Educational and Scientific Posters

Society of Thoracic Radiology
Scientific Posters
March 16-19, 2014
Grant Hyatt San Antonio Hotel, San Antonio, TX

101 The Secondary Pulmonary Lobule: An Important Anatomical Structure in the Detection and Characterization of Lung Disease on HRCT
Robert Perone, MD

102 EKG for the Cardiothoracic Radiologist
Conor M. Lowry, MD
Lowry CM, Bernheim AM and Goyal N

103 Thoracic Radiology of Left Atrial Appendage Closure Devices
Conor M. Lowry, MD
Lowry CM, Bernheim A and Goyal N

104 Computational Techniques for Detecting and Characterizing Coronary Atherosclerosis
Richard D. Abrich, BASc, MASc
Abrich RD, Paul N and Wong W

105 Accuracy of Interpreting Coronary CTA in an Inner-City Overweight Population
Andrew J. Plodkowski, MD
Plodkowski AJ, Roszler S, Levsky JM, Godelman A, Cohen HW and Haramati LB

106 Right Ventricle Pathology on Routine Chest CT
Adam Bernheim, MD
Bernheim A, Lowry CM and Goyal N

107 Imaging of Cardiac Devices: A Pictorial Review
Aimee P. Carswell, MD
Carswell AP, Restrepo CS, McCarthy MJ, Mumbower A and Katre R

108 Personalized Radiation Dose Reduction and Image Quality Optimization in CT Coronary Angiography using Iterative Reconstruction: A Practical Approach in 4 Easy Steps!
Masoud Shariat, MD
Shariat M, Wintersperger B, Nguyen E, Crean A, Thavendiranathan P and Paul N

109 Uncommon Diseases Involving the Coronary Arteries
Yuen-Li Ng, BMedSci, BMBS, FRCR
Ng Y-L, Low SA, Lath N, Lim S-Y and Cheah FK

110 Diagnosis and Management of Non-ischemic Heart Disease: Role of Non-invasive Imaging Modalities
Ayman H. Gaballah, MD, FRCR
Gaballah AH, Mueller G, Frank L and Stojanovska J

111 In vivo Normalization of Contrast Gradients in CT Coronary Angiography Using a Mathematical Function
Hany Kashani, MD-MSc
Kashani H, Hickey M, Ursani A, Homamapour S, Sajja S and Paul N

112 Cardiac Mass Evaluation with CT and MRI
Ethany Cullen, MD
Cullen E and Araoz P

113 How Typical are the 'Typical' Features of Cardiac Amyloidosis on Cardiac Magnetic Resonance?
Masoud Shariat, MD
Shariat M, Thavendiranathan P, Nguyen E, Wald R, Paul N and Crean AM
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>114</td>
<td>Cardiac Amyloidosis and Sarcoidosis: CMR Features with Pathologic Correlation</td>
<td>Patricia J. Mergo, MD, MERGO PJ, Shapiro BP, Parikh PP, Giesbrandt KJ and Bowman AW</td>
</tr>
<tr>
<td>115</td>
<td>Imaging the Tips of the Ventricles: A Systematic Approach to Apical Pathology</td>
<td>Kate Hanneman, MD, HANNEMAN K, Crean AM, Wintersperger B and Nguyen ET</td>
</tr>
<tr>
<td>117</td>
<td>Cystic Fibrosis Presenting in Adulthood: What the Radiologist Needs to Know</td>
<td>Lulu Zhang, MD, ZHANG L, Czum JM, Ashare A and Black WC</td>
</tr>
<tr>
<td>118</td>
<td>Fat Embolism - Spectrum of Manifestations in an Under Recognized Syndrome</td>
<td>Katrina Newbigin, BSc, MD, NEWBIGIN K, Marchiori E, Gupta A and Souza C</td>
</tr>
<tr>
<td>119</td>
<td>Pulmonary Drug Toxicities: An Interactive Approach</td>
<td>Eiman N. Anvari, DO, MS, ANVARI EN, Czum JM, Brandt RJ, Black WC, Delong P and Bond JS</td>
</tr>
<tr>
<td>120</td>
<td>Radiologist Performance in the Diagnosis of Birt-Hogg Dube Syndrome</td>
<td>Jay E. Haggerty, MD, HAGGERTY JE, Chughtai AR, Gross BH, Kazerooni EA and Agarwal P</td>
</tr>
<tr>
<td>121</td>
<td>An Update on the Idiopathic Interstitial Pneumonias</td>
<td>Stephen Hobbs, MD, HOBBS S, Groshong S and Lynch D,</td>
</tr>
<tr>
<td>122</td>
<td>Radiographic Approach to Non-resolving Lung Consolidation</td>
<td>Archana Laroia, MD, LAROIA A and Laroia S</td>
</tr>
<tr>
<td>123</td>
<td>Radiographic Interstitial Lung Abnormalities in Advanced NSCLC Patients During Platinum-based Chemotherapy: A Systematic Study in a Cohort with Wild-type EGFR, ALK, BRAF, and KRAS</td>
<td>Mizuki Nishino, MD, NISHINO M, Cardarella S, Araki T, Lydon C, Rabin MS and Johnson BE</td>
</tr>
<tr>
<td>125</td>
<td>Utility of Quantitative and Qualitative CT for Routine Use as an Adjunct to the Clinical Assessment of Chronic Obstructive Pulmonary Disease (COPD)</td>
<td>Alastair Moore, MD, MOORE AJ, Walsh RR, Creed WG, Lutchmedial S, Kaminsky DA, and Gentchon GE</td>
</tr>
<tr>
<td>126</td>
<td>Post-procedure Radiographic Appearance after Aeraiseal Bronchoscopic Lung Volume Reduction</td>
<td>Annie L. Harris, MD, HARRIS AL, Terry NLJ, Sonavane S, Watts JR, Dransfield MT and Singh SP</td>
</tr>
<tr>
<td>127</td>
<td>Cartilage Gone Rogue: A Review of Diseases that Affect the Airway Cartilage</td>
<td>Premal Trivedi, MD, TRIVEDI P, Vargas D, Ocazionez D and Restrepo CS</td>
</tr>
</tbody>
</table>
129 Tropical and Subtropical Parasitic Infections of the Chest: Spectrum of Imaging Findings
Julia Capobianco, MD
CAPOBIANCO J, Meirelles GSP, Souza Jr AS, Marchiori E and Araujo Neto C

