluated in the validation cohort.

RESULTS
Four of the 5 radiomics-based CT scores correlated well with the Nkam score in the validation cohort (R = 0.54 to 0.69; p<0.001) while they all correlated well with the Liou (R=0.64 to -0.74; p<0.001), and moderately with the CF-able (R=0.46 to 0.62; p<0.001) scores. All CT scores correlated well with FEV1 (R=0.65 to -0.77; p<0.001) and moderately with the number of pulmonary exacerbations in the 12 months after the CT exam (R=0.47 to 0.56; p<0.001).

CONCLUSION
Radiomics can be used to build imaging biomarkers that correlate well with clinical prognostic scores in adult CF patients

CLINICAL RELEVANCE/APPLICATION
Radiomic models were trained to predict the Nkam score, and were also well correlated with FEV1 and the Liou score, another prognostic score for CF, as well as with individual variables known to be markers of CF lung disease severity.

SSQ04-07  Radiomics Approach for Survival Prediction in Chronic Obstructive Lung Disease

Thursday, Nov. 29 11:30AM - 11:40AM Room: E353A
METHOD AND MATERIALS

The study included 371 adult COPD patients (mean age, 64.2). Patients were followed up for an average of 68 months and 45 cases of mortality were observed. From 3-D volumetric chest CT data of each patient, 525 radiomics features were semi-automatically extracted. Radiomics features were extracted from four phenotypical compartments of COPD; emphysema, airway measurement, pulmonary vessels, and air-trapping. In order to remove features that were highly related to one and another, pairs with correlation coefficients greater than 0.9 were identified and the feature with lower c-index (Harrell's concordance index) was eliminated. Then, least absolute shrinkage and selection operator (LASSO) Cox regression model and used to select the features most useful for OS prediction. Afterward, a RS was generated through the summation of selected features multiplied by their respective coefficients and cut-off value was determined by X-tile plot analysis. The difference of survival between low and high RS groups was evaluated with Kaplan-Meier survival analysis.

RESULTS

Five features which remained after LASSO analysis were as follows: (1) Low attenuation area (LAA-950), (2) PI-10 at 6th generation bronchi, (3) Average vessel cross-section area at 18mm from pleural surface, (4) Lobar heterogeneity of PI-10, (5) Z-axis heterogeneity of WA%. On multivariate Cox regression analysis, prediction performance (c-index) of the 5 features was 0.774. The c-index for pulmonary function test (PFT) results alone (DLCO, FEV1, FEV1/FVC) was 0.758. When radiomics features were combined with PFT, c-index was increased to 0.805. Patients who were classified into the high-risk group based on the generated RS demonstrated significantly worse OS than the low-risk group (log-rank test, p < 0.001; hazard ratio, 7.18:1).

CONCLUSION

The radiomics signature demonstrated good survival prediction performance in COPD patients and adequately classified patients into high and low-risk groups.

CLINICAL RELEVANCE/APPLICATION

The radiomics approach yielded a reliable survival prediction performance in this study and could potentially be adopted as an effective imaging biomarker for estimation of OS in COPD patients after further validation.

SSQ04-08 Radiomic Prediction of Survival in Patients with Rheumatoid Arthritis-Associated Interstitial Lung Disease Based on Deep-Learning, Hyper-Curvature, and Texture Features of Lung CT Images

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PURPOSE

To apply radiomics analysis on overall survival (OS) prediction in patients with chronic obstructive lung disease (COPD) and to evaluate prediction performance of the generated radiomics signature (RS).

METHOD AND MATERIALS

We retrospectively collected 70 RA-ILD patients with thin-section lung CT and serial pulmonary function tests. After automated extraction of the lung regions on the CT images, an experienced observer delineated regions of interest (ROIs) and labeled them into one of four ILD patterns (ground-class opacity, reticulation, consolidation, and honeycombing). We computed deep-learning features by training a 5-layer convolutional neural network on these ROIs for classifying the 4 patterns and by extracting the output of the last convolutional layer. We also computed hyper-curvature features including principal curvatures, curvedness, bright/dark sheets, cylinders, blobs, and curvature scales for the lungs as well as gray-level co-occurrence matrix texture features on the ROIs. An elastic-net penalty method was used to select and combine these features with a Cox proportional hazards model for predicting patient survival. Concordance index (C-index) was used as a measure of the prediction performance of the feature combinations with bootstrapping by 1,000 replications, in comparison to an established clinical prognostic biomarker known as the gender, age, and physiology (GAP) index by a two-sided t-test.
RESULTS
Bootstrap evaluation yielded C-index values of (a) GAP: 78.3%, [95% confidence interval (CI): 70.1, 86.5]; (b) hyper-curvature features: 80.8% [CI: 71.9, 89.7], P<0.01 in comparison with (a); (c) deep-learning features: 81.8% [CI: 71.9, 89.7], P<0.01; and (d) combined radiomic features: 86.9% [CI: 81.3, 93.1], P<0.0001. Kaplan-Meier survival curves of patients stratified to low- and high-risk groups based on combined radiomic features showed statistically significant (P < 0.0001) difference.

CONCLUSION
The combined radiomic features yield higher performance than GAP in the prediction of overall survival. Thus, they can be an effective imaging biomarker for predicting overall survival of patients with RA-ILD.

CLINICAL RELEVANCE/APPLICATION
Combined radiomic features that are automatically calculated from lung CT images can provide an effective prognostic imaging biomarker for precise management of patients with RA-ILD.

SSQ04-09  Radiogenomics of Non-Small Cell Lung Cancer: Predictive Modeling of miRNA Signature and CT Imaging Features

Thursday, Nov. 29 11:50AM - 12:00PM Room: E353A

Participants
Liyuan Fan, Jinan, China (Presenter) Nothing to Disclose
Qiang Cao, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Bao-Sheng Li, MD, PhD, Jinan, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
Radiomics and genomics characteristics have been widely explored to predict tumor responses to radiotherapy and in recent years, the combined application of them, radiogenomics, have increased. In this study, we developed a radiogenomics signature to estimate tumor responses to radiotherapy in patients with non-small cell lung cancer (NSCLC) and optimize management of this disease.

METHOD AND MATERIALS
This study consisted of 87 patients with non-small cell lung cancer and was approved by the institutional ethical board. The CT-based radiomics features were extracted by LIFEx. MiRNAs associated radiosensitivity was obtained from our previous study and literature retrieval. Then a radiogenomics signature was generated by LASSO and was associated with tumor responses to radiotherapy in non-small cell lung cancer patients. The Recist 1.1 was used for short-term effect and the overall survival (OS) was used for long-term effect evaluation. Multivariate Cox regression validated the radiogenomics signature as an independent biomarker. Then a radiogenomics nomogram with this signature was constructed, which was assessed to validation, calibration and discrimination.

RESULTS
The radiogenomics signature was significantly associated with radiosensitivity and OS, independent of other clinic pathologic factors. The radiogenomics nomogram has displayed a good performance for estimation of OS (C-index: 0.78, 95% confidence interval [CI]: 0.75, 0.80). Calibration curve for it was almost satisfactory, which indicated its clinical usefulness.

CONCLUSION
The radiogenomics signature is an independent biomarker and the nomogram combining it with other clinic pathologic factors could be used as a model to predict tumor responses to radiotherapy in non-small cell lung cancer, which might make a step forward individualized medicine.

CLINICAL RELEVANCE/APPLICATION
a biomarker to predict the radiosensitivity in non-small cell lung cancer
**SSQ05-01  Assessment of Changes in Regional Xenon Ventilation, Perfusion, and Ventilation-Perfusion Mismatch Using Dual-Energy Computed Tomography after Pharmacological Treatment in Patients with COPD**

**Participants**
Jeffrey B. Alpert, MD, New York, NY (Moderator) Nothing to Disclose
Mannudeep K. Kalra, MD, Boston, MA (Moderator) Research Grant, Siemens AG; Research Grant, Canon Medical Systems Corporation

**METHOD AND MATERIALS**
Combined V and Q DECT were performed at baseline and after 3-month pharmacologic treatment in fifty-three COPD patients. Virtual noncontrast images, V and Q maps were anatomically co-registered with in-house software. Normalization of V and Q values of each pixel were performed. For visual analysis, V/Q pattern was determined to be matched, mismatched, or reversed-mismatched and compared with the regional disease patterns-emphysema, bronchial wall thickening, or normal lung-in each segment in baseline and follow-up. Mean V, Q, and V/Q values, standard deviation of V/Q (V/QSD), and proportions of lung area with reversed-mismatch (Rev), mismatch (Mis) and match (Mat) of each patient were quantified and compared with pulmonary function test (PFT) parameters in baseline and follow-up. Changes of quantified CT parameters and PFT results between baseline and follow-up were compared.

**RESULTS**
Most of segments showed a matched V/Q, whereas about thirty percent of segments with bronchial wall thickening showed a reversed-mismatched V/Q. On follow-up, V/Q pattern did not change in most of segments with matched and mismatched V/Q. In about forty percent of segments with reversed-mismatched V/Q, V/Q pattern changed into matched. Quantified mean V, Q, V/Q and Rev values of baseline and follow-up CTs were positively correlated with PFT parameters, respectively ($r = 0.286-0.630$, $p < 0.05$) while V/QSD values were negatively correlated with PFT parameters ($r = -0.528$ and $-0.375$; $p < 0.05$). Changes of mean V, V/Q and Mat were positively correlated with change of FEV1 ($r = 0.315-344$; $p < 0.05$) and changes of Rev were negatively correlated with change of FEV1 ($r = -0.353$; $p = 0.010$).

**CONCLUSION**
Quantitative and visual analysis of combined V and Q DECT showed that the improvement of ventilation and V/Q mismatch may be associated with the response to pharmacological treatment in COPD patients.

**CLINICAL RELEVANCE/APPLICATION**
Combined V and Q DECT imaging can be applied to assessment of changes of regional V and Q status after pharmacologic treatment in COPD patients.
In COPD patients, distribution of emphysema shows various patterns (diffuse, unilateral, or focal), however, there is no report about distribution of emphysema in lung cancer patients. The purpose of the research is to compare heterogeneity of emphysema between lung cancer patients and lung cancer screening patients.

METHOD AND MATERIALS

Total 109 subjects with smoking history and thin section chest CT (51 patients with lung cancer M : F = 29 : 22, age = 68.10 ± 9.26, 58 lung cancer screening patients; M : F = 31 : 27, age = 64.03 ± 6.65) were retrospectively enrolled. Using commercial software (AVIEW, Coreline soft, South Korea), volume and low attenuation area under -950 HU were semi-automatically quantified in whole lung and each lobe by two radiologists. Emphysema index (EI) and emphysema heterogeneity were calculated. Intra-class correlation coefficient (ICC) and independent t-test were performed. ANOVA was performed for subgroup analysis according to cancer pathology.

RESULTS

ICC of each lobe volume among two radiologists were 0.993, 0.987, 0.999, 0.999, and 0.999. EI in RUL, RML, RLL, LUL, and LLL of two groups were 6.43 ± 9.94, 6.80 ± 9.28, 3.66 ± 5.54, 5.86 ± 6.60, and 3.83 ± 5.86 in the cancer group, and 6.56 ± 7.82, 8.24 ± 8.44, 5.68 ± 7.08, 7.16 ± 7.05, and 5.28 ± 6.66 in the screening group. EI and emphysema heterogeneity in whole lung of two groups were 5.10 ± 6.56, and 12.20 ± 5.14 respectively in the cancer group, and 6.43 ± 6.95, 8.44 ± 4.92 in the screening group. EI showed no significant difference between two groups. However, emphysema heterogeneity of the cancer group was significantly larger than that of the screening group (p < 0.001). In subgroup analysis, emphysema heterogeneity of the cancer subtypes of adenocarcinoma and squamous cell carcinoma were significantly larger than that of screening group (p = 0.006 and 0.042).

CONCLUSION

Semi-automated quantification of emphysema in each lobe was feasible. Smokers with lung cancer showed more heterogeneous distribution of emphysema than smokers without lung cancer.

CLINICAL RELEVANCE/APPLICATION

Quantification of regional and whole lung heterogeneity of emphysema may potentially help in risk stratification of COPD patients in developing lung cancer.

SSQ05-03 Hyperpolarized Xenon-129 MRI for Detection of Gas Exchange in Healthy Subjects and Lung Cancer Patients

Participants

Ozkcan Doganay, PhD, MSc, Oxford, United Kingdom (Presenter) Nothing to Disclose
Mitchell Chen, MD, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
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PURPOSE

To determine whether a novel functional magnetic resonance imaging (MRI) technique using hyperpolarized Xenon-129 (HPX) can quantify the xenon gas transfer dynamics (XGTD) from alveoli into the Pulmonary Tissue and Blood Plasma (PTBP), and Red Blood Cell (RBC) compartments of the lungs, and identify XGTD differences in patients with COPD and lung cancer pre and post radiation.

METHOD AND MATERIALS

A novel spectroscopic MRI technique was developed using Iterative Decomposition of water and fat with Echo Asymmetry and Least-square estimation (IDEAL) approach. This technique allowed acquisition of the time-series IDEAL gas, PTBP and RBC compartment images of lungs with various gas transfer times in a single breath-hold interval. The time-series IDEAL gas, PTBP and RBC compartment images were acquired from five healthy subjects at two different time points. XGTD curves were obtained from 10 scans (n=10) that represented the control group. The control group was compared to two lung-cancer patients before radiation therapy started and after radiation therapy ended.

RESULTS

In the control group, there was no statistical difference in XGTD between the left and right lungs (P-value >0.4). XGTD in the control was statistically different than the lung cancer patients (P-value <0.01) suggesting that the novel time-series IDEAL technique was sensitive to the gas exchange abnormalities. Additionally, the ratio of XGTD from the irradiated lung to un-irradiated lungs was compared pre and post radiation therapy. We found that xenon gas in the alveoli diffused into the PTBP compartment with a slower rate of 20-35% in the radiated lungs from the lung cancer patients.

CONCLUSION

In the control group, there was no statistical difference in XGTD between the left and right lungs (P-value >0.4). XGTD in the control was statistically different than the lung cancer patients (P-value <0.01) suggesting that the novel time-series IDEAL technique was sensitive to the gas exchange abnormalities. Additionally, the ratio of XGTD from the irradiated lung to un-irradiated lungs was compared pre and post radiation therapy. We found that xenon gas in the alveoli diffused into the PTBP compartment with a slower rate of 20-35% in the radiated lungs from the lung cancer patients.
The feasibility of the novel IDEAL MRI technique has been successfully demonstrated in healthy subjects and lung cancer subjects.

To our knowledge, this is the first-in-man study showing the time course of arrival of Xenon-129 gas from the alveoli to PTBP and RBC compartments of the lungs and to the pulmonary vasculature and the left ventricle of the heart in healthy subjects and patients with COPD and lung cancer.

CLINICAL RELEVANCE/APPLICATION

This technique may have potential clinical applications ranging from the detection of regional differences in gas transfer on imaging to the detection of early-stage radiation-induced lung injury.

SSQ05-04  Effect of Aging and Smoking on Regional Air Volume Change Distributions in Normal Chest CT

Participants
Kum Ju Chae, MD, Jeonju, Korea, Republic Of (Presenter) Nothing to Disclose
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Ching-Long Lin, PhD, Iowa City, IA (Abstract Co-Author) Nothing to Disclose
Eric A. Hoffman, PhD, Iowa City, IA (Abstract Co-Author) Founder, VIDA Diagnostics, Inc; Shareholder, VIDA Diagnostics, Inc; Advisory Board, Siemens AG

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PURPOSE

Image registration has been increasingly used to assess pulmonary dynamics between paired inspiratory and expiratory CT images in patients with pulmonary disease. However, information of pulmonary dynamics of normal subjects is insufficient. The purpose of the study is to describe regional air volume change distributions of subjects with normal CT and to investigate the effects of aging and smoking.

METHOD AND MATERIALS

242 subjects (114 male, 128 female) over the age of 18 years with normal inspiration and expiration CTs were included in the study. VIDA Apollo software (Coralville, IA) and an image registration technique were used to compute regional distribution of air and tissue volumes, air volume fractions, and the relative regional changes between inspiration and expiration, including relative regional air volume changes (RRAVC). In each lobe, the upper lobes, the lower lobes, and the whole lung, the mean values and standard deviations were correlated with aging and compared to those of smoking groups. Regional volumetric changes were further analyzed using 3D visualization of acinar scale parenchymal units.

RESULTS

Inspiratory air volume of the lower/upper lobes decreased with age in both nonsmoking males and females (r=-0.388; p=0.006 and r=-0.258; p=0.004, respectively). RRAVC map demonstrates the increase of air volume change from apico-ventral to dorso-basal region in non-smokers, representing gravitational dependency in normal pulmonary dynamics. In comparison, the directionality of gravitational dependency of regional volume change tends to against normality in smokers, and the coefficient of variation (CV) of RRAVC decreased in the whole lung in the smokers (0.64 and 0.35, p=0.020).

CONCLUSION

The air volume of the lower/upper lobes tends to decrease with aging, and the directionality of gravitational dependency of the air volume change appeared to be against normality in smokers. Visualization of RRAVC map helped recognize these findings more easily.

CLINICAL RELEVANCE/APPLICATION

Regional air volume change distribution helped understand the gravitational volume change of the lung in normal adults, and so it is expected that the localized functional abnormalities of the lung effected by aging and smoking are easily comprehended.

SSQ05-05 Whole-Lung Dynamic Contrast-Enhanced Perfusion Area-Detector CT: Capability for Pulmonary Function Assessment and Morphological Change Evaluation in Stage IA Non-Small Cell Lung Cancer

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (Presenter) Research Grant, Canon Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Fuji Pharma Co, Ltd; Research Grant, Guerbet SA; Yasuko Fujisawa, MS, Otawara, Japan (Abstract Co-Author) Employee, Canon Medical Systems Corporation
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PURPOSE

To prospectively and directly compare the capability of whole-lung dynamic contrast-enhanced (CE-) perfusion area-detector CT
Denoising Ultra Low Dose for Screening Lung Cancer

Thursday, Nov. 29 11:20AM - 11:30AM Room: E353B

Participants
Edith M. Marom, MD, Tel Aviv, Israel (Presenter) Speaker, Bristol-Myers Squibb Company; Speaker, Boehringer Ingelheim GmbH; Michael Green, MSc, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose; Michal Eifer, MD, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose; Eli Konen, MD, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose; Nahum Kryati, PhD, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose; Amaldo Mayer, PhD, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose

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PRESENTATION

To assess the effect of a denoising method (D) for ultra low dose CT (ULDCT) LungRADS categorization.

METHOD AND MATERIALS

36 consented patients, referred for an outpatient chest CT, underwent 2 scans: a normal dose CT (NDCT), 120 kVp and automatic current modulation, with or without contrast media, immediately followed by an ULDCT, 120 kVp and fixed current at 10 mA for BMI <29 and 20 mA for BMI>=29. Reconstruction for lung and soft tissue kernels were performed for each scan. Consecutively, each ULDCT was denoised using a locally-consistent non-local-mean (LCNLM) algorithm to obtain a high signal to noise ratio (SNR) version of the ULDCT. The LCNLM algorithm leverages large databases of image patches extracted from high-SNR chest CT scans to denoise ULDCTs while enforcing local spatial consistency to preserve fine details and structures in the image. Blinded to all clinical information, a chest radiologist separately assessed the NDCT, ULDCT, and denoised ULDCT (D), documented findings, assigned a LungRADS category and a subjective suspicion for highly suspicious lesions for lung cancer (H).

RESULTS

Radiation dose using NDCT reduced the radiation for patients with a BMI > 29 by an average of 93% and for those with a BMI of up to 29 by an average of 96%. For patients with a BMI > 29 the average effective radiation dose for ULDCT was 0.41 mSv, whereas for those with a BMI of up to 29 it was 0.24mSv. For the three imaging methods, the same score was seen in 63.9% (n=23) and a different score in 36.1% (n=13). There was complete agreement on LungRADS 4A (or higher) between NDCT and D, but ULDCT categorized one of the 4A patients as LungRads 2. One lesion assigned as LungRads 4X by ULDCT was assigned LungRads2 by D and NDCT. Of the 8 patients highly suspicious for lung cancer by NDCT, D indicated so in all 8 whereas ULDCT indicated so only in 4.

CONCLUSION

Interpretation of ULDCT may cause errors in LungRADS categorization but implementation of the LCNLM algorithm for denoising improves ULDCT images so that LungRADS categorization is similar to normal dose scans.

CLINICAL RELEVANCE/APPLICATION

Denoising ULDCT with the LCNLM algorithm enables screening for lung cancer with dose reductions of greater than 90%.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Edith M. Marom, MD - 2015 Honored Educator Edith M. Marom, MD - 2018 Honored Educator
Method and Materials

Following review board approval and informed consent, 16 patients diagnosed with CTEPH and pathologic findings in V/Q scans were included into this prospective study. Patients were scanned at 3T using the SENCEFUL approach based on a 2D-FLASH sequence. Color-coded maps of the lung perfusion and the local blood arrival time i.e. the pulsation phase were manually segmented and rated for perfusion defects in lung quadrants by three independent radiologists using a 6-point Likert scale. Coronal V/Q scan images were rated by a nuclear medicine physician accordingly. Due to variation of slice thickness between both techniques, covered lung volumes were divided into four sectors in coronal orientation each containing four quadrants to improve comparability. Statistical tests included intraclass correlation coefficient (ICC) and Mann-Whitney-U-test.

Results

Comparison of quadrant-wise rating between SENCEFUL-MRI and V/Q scans revealed good agreement between all raters when the lung perfusion and pulsation phase maps were rated simultaneously (ICC 0.75, 95% CI 0.69-0.80, p<0.05) and an improvement to perfusion rating alone (ICC 0.61, 95% CI 0.52-0.69, p<0.05). Interrater reliability of the radiologists for combined perfusion/pulsation phase rating was good (ICC 0.77, 95% CI 0.69-0.82, p<0.05). Analysis of a peak-to-offset ratio of pulsation phase histograms showed a significant difference between lung quadrants rated pathologic in scintigraphy and quadrants rated healthy (p<0.05).

Conclusion

SENCEFUL-MRI showed good agreement for detection of perfusion defects compared with V/Q scans being the current screening method for CTEPH. Analysis of MRI maps by a peak-to-offset ratio of pulsation phase showed a significant difference between quadrants rated pathologic and healthy by V/Q scans suggesting a quantifiable value for future determination of threshold values in SENCEFUL-MRI.