130 Viral Pneumonias: Patterns of Disease in Immunocompromised and Immunocompetent Patients
Elena P. Scali, MD
SCALI EP and Sedlic T

131 Thoracic Non-Tuberculous Mycobacterial Infections
Marie-Helene Levesque, MD

132 When Strange Bugs Invade: A Pictorial Review of Uncommonly Encountered Lung Infections
Adam Bernheim, MD
BERNEHEIM A, Lowry CM and Goyal N

133 “Teaching an Old Dogma New Tricks”: Classic Versus Recent Concepts in Radiographic Interpretation of Primary and Postprimary Tuberculosis
Ryan J. Brandt, MD
BRANDT RJ, Czum JM, Parker HW, Black WC and Anvari EN

134 The Microbiological and Radiographic Spectrum of Pulmonary Fungal Infections in Bronx, NY
Francis I. Baffour, MD
BAFFOUR FI, Latson L, Falamaki M, Zhu C, Gold M and Haramati L

135 Chest Wall Infections: Imaging Overview
Susana Calle, MD
CALLE S, Rodriguez F, Carrillo J, Vargas D and Restrepo CS

136 Thoracic Complications of Abdominal Interventional Radiology Procedures
Florian Fintelmann, MD
FINTELMANN F, Digumarthy S, Shepard JO, Hahn PF, Mueller PR and Sharma A

137 Larger Vessel Size in Small Subsolid Nodule is Associated with More Severe Bleeding Complication in CT-guided Percutaneous Transthoracic Biopsy
Yao-Hui Tseng, MD
TSENG Y-H and Chang Y-C

138 Thoracic Interventions for the Noninterventionalist: What the Diagnostic Radiologist Should Know
Demetrius L. Dicks, MD
DICKS DL, Ingraham CR, Ocazionez D, Killam JL, Kwan SA and Reddy GP

139 Utility of PACS-Based CT Volumetric Analysis in Estimating the Volume of Pleural Effusions Prior to Image-Guided Thoracentesis
David Chiao, MD, MPH
CHIAO D and Olayagasti J

140 Pre-Surgical Lung Nodule Localization: Past and Emerging Techniques
Lan-Chau Kha, MD, MSc
KHA L-C, Chung TB and Nguyen ET

141 Newer Embolization Agents for Pulmonary Arteriovenous Malformations
Rajeev Suri, MD
SURI R, Lamus D, Haq A, Restrepo CS, Lopera J and Garza A