Clinical Relevance/Application

SENCEFUL-MRI could be an alternative screening method for detection of lung perfusion defects in patients with suspected CTEPH without the need of contrast agent administration or radiation exposure.

Applicability of Monochromatic Energy with 40 keV for Pulmonary Embolism Detection in the Pulmonary Embolism CT Angiography: Experience Using a Dual-Layer Detector Spectral CT

Method and Materials

A total of 876 consecutive PECT using spectral CT were identified between August 2016 and March 2018. Of these, PE at least 4 mm in diameter was detected in 73 PECT. Among these, suboptimal enhancement of PA (<250 HU) was shown in 19 cases. Contrast-to-noise ratio (CNR), signal-to-noise ratio (SNR) of VMI at 50 keV, 60 keV, 70 keV, and conventional 120-kVp images (COV) were compared with VMI at 40 keV in all PECT and suboptimal PECT. Readers’ subjective scores for PE detection was also recorded. The mean diameters of PE were measured, and they were compared between VMI at 40-70 keV and COV. The frequency of significant PE diameter reduction (>40%) in VMI compared with COV was also recorded and compared between VMIs. The cut off
value of the minimum visible PE diameter at 40 keV was investigated in COV.

RESULTS
There was no significant difference in CNR between 40 keV and 50 keV, although the highest CNR and SNR were obtained at 40 keV. In the suboptimal subgroup, there were no significant differences in both CNR and SNR between 40 keV and 50 keV. The subjective scores was significantly lower at 40 keV, compared with other algorithms in both all PECT and the suboptimal group (P<0.05). The mean diameters of PE were significantly decreased in 40 keV and 50 keV, compared with those in COV (40 keV, 5.6±5.8 mm; 50 keV, 7.2±5.3 mm; COV, 8.9±4.9 mm; all P<0.05). The frequency of significant PE diameter reduction was significantly higher in 40 keV than in 50 keV (36.8% vs. 12.8%, P<0.001). The cut off value of the minimum visible PE diameter at 40 keV was 6.4 mm in COV.

CONCLUSION
VMI at 40 keV was not the best option for PE detection, although the best CNR and SNR were obtained at 40 keV. The diameter of PE was often decreased and small PE was not even detected at 40 keV.

CLINICAL RELEVANCE/APPLICATION
We propose that not only 40 keV but also other algorithms such as 50 keV should be used for PE detection to ensure that we do not miss small PEs.

SSQ05-09 Fluorine-19 MRI Ventilation Defect Analysis in Cystic Fibrosis
Thursday, Nov. 29 11:50AM - 12:00PM Room: E353B

Awards
Student Travel Stipend Award

Participants
Tyler Glass, BEng, Chapel Hill, NC (Presenter) Nothing to Disclose
Jennifer Goralski, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
Esther O. Akinnagbe-Zusterzeel, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
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Rayad Shams, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
Yuez H. Lee, MD,PhD, Chapel Hill, NC (Abstract Co-Author) License agreement, XinRay Systems Inc
Agathe Ceppe, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

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PURPOSE
The purpose of this study is to investigate the ability of novel fluorine-19 (19F) based MRI to characterize ventilation in subjects with cystic fibrosis.

METHOD AND MATERIALS
Coronal images of nine healthy controls and twelve subjects with CF were acquired using a multinuclear capable 3.0 T MRI scanner (PRISMA, Siemens) along with spirometry. Subjects inhaled 19F labelled perfluoro-propane (PFP) gas mixed with 21% O2 or room air during the wash-in phase of the scan. Fifteen second 19F GRE vibe breath hold images were obtained following three breaths of PFP for five cycles. This was repeated five times after switching PFP gas to room air for the wash-out phase. A 19F maximum intensity projection image over time was created and segmented using a semi-automatic approach with an empirically determined ventilation threshold. Anatomic 1H series taken at full inspiration were then manually segmented for all subjects. After correcting for differences in respiratory effort by comparing apex-base measurements of the lung in 19F and 1H series, the ventilation defect volume (VDV) was computed by subtracting 19F segmentation volume from 1H volume and a ventilation defect percentage (VDP) was also computed relative to 1H volume.

RESULTS
In healthy controls, the mean ventilation defect percentage (VDP) was 10% (SD 11%); for mild CF 13% (SD 25%); and for severe CF 31% (SD 24%). A significant difference was found when comparing all CF patients to normal (p=0.0275 via t-test with Satterthwaite correction). VDP had a negative correlation with FEV1 (-0.56 via Spearman correlation, p=0.011). The rate constant for gas filling (r1) was significantly increased in CF patients compared with controls, suggesting delay in filling. No safety concerns were detected throughout the study.

CONCLUSION
This study showed the ability of novel 19F ventilation MRI to rapidly and safely quantify regional ventilation defects and gas wash-in and wash-out dynamics. 19F MRI identified ventilation defects in cystic fibrosis subjects even in the setting of normal spirometry with some variability in healthy volunteers.

CLINICAL RELEVANCE/APPLICATION
This novel imaging technique has advantages over xenon ventilation MRI including cheaper contrast material and inert compound allowing functional imaging with multiple image sets. We anticipate applications for many other lung diseases including pediatric lung malformations, lung resection, COPD monitoring, and bronchiectasis.
OUTCOME OF PET/CT NEGATIVE SOLID PULMONARY NODULE: A RETROSPECTIVE STUDY

Purpose
To observe the natural history of PET/CT negative pulmonary nodules in patients without a history of malignancy such that we will be able to provide evidence-based insight into appropriate recommendations for further follow up for such nodules.

Method and Materials
Retrospective PET reports from 2005-2015 mined and analyzed to meet the following basic criteria: Individuals with no prior malignancy ages 35+ who underwent a PET study for incidental solid nodules greater than 8mm. Further PACS search and chart review conducted to follow these individual nodules of concern. Outcomes divided into nodule resolved, stable or developed malignancy.

Results
Study is currently in progress including more data acquisition and analysis. Current status: N = 62 mean age of 65. 41 of the analyzed nodules were between 0.8-1.5 cm, 20 between 1.5-2.5 cm and 1 above 2.5cm. Among the 62 analyzed nodules, 35 resolved/shrank/remained stable and 9 developed malignancy. Among the 9 nodules that developed malignancy, 77.8 (n = 7) were between 0.8 - 1.5 cm and the remainder 2 were between 1.5 -2.5 cm. The average estimated date of follow up/discovery of malignancy was 42 months.

Conclusion
Preliminary analysis shows there is a considerable number of nodules that became malignant on follow up PET/CT in subsequent years after demonstrating sub-threshold activity on initial PET/CT. Hence, it can be assumed that a PET negative nodules on initial evaluation can and should not be considered to be inert or without potential of future malignant transformation.

Clinical Relevance/Application
At this time, when an incidental pulmonary nodule is identified and meets minimum size criteria of greater than 8mm per current Fleischner guidelines, it is further worked up with PET/CT to assess for positive biological activity to suggest malignancy. However, if the nodule turns out to be PET/CT negative, pulmonologists, primary medical doctors, and radiologists alike are at a loss of what to do with these nodules or how to follow them. Historically, subjective follow up recommendations have been made by radiologist due to a lack of studies looking at outcomes of PET negative nodules or any established guidelines. This study sheds light on the fact that many of these nodules can and do prove to be slow growing with potential for malignancy and hence can not be ignored after the first negative PET/CT. This is true especially for the smaller nodules ranging below 2.5 cm.

Utilization of Bone Suppression Imaging by Using Deep Learning on Chest Radiograph: Detectability of Lung Nodules and Exploring for Effectual Interpretation Methods

Purpose
To observe the natural history of PET/CT negative pulmonary nodules in patients without a history of malignancy such that we will be able to provide evidence-based insight into appropriate recommendations for further follow up for such nodules.

Method and Materials
Retrospective PET reports from 2005-2015 mined and analyzed to meet the following basic criteria: Individuals with no prior malignancy ages 35+ who underwent a PET study for incidental solid nodules greater than 8mm. Further PACS search and chart review conducted to follow these individual nodules of concern. Outcomes divided into nodule resolved, stable or developed malignancy.

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Study is currently in progress including more data acquisition and analysis. Current status: N = 62 mean age of 65. 41 of the analyzed nodules were between 0.8-1.5 cm, 20 between 1.5-2.5 cm and 1 above 2.5cm. Among the 62 analyzed nodules, 35 resolved/shrank/remained stable and 9 developed malignancy. Among the 9 nodules that developed malignancy, 77.8 (n = 7) were between 0.8 - 1.5 cm and the remainder 2 were between 1.5 -2.5 cm. The average estimated date of follow up/discovery of malignancy was 42 months.

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Preliminary analysis shows there is a considerable number of nodules that became malignant on follow up PET/CT in subsequent years after demonstrating sub-threshold activity on initial PET/CT. Hence, it can be assumed that a PET negative nodules on initial evaluation can and should not be considered to be inert or without potential of future malignant transformation.

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At this time, when an incidental pulmonary nodule is identified and meets minimum size criteria of greater than 8mm per current Fleischner guidelines, it is further worked up with PET/CT to assess for positive biological activity to suggest malignancy. However, if the nodule turns out to be PET/CT negative, pulmonologists, primary medical doctors, and radiologists alike are at a loss of what to do with these nodules or how to follow them. Historically, subjective follow up recommendations have been made by radiologist due to a lack of studies looking at outcomes of PET negative nodules or any established guidelines. This study sheds light on the fact that many of these nodules can and do prove to be slow growing with potential for malignancy and hence can not be ignored after the first negative PET/CT. This is true especially for the smaller nodules ranging below 2.5 cm.
PURPOSE
To evaluate differences in the effect of bone suppression (BS) imaging in lung-nodule detection on chest radiographs (CXR) by interpretation method.

METHOD AND MATERIALS
The CXRs of 100 patients, of which 50 demonstrated a lung nodule (5-29 mm in diameter) and 50 did not, were interpreted by 10 observers comprising five chest radiologists with > 10 years of experience and five radiology residents. Each CXR was sequentially read, using the conventional CXR (on a left monitor) and BS image (on a right monitor) on dual monitors for initial review, and then using the conventional CXR and BS image on a single monitor after a few weeks. Reviewers could switch each other on a single monitor. The nodule location, confidence level with regard to the presence of a lung nodule, and reading time were recorded. Receiver operating characteristic (ROC) analysis and paired t-tests were used to evaluate observer performance.

RESULTS
The average area under the curve (AUC) for the observers’ ROC significantly improved from 0.830 to 0.868 (P = 0.005) and from 0.826 to 0.860 (P = 0.004) with BS image using dual monitors and a single monitor, respectively. The average AUC was not significantly different between dual monitors and a single monitor (P = 0.449). However, the specificity of BS image on a single monitor was significantly higher (P = 0.001) than on dual monitors, whereas there was weak evidence that its sensitivity tended to be lower (P = 0.061). The interpretation time for BS imaging on a single monitor (44.0 ± 9.6 minutes) was significantly shorter (P = 0.006) than on dual monitors (56.8 ± 8.9 minutes).

CONCLUSION
The use of BS image as a reference improved lung-nodule detection performance on CXRs; however, sensitivity, specificity, and reading time were differently affected by imaging review method.