142 Expected and Unexpected Imaging Findings Following Lung Tumor Ablation
NNEKA Isamah, MD
ISAMAH N and Healey T

143 Safety and Efficacy of CT Guided Fine Needle Aspiration of Nodules Up to 8 mm in Size
Benjamin J. May, MD
MAY BJ, LEE KS and Pua BB
<table>
<thead>
<tr>
<th>Poster Number</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>144</td>
<td>Prospective Clinical Study to Compare Two Iterative Reconstructions in Sub milli-Sievert Chest CT</td>
<td>Sarvenaz Pourjabbar, MD, Poujrabbar S, Singh S, Kulkarni N, Muse V, Digumarthy S and Kalra M</td>
</tr>
<tr>
<td>146</td>
<td>The Effects of Iterative Reconstruction Algorithms from Four Different Vendors on Coronary Calcium Scoring at Reduced CT Radiation Dose</td>
<td>Martin J. Willemink, MD, WILLEMINK MJ, Taks RAP, Prokop M, de Mey J, Das M and de Jong PA</td>
</tr>
<tr>
<td>147</td>
<td>Lung Nodule Detection with Micro-Dose CT</td>
<td>Andreas Christe, MD, CHRISTE A, Ebner L, Landau J and Roos JE</td>
</tr>
<tr>
<td>148</td>
<td>Primary Thoracic Sarcomas - Pictorial Review</td>
<td>David Weaver, MD, WEVER D, Sonavane S, Terry N, Watts J, Crowe DR and Singh S</td>
</tr>
<tr>
<td>150</td>
<td>A Practical Guide of the International Thymic Malignancy Interest Group (ITMIG) to Measure Thymic Neoplasms by Modified RECIST Criteria</td>
<td>Marcelo F. Benveniste, MD, BENVENISTE MF, Carter BW, Truong M, Detterbeck FC and Marom EM</td>
</tr>
<tr>
<td>151</td>
<td>Understanding the Role of Immunohistochemistry and Molecular Profiling in the Pathological Classification and Staging of Lung Cancer</td>
<td>Nancy Kim, BS, KIM N, Shiau M and Suh J</td>
</tr>
<tr>
<td>152</td>
<td>Lung Tumor Markers: What the Radiologist Needs to Know</td>
<td>Dipi Nevekar, MD, NEVREKAR D, Restauri N, Mehrotra S, Aisner D, Sachs P and Vargas D</td>
</tr>
<tr>
<td>153</td>
<td>Imaging and Pathological Features of Complete Treatment Response to Radiation and Neoadjuvant Chemotherapy in Patients who have Undergone Resection of Primary Lung Cancer</td>
<td>Emily Tsai, MD, TSAI E, Genshaft S, Wallace WD and Brown K,</td>
</tr>
<tr>
<td>154</td>
<td>Uncommon but not Forgotten: Unusual Tumors and Tumor-like Lesions of the Lung</td>
<td>Cecilia M. Jude, MD, JUDE CM, Patel MK and Tsai E</td>
</tr>
<tr>
<td>155</td>
<td>Hypervascular Mediastinal Masses - Action Points for Radiologists and Surgeons</td>
<td>Rachna Madan, MD, MADAN R, Cabral F, Bair RJ, Trotman-Dickenson B and Hunsaker A</td>
</tr>
<tr>
<td>156</td>
<td>Surgical Concepts in Diffuse Pleural Malignancies: What the Radiologist Needs to Know</td>
<td>Patricia M. de Groot, MD, DE GROOT PM, Godoy MCB, Carter BW, Munden RF and Rice DC</td>
</tr>
<tr>
<td>157</td>
<td>Average Non-local Means Filter for Improving Image Quality Validated by Nodule Quantitative Analysis with Low-Dose Pulmonary Computed Tomography Reconstructed by FBP</td>
<td>Kuo-Lung Lor, MS, LOR K-L, Chang Y-C and Chen C-M</td>
</tr>
</tbody>
</table>
158 **Texture Analysis of Lung Nodules and its Potential Role in Differentiating Malignant from Benign Lesions**
Vineeta Sethi, MBBS, MD
SETHI VA, Dennie C, Bayanati H, Thornhill R, Gupta A and Souza C

159 **Panorama of Primary Thoracic Sarcomas: Radiological Spectrum with Emphasis on Cross Sectional Imaging**
Rashmi Katre, MD
KATRE R, Baxi A, Restrepo CS and Mumbower A

160 **Multiple Pulmonary Nodules: Looking Beyond Metastasis**
Ameya J. Baxi, MD
BAXI AJ, Restrepo C, Betancourt S, Vargas D, Ocazionez D and Katre R

161 **An Overview of Uncommon Primary Pulmonary Tumors: An Imaging Spectrum Beyond Lung Cancer with Histopathological Correlation**
Ameya J. Baxi, MD

162 **RECIST 1.1: Response Evaluation Criteria in Thoracic Malignancies**
Sonia L. Betancourt, MD
BETANCOURT SL, Palacio D, de Groot P, Marom EM, Tranqu MT and Erasmus JJ

163 **Patient Lifestyle Modification Resulting from a Multidisciplinary Community Based Low-Dose CT Lung Cancer Screening Program**
Craig M. Johnson, MD
JOHNSON CM, Hasham H, Matthees N, Drosten R, Trahan A and Kuo E

164 **Imaging of the Vascular Thoracic Inlet**
Daniel Ocazionez, MD
OCAZIONEZ D, Restrepo CS, Vargas D, Lamus D and Lopera J