CLINICAL RELEVANCE/APPLICATION
This study suggested effects of bone suppression imaging review method. This constitutes highly important knowledge during the interpretation of processed images.

CH299-SD-THA3  CT Air Trapping Assessment in Usual Interstitial Pneumonia Pattern

Participants
Felipe D. Sanches, Porto Alegre, Brazil (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Our goal was to evaluate the frequency of air trapping in patients with UIP due to idiopathic pulmonary fibrosis (IPF) compared to other non-IPF etiologies of UIP.

METHOD AND MATERIALS
The current study included 84 consecutive patients with radiological or histological UIP. IPF was diagnosed by a multidisciplinary team approach or a surgical lung biopsy (SLB). Air trapping on HRCT was visually assessed by two independent chest radiologists, and quantitatively calculated as the percentage of voxels in expiratory CT with attenuation range between -950 to -856HU (ATIexp) >6% or expiratory to inspiratory ratio of mean lung density (E/I-ratio) >0.87. Survival analysis was performed.

RESULTS
A total of 51 patients (60.7%) had UIP due to IPF, and 33 (39.3%) had UIP secondary to known causes. The average survival was of 3 years (CI 95% 2.5-3.5) and 4.2 years (CI 95%: 3.6-4.7), respectively. Extensive air trapping (>=3 lobes) was present in 8 patients (9.5%) with IPF, and 6 (7.1%) with non-IPF (p = 0.764). Air trapping in the upper lobes was the only significant variable of 3 years (CI 95% 2.5-3.5) and 4.2 years (CI 95%: 3.6-4.7), respectively. Extensive air trapping is not capable of discriminate IPF from non-IPF (frequency of 3.9% vs. 33.3%, respectively; p < 0.001), being highly suggestive of chronic hypersensitivity pneumonitis.

CONCLUSION
The presence of air trapping in the upper lobes was highly associated with non-IPF etiologies of UIP. Extensive air trapping is not infrequent in patients with IPF.

CLINICAL RELEVANCE/APPLICATION
The presence of extensive air trapping on a high-resolution computed tomography (HRCT) is currently considered an inconsistent finding of usual interstitial pneumonia (UIP).

CH298-SD-THA4  The Imaging Features of TSCT Predict the Expression of PD-L1 in Patients with Surgical Resection of Lung Adenocarcinoma
**PURPOSE**

PD-L1 expression may serve as a predictive biomarker for the response to immune checkpoint inhibitors in lung cancer and were more likely to express in male and smokers. However, the relationship between PD-L1 expression and imaging features of computed tomography (CT) has not been fully understood.

**METHOD AND MATERIALS**

A total of 350 patients with pathologically-confirmed adenocarcinoma who received surgical treatment and had thin section CT (TSCT) examination were included in this study. Quantitative CT features such as the mean CT value and mass were measured on multiplanar reconstructed images.

**RESULTS**

Among 350 patients, PD-L1 positive tumors were detected in 21.1% (74/350) of all cases. Multivariate analysis identified surrounding ground glass opacity (P=0.022), shape (P=0.008), pleural tag (P=0.007), tumor mean CT value and consolidation divided by tumor of mass (C/T mass) (P=0.004) as being significantly associated with the expression of PD-L1. The receiver operation curve (ROC) analysis showed that the optimal cutoff values of -170HU for tumor mean CT value and of 30.9% for C/T mass. The sensitivity, specificity, area under curve (AUC) of C/T mass for predicting PD-L1 expression was 71.62%, 70.29% and 0.705. To improve the diagnostic accuracy, a joint model (included all significant imaging parameters at multivariate logistic regression analysis) was conducted. The AUC of joint model was 0.787, with a sensitivity of 81.08% and specificity of 65.22%.

**CONCLUSION**

PD-L1 expression was associated with invasive subtype of adenocarcinoma and imaging features, which may help clinicians make initial predictions before administration of immune checkpoint inhibitors.

**CLINICAL RELEVANCE/APPLICATION**

This study is to explore any particular imaging findings associated with PD-L1 expression in patients with surgical resection of lung adenocarcinoma and help patients predict whether they will benefit from immunotherapy.

**Participants**

Tong Wu, Shanghai, China (Presenter) Nothing to Disclose
Jingyun Shi, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the value of dual-layer detector spectral CT (DLCT) in the assessment of metastatic lymph nodes in lung cancer with multiple quantitative parameters and to evaluate the diagnostic performance of the parameters in combination with short diameter.

**METHOD AND MATERIALS**

We retrospectively analyzed the dual-phase contrast enhanced spectral CT images of 32 patients with lung cancer. The short diameter of lymph nodes and iodine uptake were measured. According to pathological findings, lymph nodes were divided into metastatic group and non-metastatic group. Arterial enhancement fraction (AEF), normalized iodine concentration (NIC) during arterial phase(AP) and venous phase(VP) and short diameter were calculated (AEF = iodine uptake in AP /iodine uptake in VP × 100%, NIC = IClymph node /ICAorta) and compared. Receiver operating characteristic (ROC) curves were performed to evaluate diagnostic performance for quantitative parameters.

**RESULTS**

A total of 84 lymph nodes were included, with 48 metastatic lymph nodes and 36 non-metastatic lymph nodes. The short diameter of lymph nodes, NICAP, NICVP and AEF all showed significant differences between the two groups (short diameter, 1.25 ± 0.50 vs. 0.92 ± 0.23; NICAP, 0.19 ± 0.08 vs. 0.13 ± 0.05; NICVP, 0.42 ± 0.14 vs. 0.31 ± 0.08; AEF, 112.40 ± 36.68 vs. 71.73 ± 15.76; each P< 0.05). AEF had the largest area under the curve (AUCAEF = 0.874, AUC AP NIC =0.721, AUC VP NIC =0.765 and AUC short diameter = 0.700). With a threshold of 81.53% for AEF, the sensitivity and specificity were 83.00% and 65.70% respectively. With a threshold of the short diameter >1cm, the sensitivity and specificity were 58.10% and 77.1% respectively. Using the parallel criteria approach to combine of AEF and short diameter, the sensitivity was increased to 92.88%, using the sequential criteria approach, the specificity was increased to 91.15%.

**CONCLUSION**

Among multiple quantitative parameters provide by DLCT, AEF has the highest diagnostic efficiency in differentiating metastatic and non-metastatic lymph nodes. Measurement of the short diameter in combination with AEF further improve the diagnostic accuracy of lymph nodes metastasis.

**CLINICAL RELEVANCE/APPLICATION**

Multiple quantitative parameters of DLCT provide an effective noninvasive method for accurate evaluation of lymph nodes metastasis of lung cancer. The association of quantitative parameters facilitates the detection of lymph nodes metastasis.
Kernels at CT: Convolutional Neural Network-based Kernel Conversion

**Participants**

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**PURPOSE**
To assess whether CT kernel conversion using convolutional neural network (CNN) could improve measurement variability of radiomic features of lung nodules between routine reconstruction kernels and different readers.

**METHOD AND MATERIALS**
Total 104 patients with pulmonary lesions underwent chest CT using single CT machine. Among them, 53 patients underwent contrast enhanced CT and 51 patients underwent nonenhanced CT scan. All of the chest CT was reconstructed in both B30f and B50f kernels. To convert different kernels without sonogram, the CNN model was developed using residual learning and an end-to-end way. Afterward, the kernel converted images were generated, from B30f to B50f (cB30) and from B50f to B30f (cB50). Lung lesions were semi-automatically segmented by two different readers for extracting radiomic features. A total of 718 radiomic features including shape, tumor intensity, texture and wavelet features were obtained from 4 different kernels of images: B30, B50, cB30 and cB50 images. Measurement variability of radiomics features were evaluated among different readers and kernels using concordance correlation coefficient (CCC).

**RESULTS**
In terms of the effect of kernel on measurement variability, CCC between different kernels (B30 and B50) but same reader was 0.41 ± 0.36 (shape, 1.0 ± 0), tumor intensity, 0.915 ± 0.13, texture 0.66 ± 0.21, and wavelet features 0.36 ± 0.34) in total patients, 0.41 ± 0.36 on nonenhanced CT and 0.42 ± 0.37 on enhanced CT. After applying kernel conversion, CCC improved in all radiomic features (B30 vs cB30, 0.93 ± 0.10; B50 vs cB50, 0.89 ± 0.13). Comparing nonenhanced and enhanced CT, kernel conversion were effective in both image settings, improving CCC to 0.91 ± 0.13 on nonenhanced CT and 0.88 ± 0.17 on enhanced CT. CCC between different readers but same kernel (inter-reader variability) was 0.91 ± 0.14 in B30 and 0.89 ± 0.14 in B50.

**CONCLUSION**
Among radiomic features, texture and wavelet features are significantly affected by kernel in both enhanced and nonenhanced CT images. Kernel conversion using CNN can effectively improve measurement variability in the values of radiomics features.

**CLINICAL RELEVANCE/APPLICATION**
Kernel conversion using CNN can effectively improve measurement variability of radiomic features which could aid multicenter researches or retrospective studies of radiomics field.

**CH2S3-ED-THA7**  

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**TEACHING POINTS**
- While most radiologists are familiar with traditional devices such as pacemakers and defibrillators on chest radiograph, newer and less commonly observed devices may present challenges in imaging interpretation - The purpose of this exhibit is to improve familiarity with less frequently encountered devices - Indications, function, normal appearance on chest radiographs, and complications will be discussed

**TABLE OF CONTENTS/OUTLINE**
Devices discussed will include but not be limited to: Leadless pacemaker Implantable loop recorder Subcutaneous implantable cardioverter-defibrillator (ICD) LifeVest wearable defibrillator Mechanical circulatory support devices - Impella, Impella RP - Extracorporeal membrane oxygenator pump (ECMO) - Ventricular assist devices: LVAD, RVAD, BIVAD - Total artificial heart - Parachute left ventricular partitioning device CardioMEMS Transcatheter aortic, pulmonic, and mitral valve replacement/repair (e.g. TAVR, Melody, MitraClip) Occlusion devices (Amplatzer, Watchman, AtriClip) Endobronchial valves Implanted phrenic nerve stimulator Transesophageal voice prosthesis Esophageal probe LINX reflux management system Neurostimulator

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at:  
https://www.rsna.org/Honored-Educator-Award/ Cameron Hassani, MD - 2018 Honored Educator
TEACHING POINTS

To define the halo and reverse halo sign. To describe the imaging characteristics of the these signs. Describe a differential diagnoses that may be elucidated by proper interpretation of these signs.

TABLE OF CONTENTS/OUTLINE

Review the definitions of CT halo and reverse halo signs Outline key factors including host immune status, geographic location and clinical presentation that narrow the differential diagnosis Review spectrum of diagnosis Infections Inflammatory conditions Neoplasms Clarify the pathologic findings that contribute to the CT appearance of these signs
Assessment of Invasive Pulmonary Adenocarcinoma and Non-Invasive Pulmonary Adenocarcinoma in Pure Ground Glass Nodules with the Maximum Diameter Less Than 1cm Using Quantitative CT

METHOD AND MATERIALS
169 patients with pGGN with the maximum diameter less than 1cm confirmed by surgical pathology in our hospital were enrolled in this study for retrospective analysis, including 169 lesions, 16 atypical adenomatous hyperplasia (AAH) (9.5%), 100 adenocarcinoma in situ (AIS) (59.2%), 47 minimally invasive adenocarcinoma (MIA) (27.8%) and 6 IA (3.7%). All patients performed HRCT scan within 1 week before surgery. We measured the maximum diameters and average CT values of all pGGNs and recorded the relevant imaging characteristics on HRCT. Using SPSS17.0 statistical software, we compared clinical and radiographic features of IA with non-IA.

RESULTS
1) In pGGNs with the maximum diameter less than 1cm, IA accounted for 3.7%. 2) The mean CT values between IA (-481.2±50.8HU) and non-IA (-586.8±100.3HU) in pGGNs with the maximum diameter less than 1cm were statistically different, p=0.012, AUC=0.811, 95%CI(0.726-0.896), The optimal cutoff value -538.5HU, sensitivity 100%, specificity 73%. 3) Vacuole and smoking history differed significantly between two groups, p=0.029, 0.034, respectively. 4) The sex, year and pleural indentation had no statistical difference between two groups, p=0.185, 0.382, 1.000.

CONCLUSION
In pGGNs with the maximum diameter less than 1cm, IA accounted for 3.7%. It is helpful to judge the infiltration of histology using the average CT value, smoking history and vacuole. The mean CT values could differentiate IA from non-IA in pGGNs with the maximum diameter less than 1cm; it had higher sensitivity.

CLINICAL RELEVANCE/APPLICATION
Early diagnosis and early treatment is very important to the prognosis of patient, it will greatly improve the patient’s quality of life.

Imaging-Based Surrogate Markers of Epidermal Growth Factor Receptor (Egfr) Mutation in Lung Adenocarcinoma: A Local Perspective

METHOD AND MATERIALS
169 patients with pGGN with the maximum diameter less than 1cm confirmed by surgical pathology in our hospital were enrolled in this study for retrospective analysis, including 169 lesions, 16 atypical adenomatous hyperplasia (AAH) (9.5%), 100 adenocarcinoma in situ (AIS) (59.2%), 47 minimally invasive adenocarcinoma (MIA) (27.8%) and 6 IA (3.7%). All patients performed HRCT scan within 1 week before surgery. We measured the maximum diameters and average CT values of all pGGNs and recorded the relevant imaging characteristics on HRCT. Using SPSS17.0 statistical software, we compared clinical and radiographic features of IA with non-IA.

RESULTS
1) In pGGNs with the maximum diameter less than 1cm, IA accounted for 3.7%. 2) The mean CT values between IA (-481.2±50.8HU) and non-IA (-586.8±100.3HU) in pGGNs with the maximum diameter less than 1cm were statistically different, p=0.012, AUC=0.811, 95%CI(0.726-0.896), The optimal cutoff value -538.5HU, sensitivity 100%, specificity 73%. 3) Vacuole and smoking history differed significantly between two groups, p=0.029, 0.034, respectively. 4) The sex, year and pleural indentation had no statistical difference between two groups, p=0.185, 0.382, 1.000.

CONCLUSION
In pGGNs with the maximum diameter less than 1cm, IA accounted for 3.7%. It is helpful to judge the infiltration of histology using the average CT value, smoking history and vacuole. The mean CT values could differentiate IA from non-IA in pGGNs with the maximum diameter less than 1cm; it had higher sensitivity.

CLINICAL RELEVANCE/APPLICATION
Early diagnosis and early treatment is very important to the prognosis of patient, it will greatly improve the patient’s quality of life.
To identify CT features of epidermal growth factor receptor (EGFR) mutation-positive lung adenocarcinoma in a heterogeneous, multi-ethnic population. Our secondary objective is to determine whether the imaging-based surrogate markers of EGFR mutation in our population are similar to those found in the Asian population.

**METHOD AND MATERIALS**

EGFR mutation was determined by using polymerase chain reaction system EGFR kits. Preoperative chest CT scans of 223 patients with adenocarcinoma of the lung (112 with EGFR mutation and 111 without mutation) were independently assessed for 20 specific CT features by two radiologists, who were blinded to the EGFR mutation status of patients. Univariable and Multiple logistic regression analyses were performed to discriminate characteristics of tumors with and without EGFR mutation, and determine areas under the receiver operating characteristic curve (ROC).

**RESULTS**

EGFR mutation-positive adenocarcinomas were more frequently found in female patients (p < 0.06), less than 20-year pack smoking history (p < 0.01), smaller tumor size (p < 0.01) and tumors without emphysema (p < 0.01). Ill-defined borders, spiculations, bubble-like lucency, non-central distribution, pleural retraction and lack of lobulations were more common in EGFR mutation-positive tumors but without reaching statistical significance, in contrast to the Asian population. Multivariable logistic regression analyses of combined clinical and radiological features identified less than 20 year-pack smoking history, smaller tumor diameter, fine or coarse spiculations, pleural attachment, non-central distribution and lack of centrilobular emphysema, as the strongest independent prognostic factors for the presence of EGFR mutation. These combined features improved prognostic ability (area under ROC curve: 0.874) compared to clinical features only (areas under ROC curve: 0.798).

**CONCLUSION**

Several CT findings help to predict the presence of EGFR mutation in lung adenocarcinomas in our population, essentially similar to those found in the Asian population. Combining clinical and radiological features improves the prognostic ability to determine the EGFR mutation status compared to clinical features alone.

**CLINICAL RELEVANCE/APPLICATION**

Identification of CT features can improve the prognostic predictive ability of lung adenocarcinomas, future diagnostic tools and treatment selection. This will improve overall cost-benefit and burden on the healthcare system.

**CH305-SD-THB4**

**Logistic Regression Model of Thin-Slice Computed Tomography Features Differentiate Invasive Lung Adenocarcinoma Appearing as Subsolid Nodules within 5 to 10 mm in Diameter**

**Participants**

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**PURPOSE**

To comprehensively investigate the role of multifactor analysis of thin-slice computed tomography (TSCT) features using logistic model in the differential diagnosis of invasive adenocarcinomas (IACs), appearing as lung subsolid nodules with 5 to 10 mm in diameter.

**METHOD AND MATERIALS**

Two hundred eighty-eight patients with 313 pathologically diagnosed ground glass nodules (GGNs) were included in this study. The TSCT features of adenocarcinoma in situ and minimally invasive adenocarcinoma (AIS & MIA) and invasive adenocarcinoma (IAC) were compared and analyzed. A logistic regression model was trained and tested based on TSCT features, and receiver operating characteristic (ROC) analysis were compared between the model and size or mean CT value.

**RESULTS**

There were 247 AISs & MIAs (58 AISs, 189 MIAs) and 66 IACs were included. Compared with AISs & MIAs, the IACs was significantly larger in size and higher in mean CT value, and presented higher frequency of mixed GGNs (P both < 0.001), clear interface of tumor-lung, bubble lucency, spiculation, pleural indention, and different locations (P all < 0.05). Logistic regression model found some characters (gender, size, interface of tumor-lung, pulmonary vessel change, and mean CT value2) were most significantly related (P < 0.001). The AUC of logistic regression model of 0.894 with the sensitivity of 89.4% and the specificity of 78.1%, cut off value of -499.53 Hu, P both <0.001).

**CONCLUSION**

Conclusion: Logistic model using TSCT features may help the differential diagnosis of the lung subsolid nodules within the diameter of 5 mm to 10 mm. And a clinical diagnosis clue of IACs was discovered that subsolid nodules which are larger in size and higher in
mean CT value. Besides, the logistic regression model needs validation of the predict capacity from further study.

**CLINICAL RELEVANCE/APPLICATION**

Logistic regression model of thin-slice computed tomography features differentiate invasive lung adenocarcinoma appearing as sub-solid nodules within 5 to 10 mm in diameter

**CH306-SD-TH6**  
**Association Between CT Texture Characteristics and EGFR Gene Mutation of Lung Adenocarcinoma**

Participants
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**PURPOSE**

To investigate the correlation between epidermal growth factor receptor (EGFR) gene mutation and CT texture characteristics of lung adenocarcinoma.

**METHOD AND MATERIALS**

94 CT texture features, including 19 First Order Statistics characteristics, 27 Gray Level Co-occurrence Matrix (GLCM) characteristics, 16 Gray Level Run Length Matrix (GLRLM), 16 Gray Level Size Zone Matrix (GLSZM) characteristics and 16 Shape-based characteristics, were extracted from thin-slice CT images of 411 patients with pathological proved lung adenocarcinoma using an open source texture analysis software (PyRadiomics, available at http://www.radiomics.io/pyradiomics.html). The requirement of informed consent was waived by the medical ethic committee of our hospital due to retrospective nature. The association of 94 CT texture features and 3 clinical features (age, gender and smoking status) with EGFR gene phenotype was compared using univariate analysis. CT texture features with p value less than 0.05 at multivariate analysis and clinical features were introduced into Logistic regression model to identify the independent risk factors.

**RESULTS**

Of the 411 patients with lung adenocarcinoma, 209 (50.9%) were EGFR mutants and 202 (49.1%) were wild type. EGFR mutation status were related to gender (P = 0.000) and smoking status (P = 0.000). Four CT texture features, which were termed as Energy, Large Area Low Gray Level Emphasis, SizeZoneNonUniformityNormalized and Small Area Emphasis, showed P value less than 0.05 at univariate analysis. Logistic regression analysis identified that smoking status and SizeZoneNonUniformityNormalized can independently predict EGFR mutation status with OR values of 0.294 (95% CI: 0.183-0.470; P=0.000) and 0.007 (95% CI: 0.000-0.012; P=0.007), respectively. The AUC values of Smoking status, SizeZoneNonUniformityNormalized and SizeZoneNonUniformityNormalized combined with smoking status predicting EGFR gene mutation in lung adenocarcinomas were 0.629, 0.571 and 0.663, respectively.

**CONCLUSION**

Some CT texture features of lung adenocarcinoma were associated with EGFR mutation. CT texture features combined with clinical features can be valuable imaging biomarkers to predict EGFR gene mutation status of lung adenocarcinoma.

**CLINICAL RELEVANCE/APPLICATION**

Using CT texture features to predict EGFR status of lung adenocarcinoma can provide decision support for personalized therapy.

**CH307-SD-TH6**  
**Comparison of Novel Whole Nodule First Pass Analysis versus Standard Maximum Slope Model in the Detection of Lung Malignancies using Low-Dose CT Perfusion**

Participants
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**PURPOSE**

To assess the diagnostic capability of a novel, whole nodule, first-pass analysis technique to the current maximum slope model when classifying pulmonary nodules as benign or malignant using low-dose CT perfusion.

**METHOD AND MATERIALS**

Nineteen patients (8 males, 11 females; mean age of 61 years) with pulmonary nodules underwent low-dose dynamic CT perfusion scan and histopathological diagnosis. A total of 20 volume scans were acquired using a 320-detector CT scanner for duration of 90 seconds after 40 mL of contrast followed by a 40 mL saline chaser at an injection rate of 5 mL/sec. Pulmonary arterial perfusion (PAP) and bronchial arterial perfusion (BAP) in mL/min/100ml and Perfusion Index (PI = PAP/(PAP+BAP)) were assessed using all 20 volume scans for dual-input maximum slope model (MSM) perfusion using standard 2D technique. For the novel, dual-input, whole nodule first-pass analysis (FPA) measurement, only four volume scans were used to obtain absolute PAP, BAP (both in mL/min/g) and PI. Average perfusion values within the entire tumor were compared with the biopsy results as the reference standard. To
evaluate diagnostic capability, student’s t-test, 95% confidence interval, and receiver-operating characteristic (ROC) curve analysis were performed.