165 **Vascular Aspects of Sarcoidosis: A Single Center Retrospective Review**
Michael A. Kadoch, MD
KADOCH MA, Rivaud Y, Marchione J, Edwards M, Ward TJ and Jacobi AH

166 **Missed Pulmonary Embolism on Abdominal Computed Tomography**
Cheng Ting Lin, MD
LIN CT, Lim KY, Kligerman S and White CS

167 **How Much Contrast Enhancement Is Needed to See a Pulmonary Embolus on CT Pulmonary Angiography?**
Ernest Scalzetti, MD
SCALZETTI E

168 **Systemic Venous Anomalies of the Thorax**
Aamer Chughtai, MD
CHUGHTAI A and Agarwal P

169 **Postoperative Imaging of Transcaval and Transapical Transcatheter Aortic Valve Replacement**
Shehbaz H. Shaikh, MD
SHAIKH SH, Reeser N, Nelson C, Wang DD, Greenbaum A and Song T

170 **“From Gene to Aneurysm” - Genetic Mutations that Predispose to Thoracic Aneurysm Formation**
Christopher Sigakis, MD
SIGAKIS C, Vargas D, Agarwal S, Ocazionez D, Javidan-Nejad C and Restrepo CS

171 **Pulmonary Arteries Great and Small: Imaging Approach to the Differential Diagnosis**
Brett W. Carter, MD
CARTER BW, de Groot P, Gilman MD, Sharma A, Abbott GF and Wu CC
<table>
<thead>
<tr>
<th>Poster Number</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>172</td>
<td>AMPLATZER Occlusion Devices – Beyond Atrial Septal Defect (ASD) Closure</td>
<td>David Wever, MD, WEVER D, Sonavane S, Terry N, Watts J, Nath H and Singh S</td>
</tr>
<tr>
<td>174</td>
<td>Varied Appearance of Internal and External Hernias Pulmonis</td>
<td>Desmin Milner, MD, MILNER D, Terry NLJ, Sonavane S, Watts JR, Nath PH, Singh SP</td>
</tr>
<tr>
<td>175</td>
<td>Factors Leading to Precipitation of Peri-Breast Implant Gas Following Airline Travel to High Altitude</td>
<td>Matthew A. Brown, MD, BROWN MA, Nevrekar D, Cox C and Chung J</td>
</tr>
<tr>
<td>176</td>
<td>Recurrent Respiratory Papillomatosis (RRP): A Review</td>
<td>Archana Laroia, MD, LAROIA A, Mueller J and Laroia S</td>
</tr>
<tr>
<td>177</td>
<td>MDCT of the Large Airway Disease</td>
<td>Archana Laroia, MD, LAROIA A and Laroia S</td>
</tr>
<tr>
<td>178</td>
<td>The Interventricular Septum - A Multimodality Analysis of Anatomy and Pathology</td>
<td>John P. Lichtenberger III, MD, LICHTENBERGER III JP, Millard-Hasting B, McQuillan BF and Carter BW</td>
</tr>
<tr>
<td>182</td>
<td>Esophageal Cancer Staging: PET/CT Imaging, A Pictorial Review of Technique, Strengths, Limitations &amp; Pitfalls</td>
<td>Bijan Bijan, MD, MBA, BIJAN B, Doroudinia A, Shelton DK and Moore EH</td>
</tr>
<tr>
<td>183</td>
<td>Pitfalls in the Interpretation of PET/CT Findings in the Chest</td>
<td>Brett W. Carter, MD, CARTER BW, Truong MT, Viswanathan C, Marom EM and Erasmus JJ</td>
</tr>
<tr>
<td>184</td>
<td>When the Pump Will Not Pump: Contemporary Imaging of the Common Heart Failure Treatment Devices and Pre-Transplant Evaluation</td>
<td>Demetrius L. Dicks, MD, DICKS DL, Ocazionez D, Kicska GA, Rubinowitz AN, Godwin D and Reddy GP</td>
</tr>
<tr>
<td>185</td>
<td>Hypertrophic Cardiomyopathy from A to Z: Genetics, Pathophysiology, Imaging and Management</td>
<td>Ameya J. Baxi, MD, BAXI AJ, Restrepo C, Murillo H, Vargas D, Ocazionez D and Marmol A</td>
</tr>
<tr>
<td>186</td>
<td>Radiation Dose during Thoracic CT: Influence of Ethnicity and Gender</td>
<td>Maryam Jafari, DDS, JAFARI M, Odedra D, Menezes R, Khak J, Kashani H and Paul N</td>
</tr>
<tr>
<td>187</td>
<td>Thoracic Findings in Patients with Multiple Sclerosis</td>
<td>Michael A. Kadoch, MD, KADOCH MA, Edwards M, Ward TJ, Stern J, Cham M and Jacobi AH</td>
</tr>
</tbody>
</table>
Educational and Scientific Posters

188 The How To of Lung Cancer Screening
Florian Fintelmann, MD
FINTELMANN F, Digumarthy S, Lennes IT, Muse V, Kalra M and Shepard J

189 DiverseAppearances of Coccidiodomycosis - An Institutional Experience
Veronica A. Arteaga, BS, MD
ARTEAGA VA, Knox K and Malo J

190 Incidental Musculoskeletal Findings on Cross-sectional Imaging of the Chest
Deborah Stedman, MD, MBA
STEDMAN D, Restrepo CS, Bean G, Mumbower A, Deuel B and Loredo R

191 Acute and Chronic Complications of Lung Transplantation: Pictorial Essay and Review of
the Literature
Scott Simpson, DO, MS
SIMPSON S and Barbosa E

192 Imaging Characteristics of Pathologically-Proven Thymic Hyperplasia: Identifying
Features that can Differentiate True Versus Lymphoid Hyperplasia
Tetsuro Araki, MD
ARAKI T, Sholl LM, Gerbaudo VH, Hatabu H and Nishino M

193 Thymic Measurements in Pathologically Proven Normal Thymus and Thymic Hyperplasia:
Intra- and Interobserver Variability
Tetsuro Araki, MD
ARAKI T, Sholl LM, Gerbaudo VH, Hatabu H and Nishino M

194 More than Meets the Eye: Thoracic Manifestations of Ocular Disorders
Matthew H. Lee, MD
LEE MH, Yamanuha J, Kanne J, Chen Y and Meyer C

195 Invasive Diseases of the Chest Wall, A Pictorial Review
Daniel Ocazionez, MD
OCAZIONEZ D, Dicks D, Oldham SAA, Kicska G, Mohammed T-L and Reddy G

196 Estimation of Pleural Fluid Volumes on CXR using CT Volumetric Analysis
Joseph G. Mammarappallil, MD, PhD
MAMMARAPPALLIL JG, Anderson SA, Danelson KA, Stitzel JD and Chiles C

197 How Small is Small? The Utility of the Chest Radiograph in Quantifying the Size of a
Pleural Effusion – A 2013 Perspective, Updated with CT Volumetric Analysis.
David Chiao, MD, MPH
CHIAO D and Olazagasti J

198 Silica-related Thoracic Diseases: Underdiagnosed but Always Here
Gustavo S.P. Meirelles, MD, PhD
MEIRELLES GSP, Capobianco J, Napolis L, Bagatin E, Terra Filho M and Nery LE

199 Post Esophagectomy Diaphragmatic Hernia – An Overlooked Complication
RACHNA Madan, MD
MADAN R and Cabral F

200 Axial and Multiplanar CT Analysis of Pulmonary Vasculature in COPD: Correlation with
Exacerbation
Ji Young Rho, MD, PhD
RHO JY, Sheikh N, Chu J, Zach J, Suh YJ and Lynch D

201 Standard Deviation Aorta (SDA): An In Vivo Measurement of Image Noise Useful in
Optimizing CT Protocols and Minimizing Dose Across Multiple Vendors and Scanners
Zach Winter, MD
WINTER Z, Teel G, Cohrs M, Steinbach A, Cohrs A and Schindler S

202 A Pictorial Essay of Mosaic Attenuation: Not a Black and White Issue
Robert Perone, MD
PERONE R, Sarmast U, Gaur S, Mikhail G, Glass S and Cunningham R
The Secondary Pulmonary Lobule: An Important Anatomic Structure in the Detection and Characterization of Lung Disease on HRCT

PERONE R, Sarmast U, Gaur S, Mikhail G, Glass S and Cunningham R

Objectives: The Secondary Pulmonary Lobule (SPL) is an important fundamental anatomic unit of the lung. Understanding of this simple structure and its anatomic components can provide the groundwork for comprehending virtually all pathologic lung processes. Each of the three main components of the SPL can be defined and assessed on HRCT. Identification of the distribution of disease within the lobule can provide a discrete differential diagnosis, simplifying an otherwise dizzying array of pathology.

Principal Information: The SPL will be defined and its anatomic components illustrated. Initially diseases will be categorized based on their distribution within the SPL. They will be further categorized based on the HRCT pattern produced: Increased opacity, decreased opacity/cystic changes, mixed patterns including mosaic perfusion, headcheese and nodular patterns. A pictorial essay illustrating important disease entities that affect the pulmonary lobule and their resultant HRCT patterns will be presented.

Conclusions: The SPL is a basic, yet critical anatomic unit of lung structure which is well defined and characterized on HRCT. Understanding of its anatomy and the distribution of pathology within the lobule will enhance the diagnostic acumen of the radiologist and help narrow an otherwise broad differential diagnosis of lung pathology.

EKG for the Cardiothoracic Radiologist

LOWRY CM, Bernheim AM and Goyal N

Objectives: The purpose of this exhibit is to explain basic EKG interpretation and how knowledge of particular tracings affect a cardiothoracic radiologist on a daily basis.