**RESULTS**

Using the perfusion index with a cutoff threshold of 0.6 for MSM technique and 0.5 for the FPA technique, the overall accuracy, sensitivity, and specificity were 0.47, 0.46, 0.50 and 0.68, 0.73, 0.63, respectively. The effective radiation dose for the MSM and the FPA technique were estimated to be 26 and 2.4 mSv, respectively.

**CONCLUSION**

Whole nodule, first-pass analysis perfusion technique is more accurate in detecting malignant pulmonary nodules using the perfusion index as an imaging biomarker while simultaneously lowering the radiation dose by a factor of 10 when compared to standard maximum slope low-dose CT perfusion techniques.

**CLINICAL RELEVANCE/APPLICATION**

Whole nodule first-pass technique can be prospectively implemented to substantially reduce patient dose while accurately detecting malignant pulmonary nodules.

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**Molecular Testing Guideline for the Selection of Patients with Lung Cancer for Treatment with Targeted Therapies as per ASCO 2018 Guidelines: Relevance for Radiologists**

Station #7

**Awards**

**Certificate of Merit**

Participants

Nikhil H. Ramaiya, MD, Jamaica Plain, MA (Abstract Co-Author) Nothing to Disclose
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**TEACHING POINTS**

1. Discuss the new 2018 ASCO guidelines for selection of advanced lung cancer patients being considered for treatment with targeted Tyrosine Kinase and Immune check point inhibitors. 2. Discuss the various oncogenic drivers associated with non-small cell lung cancer and its relevance for radiologists. 3. Discuss the different subtypes of lung adenocarcinoma with respect to its initial presentation, clinical behavior over the course of disease, targeted treatment options, response criteria and toxicity profile of the common and the uncommon agents used for treatment of advanced lung cancer.

**TABLE OF CONTENTS/OUTLINE**

- Overview of the new 2018 ASCO guidelines.
- Image rich presentation of various EGFR, ALK rearranged, ROS-1 and BRAF V600 mutant lung cancer patients.
- Provide examples of Tyrosine Kinase Inhibitors (Tarceva, Crizotinib, Ceritinib, Darafenib and Trametinib) in lung adenocarcinoma along with response assessment and adverse events of the Tyrosine Kinase Inhibitors (colitis, Pneumonitis, osteopenia, Renal cysts).
- Provide examples of Immune Check point Inhibitors (Pembrolizumab and Nivolumab) used commonly in lung adenocarcinoma and squamous cell carcinoma along with discussion of the evolving immune response criteria and immune related adverse events.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Nikhil H. Ramaiya, MD - 2017 Honored EducatorSreeharsha Tirumani, MBBS, MD - 2016 Honored Educator
Hot Topic Session: Biomarker and Personalized Medicine in Lung Cancer Imaging

Thursday, Nov. 29 3:00PM - 4:00PM Room: E350

Participants
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Sub-Events

SPSH52A Personalized Medicine and Lung Cancer Biomarkers: The Oncologist's Perspective

Participants
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LEARNING OBJECTIVES
1) Describe the goals and current state of personalized therapy for patients with non-small cell lung cancer. 2) Identify the lung cancer biomarkers now in clinical use as well as those in experimental trials. 3) Understand the barriers to optimal selection of individual patient therapy from the clinical and basic research perspective.

SPSH52B Imaging Biomarkers in Non-small Cell Lung Cancer

Participants
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LEARNING OBJECTIVES
1) Identify the imaging manifestations and patterns of disease associated with specific non-small cell lung cancer genetic mutations such as EGFR and KRAS and rearrangements such as ALK on computed tomography (CT) and FDG positron emission tomography (PET)/CT. 2) Describe the role of established response criteria and emerging and novel imaging techniques on the assessment of treatment response in non-small cell lung cancer. 2) Understand the continuously evolving impact of radiogenomics, defined as the linking of medical images with the genomic properties of neoplasms, in predicting the presence of specific genetic alterations, response to therapy, and survival of patients with non-small cell lung cancer.

Honored Educators
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SPSH52C Using Artificial Intelligence to Develop Non-invasive Biomarkers in Lung Cancer

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

LEARNING OBJECTIVES
1) Learn about the motivation and methodology of AI technologies in lung cancer imaging. 2) Learn about scientific studies investigating the role of radiologic AI with other -omics data for precision medicine. 3) Learn about open-source informatics developments.
**RC701**  
**Imaging of Thoracic Neoplasms: Update 2018 (Interactive Session)**

*Thursday, Nov. 29 4:30PM - 6:00PM Room: E450A*

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**Participants**
Edith M. Marom, MD, Tel Aviv, Israel (*Moderator*) Speaker, Bristol-Myers Squibb Company; Speaker, Boehringer Ingelheim GmbH;

For information about this presentation, contact:
edith.marom@gmail.com

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

**Sub-Events**

**RC701A  Lung Nodule Management**

*Participants*
Jin Mo Goo, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Research Grant, Samsung Electronics Co, Ltd; Research Grant, Lunit Inc

For information about this presentation, contact:
jmgoo@plaza.snu.ac.kr

**LEARNING OBJECTIVES**
1) List the major components in determining lung nodule management. 2) Compare the management guidelines for lung cancer screening and those for incidental nodules. 3) Describe how to measure lung nodules at CT.

**RC701B  Lung Cancer Staging: TNM 8th Edition**

*Participants*
Girish S. Shroff, MD, Houston, TX (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**
1) Review revisions to the TNM staging system. 2) Review how the new TNM staging system addresses lung adenocarcinoma.

**RC701C  Advances in MR Imaging of Lung Cancer**

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

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**LEARNING OBJECTIVES**
1) Understand the appropriate MR sequence for answering each clinical question, especially lung cancer patients. 2) Identify the clinical relevance of MR imaging as compared with other modalities in not only lung cancer, but also pulmonary nodule and mass. 3) Recognize the potential of state-of-the-art MR imaging for thoracic oncologic patients.

**ABSTRACT**
Since the clinical application of MR imaging in thoracic diseases, numerous basic and clinical researchers reported technical advances in sequencing, scanners and coils, image acquisition and reconstruction techniques, contrast media utilization, and development of post-processing tools. As a result, state-of-the-art thoracic MR imaging now has the potential to be used as a substitute for traditional imaging techniques and/or play a complimentary role in patient management. In this lecture, I will have a lecture for 1) understanding the appropriate MR sequence for answering each clinical question, especially lung cancer patients, 2) demonstrating the clinical relevance of MR imaging as compared with other modalities in not only lung cancer, but also pulmonary nodule and mass, and 3) showing the potential of state-of-the-art MR imaging for thoracic oncologic patients.

**RC701D  Evaluating Tumor Response**

*Participants*
Tina D. Tailor, MD, Durham, NC (*Presenter*) Nothing to Disclose
LEARNING OBJECTIVES

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

Active Handout: Tina Dinesh Tailor

**RC701E Imaging of Thymoma**

Participants
Edith M. Marom, MD, Tel Aviv, Israel (Presenter) Speaker, Bristol-Myers Squibb Company; Speaker, Boehringer Ingelheim GmbH;

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LEARNING OBJECTIVES

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

Active Handout: Edith Michelle Marom

**Honored Educators**

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RC803  
**MR Imaging in the Thorax**

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

CA CH MR VA

AMa PRA Category 1 Credit ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

**Sub-Events**

**RC803A  MR Imaging of Mediastinal Masses**

Participants
Jeanne B. Ackman, MD, Boston, MA *(Presenter)* Spouse, Stockholder, Everest Digital Medicine; Spouse, Consultant, Everest Digital Medicine; Spouse, Stockholder, Cynvenio Biosystems, Inc; Spouse, Scientific Advisory Board, Cynvenio Biosystems, Inc; Spouse, Consultant, PAREXEL International Corporation

**LEARNING OBJECTIVES**

1) Comprehend value of Thoracic MRI as a problem solver in the mediastinum 2) Understand how MR assists with tissue diagnosis 3) Learn how MR can add diagnostic specificity beyond that of CT

**RC803B  MR Imaging of the Lung: A Practical Clinical Approach**

Participants
Juergen Biederer, MD, Heidelberg, Germany *(Presenter)* Nothing to Disclose

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**LEARNING OBJECTIVES**

1) To give an overview over appropriate indications for lung MRI. 2) To suggest a practical approach for the selection of suitable standard imaging protocols. 3) To discuss, how to adjust the standard examination for specific questions. 4) To make familiar with general aspects of lung MR image interpretation and the diagnostic scope of the technique.

**Active Handout:** Juergen Biederer


**RC803C  MR Imaging of Cardiac Masses**

Participants
Phillip M. Young, MD, Rochester, MN *(Presenter)* Consultant, Arterys Inc

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**RC803D  MR Imaging of Aortopathies**

Participants
Cristina Fuss, MD, Portland, OR *(Presenter)* Spouse, Officer, ViewRay, Inc

*For information about this presentation, contact:*

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**LEARNING OBJECTIVES**

1) To familiarize the learner with the most common familiar aortopathies, their clinical background, imaging appearance on MRI and specific considerations for MR acquisition planning.

**ABSTRACT**

Familial aortopathies comprise a group of inherited disorders of aortic aneurysms and/or dissection including. These include Thoracic Aortic Aneurysms and Aortic Dissections (TAAD), Marfan syndrome, Loeys-Dietz syndrome, and Ehlers-Danlos syndrome, only to name the most common ones.
PURPOSE

Based on pathological size TNM8 introduced additional T-descriptor size cutpoints at 1cm intervals impacting stage groups. Our aim was to determine whether radiological staging by different radiologists consistently classifies lesion size within this more detailed staging.

METHOD AND MATERIALS

4 thoracic radiologists (4-17yr experience) staged 180 consecutive new lung cancers, recording multiple parameters blinded to the study aim. Readers were provided with axial 2.5mm, 1mm, coronal and sagittal 3mm images and asked to stage the primary as per clinical practice. Readers recorded the solid component for subsolid lesions. 2 observers covertly recorded the image series used for review and measurement. Inter-rater consistency of primary lesion size and T-size determination was evaluated. The impact of reader recorded lesion characteristics on consistency was assessed.

RESULTS

Readers recorded lesions as solid in 78-87% of cases, part-solid in 11-17% and pure ground glass in 1-2% with a moderate mean inter-rater kappa (0.71). 176 lesions were considered measurable by at least 3 readers (median 38mm, 7-113mm), 95% evaluated by all 4 readers. Readers varied widely in measurement plane (2.5mm:20-90%, 1mm:2-54%, coronal:7-24%, sagittal:0-26%) and mean number of planes reviewed (1.1-3.0). For lesions the mean range of measurement about the consensus median size was 31% (3-175%). Increased reader range of measurement about the median size was associated with part solid (mean 43% v 29% solid, p<0.01 Mann Whitney U) and cavitary lesions (32 v 19%, p<0.05). Atelectasis and spiculation were not significant.