Principal Information: Definition, explanation and pictorial review of important EKG tracings involved in the process of acquiring cardiac images. The main rhythms we will describe include normal sinus rhythm, tachycardia, atrial fibrillation, PVCs, PACs, and third degree heart block. We will discuss the implications of these tracings in the process of acquiring images:
- How the gating process works using EKG
- How they can cause common artifacts
- How they affect protocoling studies
- How they are related to certain medication contraindications
- Demonstrate the ability to do EKG editing to help “clean up” images with image-rich examples

Conclusion: The key teaching points of this exhibit are to explain (using pictorial displays) the basic EKG tracings involved in the process of cardiac CT imaging from the protocoling process to interpretation.
Thoracic Radiology of Left Atrial Appendage Closure Devices

LOWRY CM, Bernheim A and Goyal N

Objective: The purpose of this exhibit is to explain left atrial appendage closure procedures, the imaging appearance prior to and following the procedure, and the role cardiac imaging plays in the evaluation of them.

Principal Information: Definition, explanation and pictorial review of the procedure involved in the process of left atrial appendage closure. The pathophysiology will be described. The preoperative requirements/images involved in this process will be discussed and displayed, giving insight into the importance of imaging in this process. Lastly, the appearance of the heart will be displayed and explained via cardiac images using a series of example cases.

Conclusion: The key teaching points of this exhibit are to explain the basic pathophysiology of the diseases and indications requiring left atrial appendage closure. Representative images will be displayed to describe the anatomy, the procedure and the imaging appearance prior to and following the procedure. The goal of the presentation is to highlight the importance that cardiac imaging plays in the pre and post procedural setting.

Computational Techniques for Detecting and Characterizing Coronary Atherosclerosis

ABRICH RD, Paul N and Wong W

Objectives: To review and illustrate state of the art and future approaches to the computational detection and characterization of atherosclerotic plaque in CT coronary angiography.

Principal Information: Coronary atherosclerosis is the leading cause of mortality in developed countries; early detection is paramount to reducing morbidity and mortality. Increasingly, computed tomography coronary angiography (CTCA) is becoming the imaging modality of choice for detection and diagnosis of coronary atherosclerosis, owing to its speed, simplicity, and non-invasive nature. The large volumes of resulting data have recently led researchers towards developing automated methods of screening CT scans for coronary atherosclerosis. These methods typically consist of lumen extraction, plaque detection, plaque quantification, and material discrimination tasks. In this exhibit, we compare and contrast the different approaches and degrees of automation in software algorithms designed to accomplish these tasks. In addition, we illustrate the future direction of these efforts by means of a proof-of-concept plaque segmentation algorithm which extracts the size, shape, and position of plaques, thereby inferring the degree of stenosis implicitly. We show how this type of transformation from low level image features to more complex models can be understood as feature extraction in the context of statistical learning algorithms. We then discuss how these algorithms can be applied to the task of material discrimination, and might one day provide high-level automated decision making in the clinical setting.

Conclusions: As demand increases on health care systems around the globe, efforts to automate time-consuming diagnostic tasks are becoming increasingly relevant. In this exhibit, we explored the results of these efforts as applied to the task of detecting coronary atherosclerosis in CT images across a wide range of algorithmic approaches, including image processing, computer vision, and machine learning.
Accuracy of Interpreting Coronary CTA in an Inner-City Overweight Population

PLODKOWSKI AJ, Roszler S, Levsky JM, Godelman A, Cohen HW and Haramati LB

Objective: To assess the accuracy of CT coronary angiography (CTA) interpretation as compared to catheter angiography (cath), the reference standard, in assessing coronary artery stenosis.

Methods: We retrospectively identified 1508 consecutive patients who underwent CTA 3/21/2007 - 12/27/2012. A total of 6% (n=91, 49 women, mean age 61, mean BMI 30) also had cath performed within 7 months of CTA without interim intervention. 6 different radiologists interpreted the CTAs clinically. A panel of 3 cardiothoracic radiologists retrospectively reviewed each CTA jointly to reach a majority or consensus interpretation for the presence of severe stenosis at the patient level (≥ 50% - left main and ≥ 70% - other vessels on cath).

Results: 65% (59/91) had positive cath and 76% (69/91) had positive CTA. CTA was discordant with cath in 22% (20/91). Sensitivity and specificity of CTA were 92% and 53%, respectively. There was no significant difference between the 6 readers (p=0.64). The panel reached consensus on 88% (80/91) of CTAs and had a 23% (21/91) discordance rate with cath, not significantly different from initial interpretation (p=0.8). Sensitivity and specificity of the panel interpretation was 82% and 68%, respectively. The panel differed from the clinical interpretation in 25% (23/91) of cases. 48% (11/23) of the changes were concordant, and 52% (12/23) of the changes were discordant with cath.