Using median size to determine T-descriptors, only 42% of cases had 100% reader concordance (74% concordance for at least 67% of readers). Complete concordance was significantly lower for groups T1c-T3 (20-35%) and higher in the remaining groups (42-67%). Mean inter-rater T assignment kappa was 0.57 (moderate), but higher with weighted kappa (0.80, good).

CONCLUSION

There is considerable variation in tumor size determination by thoracic radiologists, influenced by lesion perceived morphology, and measurement choices that result in lower inter-reader concordance for the narrower range TNM8 T-size criteria.

CLINICAL RELEVANCE/APPLICATION

Pathological size data informed increased numbers of cutpoints in TNM8 to better predict survival but increases radiological stage uncertainty and inter-reader variance in clinical practice.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Ioannis Vlahos, MRCP,FRCR - 2015 Honored Educator
A Novel Algorithm to Approach Multiple Lung Cancers with Multiple Pulmonary Sites of Involvement: Differentiation between Multiple Primary Lung Cancers and Intrapulmonary Metastasis

Friday, Nov. 30 10:40AM - 10:50AM Room: E350

Participants
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Yoon Kyung Jeon, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

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PURPOSE
To develop an differentiation algorithm in patients with multiple lung cancers, using clinical and imaging variables.

METHOD AND MATERIALS
We retrospectively included 112 lesions in 55 patients (57 pairs) with multiple lung cancers who received at least two separate surgeries between January 2007 and December 2016. Each pair of multiple lung cancers was classified into two categories with histopathologic findings as the standard reference: multiple primary lung cancer (MPLC) and intrapulmonary metastasis (IPM). We established five serial questions for differentiation; ‘Is either nodule pure ground-glass nodule on CT?’ or ‘Are both of the two lesions ground-glass dominant nodules?’ (Step1), ‘Does either nodule harbor air-bronchogram or irregular shape?’ (Step2), ‘Do both of the two nodules have the same or different grade of maximal standardized uptake values (SUVmax) on PET/CT?’ (Step3), and ‘Does either case harbor mediastinal LN or distant metastasis on preoperative work-up?’ (Step4). The SUVmax values were classified into grade 1(<2.5), grade 2(2.5-5.0), and grade 3(>5.0). At each decision step, each pair was classified as MPLC or IPM. The sensitivity, specificity, and accuracy of the differentiation algorithm were analyzed.

RESULTS
Among 57 pairs, 36 pairs (63.2%) were classified as MPLCs, and the other 21 pairs (36.8%) as IPMs of standard reference. In step1, 14 pairs were classified as MPLC. In step2, 10 pairs with absence of air-bronchogram or irregular contour on both lesions were classified as IPM. In step3, 8 pairs showing two grades of separate SUV were classified as MPLC. In step4, 3 pairs with mediastinal LN or distant organ metastasis were classified as IPMs and 22 pairs were considered MPLC. The sensitivity for MPLC (specificity for IPM), specificity for MPLC (sensitivity for IPM), and accuracy were 94.4%, 52.4%, and 78.9%, respectively. Accuracy for each step was 100% for step 1, 90% for step 2, 62.5% for step 3 and 68% for step 4, respectively.

CONCLUSION
Approach algorithm using comprehensive information and imaging questions can allow differentiation between MPLCs and IPMs in a substantial number of cases of multiple lung cancers with multiple pulmonary sites of involvement.

Risk of Occult Mediastinal Disease in Non-Small Cell Lung Cancer Patients with Radiographic N0 Disease according to Tumor Location

Friday, Nov. 30 10:50AM - 11:00AM Room: E350

Participants
Dongyoung Jeong, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
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PURPOSE
Lung cancer guidelines recommend invasive mediastinal staging for patients with centrally located tumors without evidence of nodal disease on imaging studies. However, there is no uniform definition of central tumor. This study aims to evaluate the risk of occult mediastinal disease in non-small cell lung cancer (NSCLC) patients with radiographic N0 disease according using several different definitions for central tumor.

METHOD AND MATERIALS
Of the patients who underwent curative-intent surgical resection or endobronchial ultrasound-guided transbronchial needle
aspiration between January 2014 and December 2015, 1,337 consecutive patients with radiographic N0 disease were identified. Based on the most proximal part of the tumor in computed tomography (CT) image, tumors were categorized using five different definitions; contact with hilar structure, located within inner one-third or two-thirds of hemithorax according to concentric or sagittal lines.

RESULTS
About 7% (93/1337) of patients had occult N2 disease and they had significantly larger tumor size and more solid tumors in CT image. All but inner two-thirds of hemithorax by sagittal line were associated with N2 disease. However, only inner one-third of hemithorax by concentric line remained significant after adjustment for tumor size and density in CT (adjusted odds ratio [95% confidence interval], 2.29 [1.28-4.11]).

CONCLUSION
We suggest using inner one-third of hemithorax by concentric line as indication of EBUS-TBNA in NSCLC with radiographic N0 disease.

CLINICAL RELEVANCE/APPLICATION
Using inner one-third of hemithorax by concentric line as indication of EBUS-TBNA in NSCLC with radiographic N0 disease.

SST02-04 Comparison of Computed Tomography and Clinical Findings Between Immune-Related Pneumonitis and Pneumonia by Pathogen in Patients Treated with Anti-Programmed Death-1 (PD-1)/Programmed Death Ligand 1 (PD-L1) Therapy

Friday, Nov. 30 11:00AM - 11:10AM Room: E350

Participants
Cherry Kim, MD, Ansan, Korea, Republic Of (Presenter) Nothing to Disclose
Mi Young Kim, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Chang-Min Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yeon Joo Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Immune-related pneumonitis (IRP) is an uncommon but potentially fatal toxicity of anti-programmed death-1 (PD-1)/programmed death ligand 1 (PD-L1) therapy for intrathoracic malignancy including non-small cell lung cancer. The purpose of study was to compare CT and clinical findings between IRP and pneumonia by pathogen.

METHOD AND MATERIALS
A total of 154 patients who received anti-PD-1/PD-L1 therapy were identified from 2014 to 2017. Among these patients, IRP developed in 9 (5.8%) and pneumonia in 30 (19.5%), which were confirmed through multidisciplinary approach. CT findings (reticulation, consolidation, ground glass opacity [GGO], interlobular septal thickening, micro- [<10mm] and macro-nodules [>=10mm], bronchial wall thickening, bronchiectasis, pleural effusion, and lesion distribution/bilaterality) and clinical features (symptom, smoking history, cancer staging, laboratory findings, underlying disease, prior radiotherapy history) were compared between IRP and pneumonia. Grade and outcome of IRP were also investigated.

RESULTS
In chest CT, diffuse reticulation (44.4% vs.0%, P=0.02), patchy/diffuse GGO (100% vs. 50%, P=0.01), and interlobular septal thickening (66.7% vs. 10%, P=0.002) were significantly more frequent in IRP than in pneumonia, whereas macronodule (0 vs. 36.7%, P=0.033) was significantly more common in pneumonia than IRP. IRP significantly showed peripheral location (77.8% vs. 16.7%, P=0.001) and bilateral distribution (44.4% vs. 3.3%, P=0.007). However, there were no significant differences in clinical findings between IRP and pneumonia. Among the IRP patients, 66.7% (6 of 9) of cases were grade 3, and 66.7% improved with drug holding/steroid therapy. The median onset duration of IRP from the first prescription was 126 days (range, 40-669), the median time for improvement was 43 days (range, 21-45), and the median time to death due to IRP was 18 days (range, 11-55).

CONCLUSION
Several CT findings including diffuse reticulation, patchy/diffuse GGO, and interlobular septal thickening with bilateral and peripheral distribution were more frequent in IRP than pneumonia by pathogen. Grade and outcome of IRP were also investigated.

CLINICAL RELEVANCE/APPLICATION
It is crucial to suspect IRP as opposed to pneumonia in routine practice. Radiologists should be familiar with those findings of IRP to avoid delayed diagnosis and serious drug related complication.

SST02-06 Growth Rates of Thymic Epithelial Tumor and Thymic Cyst: Is Differentiation Feasible?

Friday, Nov. 30 11:20AM - 11:30AM Room: E350

Participants
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Jin Mo Goo, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Research Grant, Samsung Electronics Co, Ltd; Research Grant, Lunit Inc

PURPOSE
Growth Rates of Thymic Epithelial Tumor and Thymic Cyst: Is Differentiation Feasible?
To investigate the growth rate of thymic epithelial tumors (TETs) and thymic cysts to determine whether they can be differentiated, and to identify clinico-radiological predictors of interval growth and their differential implications.

METHOD AND MATERIALS
This retrospective study included 122 patients (male:female=64:58; mean age, 57.2 years) with pathologically proven thymic cysts (n=56) or TETs (n=66) who underwent 2 serial chest CT scans at least 8 weeks apart. Average diameters were measured, and volume-doubling times (VDTs) were calculated. Attenuation was also measured and clinical characteristics were recorded. VDTs were compared between the thymic cysts and TETs using the log-rank test. Predictors of growth were analyzed using the log-rank test and Cox regression analysis.

RESULTS
The frequency of growth did not significantly differ between TETs and thymic cysts (P=0.279). The VDT of the thymic cysts (median, 324 days) was not significantly different from that of the TETs (median, 475 days; P=0.808). Water attenuation (<=20 Hounsfield Unit) predicted growth in thymic cysts (P=0.016; HR, 13.2 [95% CI, 1.6-107.3]) and lesion size (>17.2 mm) predicted growth in TETs (P=0.008 for size and P=0.029 for size*time; HR=e^(-0.001×time+1.654)). Among the growing lesions, positive and negative predictive values of water attenuation for the thymic cysts was 93% and 80%, respectively.

CONCLUSION
The frequencies of interval growth and VDTs were indistinguishable between TETs and thymic cysts. Water attenuation and lesion size predicted growth in thymic cysts and TETs, respectively. Among the growing lesions, the water attenuation was a differential feature of thymic cysts.

CLINICAL RELEVANCE/APPLICATION
Water attenuation (<=20 HU) indicates thymic cysts for the growing thymic lesions. Thus, CT follow-up, instead of surgical resection, can be recommended for the obvious cysts even if they show interval growth.

SST02-07 Cut-Off Value of MR Enhancement for Differentiating Benign Cysts from Solid Anterior Mediastinal Lesion: A Preliminary Observation

Participants
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PURPOSE
To determine the optimal cut-off value of MR enhancement for the differentiation of benign cysts from solid lesions in the anterior mediastinum.

METHOD AND MATERIALS
The derivation dataset consisted of 19 consecutive patients with pathologically proven benign cysts (n=7) and solid lesions (n=12) in the anterior mediastinum who underwent a diagnostic contrast-enhanced MR from two institutions. We measured maximum diameters, T1 and T2 signal intensities (SI), apparent diffusion coefficients (ADCs) from diffusion-weighted images, and relative enhancement ratios (RERs). T1 and T2 SIs were normalized by SI of cerebrospinal fluid. RERs were obtained from the subtraction of diameters, T1 and T2 signal intensities and ADCs. Relative enhancement ratios (RERs) were determined based on a receiver operating characteristic curve. For validation, two separate datasets were utilized: 1) 15 patients with 8 cysts and 7 solid lesions from another institution (validation dataset 1); 2) 11 patients with MR-proven stable benign cysts more than 2 years (validation dataset 2). Diagnostic accuracies were calculated from validation datasets.