Conclusion: In this high-disease prevalence population, clinical CTA interpretation demonstrated high sensitivity and poor specificity for severe coronary artery stenosis on cath. The panel interpretation demonstrated a similar degree of concordance with cath with a modest increase in specificity at a cost to sensitivity.

Right Ventricle Pathology on Routine Chest CT

BERNHEIM A, Lowry CM and Goyal N

Objectives: The purpose of this exhibit is to examine various pathologies specifically involving the right ventricle that may be identified on routine CT examination of the thorax. For each disease entity, the relevant epidemiology, etiologies, clinical presentation, and management will be discussed. An additional aim will be to present imaging findings through several example cases.

Principal Information: Definitions, background, and relevant epidemiology of various pathological findings of the right ventricle will be presented. Disease entities include arrhythmogenic right ventricular dysplasia, right heart strain in the setting of pulmonary arterial thromboembolism, right ventricular aneurysm, air within the right ventricle, right ventricular perforation due to a pacemaker wire, primary right ventricular neoplasia, and metastatic disease. Pathophysiology, clinical manifestations, and imaging findings will be discussed through a series of example cases.

Conclusions: The key teaching points of this exhibit are that there are several important disease entities affecting the right ventricle that may be identified on routine chest CT. Patterns on imaging examinations may be recognized that are suggestive or diagnostic of various right ventricular disease processes. Finally, medical and surgical treatment options are available for many of these entities.
**Imaging of Cardiac Devices: A Pictorial Review**

CARSWELL AP, Restrepo CS, McCarthy MJ, Mumbower A and Katre R

**Objectives:** The intent of this exhibit is to illustrate the common cardiac devices, including appropriate and inappropriate appearance and position, as well as common complications.

**Principal Information:** Radiographic and CT imaging features are described for the cardiac devices with gross imaging of devices also covered.

**Conclusion:** Given the common occurrence of encountering cardiac devices on routine chest x-ray, it is important for the radiologist to understand the types of devices, as well as the appropriate appearance and location of devices. It is also crucial to be able to accurately interpret any common or severe complications associated with these devices.

---

**Personalized Radiation Dose Reduction and Image Quality Optimization in CT Coronary Angiography using Iterative Reconstruction: A Practical Approach in 4 Easy Steps!**

SHARIAT M, Wintersperger B, Nguyen E, Crean A, Thavendiranathan P and Paul N

**Objective:** This exhibit presents a practical, validated and robust 4-step approach to implementation of an efficient and effective radiation dose reduction and image optimization protocol for computed tomography coronary angiography (CTCA) using Iterative Reconstruction (IR).

**Principal Information:** The exhibit describes implementation of IR algorithms to achieve radical radiation dose reduction and image optimization in a CTCA protocol that has already been optimized for filtered back projection (FBP). The emphasis is on a practical “how to do it” approach with discussion of the issues that arise when implementing such a program and the requisite solutions. This exhibit uses a 4-step approach which is applicable to all current IR algorithms and outlines the process for qualitative and quantitative assessment of the incremental improvements in image quality (IQ) and radiation dose at each step of this 4-8 week program. There is detailed description of the stratification in exposure parameters to patient body habitus and the consequent individualization of the CTCA protocol to ensure optimal and consistent dose reduction and robust diagnostic image quality. By implementing this program into our busy (1800 CTCA studies per annum) cardiac imaging practice, we achieved a 5 fold increase in the number of sub-millisievert CTCA studies compared to existing protocols optimized for FBP!

**Conclusion:** The stepwise approach described in this exhibit can be used to optimize any CTCA protocol to achieve substantial reductions in radiation dose, maintain diagnostic IQ and build a personalized approach to CTCA.
Uncommon Diseases Involving the Coronary Arteries

NG Y-L, Low SA, Lath N, Lim S-Y and Cheah FK

Objective: The purpose of this educational exhibit is to present the uncommon disease entities involving the coronary arteries, that were encountered in our institution.

Principal Information: The imaging features of the uncommon disease entities involving the coronary arteries are illustrated including coronary artery vasculitis (e.g., Kawasaki disease), malignant lymphoma, Erdheim-Chester Disease and immunoglobulin G4 (IgG4)-related disease. Some also show multisystemic involvement which aid in the diagnosis.

Conclusion: Radiologists should be aware of these uncommon causes and their ancillary findings in order to facilitate early, accurate diagnosis and to direct appropriate management.

Diagnosis and Management of Non-ischemic Heart Disease: Role of Non-invasive Imaging Modalities

GABALLAH AH, Mueller G, Frank L and Stojanovska J

Objectives: 1. Review clinical classifications of non-ischemic cardiomyopathies as illustrated by imaging features.
2. Review and illustrate the cardiac MRI, PET and echocardiography techniques used for evaluation and cross modality correlation.
3. Describe the appropriate use of MRI, PET, and echocardiography in evaluation of suspected non ischemic cardiomyopathy.
4. Discuss the role of non-invasive imaging modalities in the diagnosis and management of non-ischemic heart disease.