RESULTS
Normalized T2 SI (0.21-0.92 vs. 0.12-0.58; P<.013), ADC (1.76-4.09 vs. 0.66-2.93 10-3 mm2/s; P<.013), and RER (0.41-24.1% vs. 28.1-771.7%; P<.001) significantly differed between cysts and solid masses. RER of 26% or less was determined as the cutoff value for differentiation of cysts from solid masses. In validation dataset 1, the cutoff value showed sensitivity of 87.5% and specificity of 100%, the sensitivity of 90.9% was observed in validation dataset 2.

CONCLUSION
The assessment of RER with the cutoff value of 26% can appropriately differentiate benign cysts from solid anterior mediastinal masses.

CLINICAL RELEVANCE/APPLICATION
The differentiation of benign cysts from solid anterior mediastinal masses can be supported by quantitative measurement of RER, potentially reducing a futile thymectomy.

SST02-08 Primary Tumor Standardized Uptake Value (SUVmax) as Powerful Prognostic Factor for Early...
**Esophageal Squamous Cell Carcinoma**

Friday, Nov. 30 11:40AM - 11:50AM Room: E350

Participants
Dongyoung Jeong, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Kyung Soo Lee, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yeonu Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sunggoo Park, MD,DVM, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**
We have previously shown that initial PET-SUVmax (Standardized uptake value) of early esophageal cancer helps both discriminating T1a and T1b stage esophageal squamous cell carcinoma (eSCC) from other eSCCs. In this study, we analyze the impact of PET-SUVmax for patient’s survival.

**METHOD AND MATERIALS**
This retrospective study was based on 435 patients with a surgically proven early T- (Tis or T1a [< T1a], T1b and T2) stage eSCC. We performed survival analysis by the Kaplan-Meier method and comparisons of survival using log-rank test.

**RESULTS**
131 < T1a, 234 T1b, and 70 T2 eSCCs were enrolled. Mean SUVmax value were 2.53 for < T1a eSCCs, 4.02 for T1b eSCCs and 9.69 for T2 eSCCs. With ROC curve analysis, cut off value of SUVmax 3.05 (AUC: 0.757; 95% CI, 0.710-0.803; P < .001) at PET provided sensitivity 74.8% (98/131), specificity 70.1% (213/304), respectively, for differentiating < T1a eSCCs from other cancers. Cut off value of SUVmax 5.65 (AUC: 0.897; 95% CI, 0.857-0.937; P < .001) provided sensitivity 77.1% (54/70), specificity 87.7% (320/365), respectively, for differentiating T1 (< T1b) eSCCs from T2 eSCCs. In multivariate analysis, both SUVmax and pathologic staging including tumor size and node involvement were significant predictors of survival (p < 0.01). Survival analysis and log-rank test showed significant difference for overall survival among groups based on proposed cut-off SUVmax values (p =0.008 for cut off value 3.05, p =0.001 for cut off value 5.65).

**CONCLUSION**
In early esophageal squamous cell carcinomas, SUVmax gives us powerful predictor of overall survival after resection.

**CLINICAL RELEVANCE/APPLICATION**
Pretreatment SUVmax of primary esophageal cancer shows powerful predictive values which can be comparable to pathologic T stage.

**SST02-09 Surgically Resected T1- and T2-Stage Esophageal Squamous Cell Carcinoma: T and N Staging Performance of EUS- and PET/CT**

Friday, Nov. 30 11:50AM - 12:00PM Room: E350

Participants
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Myung Jin Chung, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Research Grant, General Electronic Company; Research Grant, Samsung Electronics Co, Ltd; Research Grant, Lunit Inc
Joon Young Choi, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**
To demonstrate the frequency of nodal metastases and to disclose the diagnostic performance of endoscopic ultrasonography (EUS) and PET/CT in T and N staging in surgically resected early-stage esophageal squamous cell carcinomas (eSCCs).

**METHOD AND MATERIALS**
IRB approved this retrospective study with waiver of informed consent for reviewing medical record. We included 435 patients with an early T-stage (Tis or T1a [< T1a], T1b and T2) eSCC. The rates of metastatic lymphadenopathy were calculated. Then, the performance of EUS and PET/CT in subdividing T and N stages was assessed.

**RESULTS**
131 < T1a, 234 T1b, and 70 T2 eSCCs were identified. In discriminating < T1a from other cancers, the sensitivity, specificity and accuracy of EUS were 60.3% (79/131), 80.3% (244/304), and 74.3% (323/435), respectively. With ROC curve analysis, cutoff value of SUVmax 3.05 at PET provided sensitivity 73.3% (96/131), specificity 70.4% (214/304), and accuracy 71.3% (310/435) for differentiating < T1a eSCCs from others. Ten (7.6%) of 131 < T1a cancers had nodal metastasis. In discriminating N0 from node-positive disease, sensitivity, specificity and accuracy of EUS were 89.6% (267/298), 41.6% (57/137) and 74.5% (324/435), respectively, whereas those of PET/CT were 98.9% (265/298), 38.7% (53/137), and 73.1% (318/435), respectively.

**CONCLUSION**
In > 70% of patients with < T1a eSCCs, the tumor stage can be discriminated from higher stage cancers by using EUS or PET/CT, and substantial percentage (7.6%) of < T1a eSCC patients have nodal metastases, but the nodes are missed in more than half of the patients in clinical staging.
Substantial percentage (7.6%) of < T1a eSCC patients have nodal metastases, and nodal metastasis rates increase as T stage increases (T1b [37.6%] and T2 [55.7%]). Moreover, more than half of nodal metastases were missed on PET/CT or EUS. Thus, after endoscopic surgery or even after curative surgical resection of < T1a eSCCs, adjuvant therapy is needed for those having nodal metastasis.
SPFR61

Friday Imaging Symposium: Screening with Imaging in 2018: Who Benefits?

Friday, Nov. 30 12:30PM - 3:00PM Room: E350

BR CH GI GU OI

AMA PRA Category 1 Credits ™: 2.50
ARRT Category A+ Credits: 3.00

FDA Discussions may include off-label uses.

Participants
Hebert Alberto Vargas, MD, Cambridge, United Kingdom (Moderator) Nothing to Disclose
Dow-Mu Koh, MD, FRCR, Sutton, United Kingdom (Moderator) Nothing to Disclose

Sub-Events

SPFR61A Breast Cancer Screening: Lessons Learned from Where it all Started

Participants
Victoria L. Mango, MD, New York, NY (Presenter) Nothing to Disclose

For information about this presentation, contact:
mangov@mskcc.org

LEARNING OBJECTIVES
1) Discuss early mammography screening trials for breast cancer. 2) Analyze recent multi-modality breast cancer screening literature. 3) Apply lessons learned from breast cancer screening to future screening for other diseases.

ABSTRACT
N/A

URL
N/A

SPFR61B Emerging CRC Screening Options

Participants
Perry J. Pickhardt, MD, Madison, WI (Presenter) Stockholder, SHINE Medical Technologies, Inc; Stockholder, Elucent Medical; Advisor, Bracco Group;

LEARNING OBJECTIVES
1) To Understand the various CRC screening options, with emphasis on newer emerging strategies.

ABSTRACT
N/A

URL
N/A

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Perry J. Pickhardt, MD - 2014 Honored Educator Perry J. Pickhardt, MD - 2018 Honored Educator

SPFR61C Liver Cancer Screening: Who Benefits?

Participants
Bachir Taouli, MD, New York, NY (Presenter) Research Grant, Guerbet SA; Research Grant, Bayer AG

For information about this presentation, contact:
bachir.taouli@mountsinai.org

LEARNING OBJECTIVES
1) Review current guidelines for liver cancer screening, including target population and methods used. 2) Review the limitations of blood markers and ultrasound for liver cancer screening. 3) Review new methods such as abbreviated MRI for liver cancer
screening.

**ABSTRACT**

Hepatocellular carcinoma (HCC) is the 2nd leading cause of cancer-related death worldwide, and the fastest growing cause of cancer death in the USA. The most important risk factor for HCC is cirrhosis. In this presentation, we will discuss the rationale of HCC screening, the most recent AASLD guidelines for HCC screening and surveillance using ultrasound (US) with or without alpha-fetoprotein (AFP). We will review the current results and limitations of this strategy. We will also review recent developments in the use of abbreviated MRI protocols for HCC screening and surveillance.

**SPFR61D Lung Cancer: Should We Be Screening Patients with Other Cancers?**

Participants
Michelle S. Ginsberg, MD, New York, NY (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the approach to the inclusion of patients with a previous history of malignancy in lung cancer screening studies. 2) To discuss the need for lung cancer screening in survivors of other cancers.

**SPFR61E Prostate Cancer Screening: Will it Ever Happen?**

Participants
Harriet C. Thoeny, MD, Bern, Switzerland (Presenter) Advisory Board, Guerbet SA

**LEARNING OBJECTIVES**

1) To identify the disadvantages of the current gold standard of prostate cancer detection. 2) To differentiate significant form insignificant PCa and to understand its impact on management. 3) To assess the prerequisites of mpMRI as a screening tool of prostate cancer detection.

**ABSTRACT**

Prostate cancer (PCa) is the most frequent malignant tumor in men in Europe and the USA. Up to date systematic transrectal ultrasound guided- (TRUS) biopsy based on a rise in PSA and/or a suspicious digital rectal examination is the gold standard in PCa detection. However, this approach is unsatisfactory as it leads to over- and underdiagnosis of PCa. MpMRI is now an integrated part in the workup of PCa in many institutions and MR/TRUS-fusion guided instead of systematic blind biopsies are more frequently used leading to a higher detection rate of significant PCa on one hand and a lower detection rate of insignificant PCa on the other hand. The NPV of mpMRI to detect significant PCa is reported between 63-98% deepening on patient selection. mpMRI improves PCa detection and might therefore be a valuable tool for PCa screening however, the prerequisites include excellent image quality, a dedicated and experienced radiologist, availability of MRI and a short imaging protocol without contrast medium administration to make the healthcare authorities considering mpMRI as a cost effective screening tool. Furthermore, an improved NPV might reduce the number of unnecessary biopsies in a high number of men and therefore decrease costs for the healthcare system.

**SPFR61F Ovarian Cancer Screening: Have We Given Up Yet?**

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

**LEARNING OBJECTIVES**

1) To know about the results of ovarian cancer screening studies. 2) To understand the possible reasons for failure. 3) To be aware of screening studies in high risk patients.

**Honored Educators**

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**SPFR61G Non-cancer Screening: Should We Screen for Cardiovascular Diseases with Imaging?**

Participants
Mathias Prokop, PhD, Nijmegen, Netherlands (Presenter) Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG; Research Grant, Canon Medical Systems Corporation; Speakers Bureau, Canon Medical Systems Corporation; Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Departmental spinoff, Thirona; Departmental licence agreement, Varian Medical Systems, Inc;

**SPFR61H Whole-body Screening for Multiple Cancers: Is a One-Stop-Shop Approach Feasible?**

Participants
Giuseppe Petralia, MD, Milan, Italy (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the most appropriate imaging technique for whole-body cancer screening. 2) Arrange a whole-body MRI scanning protocol in their home Institutions. 3) Describe findings observed in a whole-body MRI performed for cancer screening in a Likert scale. 4) Recommend the whole-body MRI for cancer screening to the appropriate population.