Principal Information: There is a wide spectrum of non-ischemic cardiomyopathies for which the early use of non-invasive testing may forestall morbidity and mortality. Non-ischemic cardiomyopathies can be grouped into primary genetic/hereditary forms, including non-compaction, hypertrophic, restrictive, dilated and arrhythmogenic right ventricular cardiomyopathies, and secondary non-ischemic cardiomyopathies including sarcoid, amyloid, myocarditis, hemochromatosis, and chemotherapy induced cardiomyopathies. Each will be illustrated using clinical case-based scenarios with cross modality correlation including image-based risk stratification. The role of imaging modalities in the determining the management option will be illustrated.

Conclusion: There are a variety of non-invasive imaging tools available to evaluate non ischemic cardiomyopathies for characterization of myocardial morphology, tissue composition and function. The use of these techniques, especially in patients predisposed by genetics or exposure to chemotherapy, can guide management and reduce morbidity and mortality.
In vivo Normalization of Contrast Gradients in CT Coronary Angiography Using a Mathematical Function

KASHANI H, Hickey M, Ursani A, Homamapour S, Sajja S and Paul N

Objective: To validate a mathematical function for normalization of the in vivo density gradient present in normal coronary arteries.

Materials and Methods: 20 patients (6M, mean age 52.7±10.1) with normal CT coronary angiography (CTCA) had MPR images of the LAD and RCA segmented every 0.5mm from the ostium to the tip. Circular lumen ROIs measured the contrast density [HU] which was plotted against lumen cross sectional area (A), the largest and smallest diameters (d1,d2) and the SQRT d1*d2. The gradient(G) was defined as the slope of the regression model measured at HU=Diameter*G+c. A mathematical function was used to calculate predicted G based on the average diameters in the coronary cross-section. The Wilcoxon test measured the difference between the measured and predicted gradient and the difference between the average gradient of the LAD and RCA. The Kruskal Wallis test assessed any significant difference between the measured and predicted densities in different coronary segments.

Results: A meaningful correlation (p<0.05). There was a significant difference between the discrepancy in density measurements for different coronary segments (p<0.05); it was the highest in the fastest segments.

Conclusion: The partial volume effect that contributes to the contrast density gradient in normal coronary arteries can be significantly corrected using a mathematical function. This is an important step in the evaluation of CTCA as a non-invasive measurement of coronary flow disturbance.

Cardiac Mass Evaluation with CT and MRI

CULLEN E and Araoz P

Objectives: Cardiac masses are uncommon with a reported incidence of 0.2% in autopsy studies. Given the rarity of cardiac masses many radiologists are unfamiliar with the imaging findings and appropriate differential diagnosis. This exhibit will illustrate the MRI and CT findings of several cardiac masses. We will also describe an approach to formulating a differential diagnosis as well as key features of the more common cardiac masses that can help you narrow your differential.

Principal Information:
(1) Approach to formulating a differential diagnosis for a cardiac mass
(2) Features that are important to referring cardiologists and cardiothoracic surgeons.
(3) MRI and CT findings of aggressive and non-aggressive cardiac masses
(4) Imaging features that can narrow your differential diagnosis

Conclusion: Cardiac masses while rare can present a diagnostic dilemma for the unfamiliar. Given the low incidence of cardiac masses in the population educational exhibits such as this one are important to give imagers the opportunity to quickly review salient findings and familiarize themselves with key features in formulating a differential diagnosis.
How Typical are the ‘Typical’ Features of Cardiac Amyloidosis on Cardiac Magnetic Resonance?

SHARIAT M, Thavendiranathan P, Nguyen E, Wald R, Paul N and Crean AM

Background: Amyloidosis is caused by deposition of proteinaceous material in the extracellular spaces. Cardiac magnetic resonance imaging (CMR) is often regarded as the non-invasive test of choice in the setting of possible cardiac amyloidosis with a variety of reported ‘typical’ features. However the actual frequency with which these features are present in any individual case has not been previously described.

Objectives: To describe the prevalence of ‘typical’ CMR features of cardiac amyloidosis in a sequential cohort with evidence of cardiac involvement.

Methods: We retrospectively reviewed CMR studies of 41 patients with definite or very high probability of cardiac amyloidosis. Cases were scored independently for a range of pre-determined imaging features by two blinded cardiac radiologists. Disagreements were arbitrated by a 3rd CMR reader. We defined a ‘typical’ feature as one that occurred in at least 75% of cases.

Results: Late gadolinium enhancement (LGE) within the left ventricle was present in 100% of patients and this was the most common finding in our cohort. Left ventricular hypertrophy (LVH) was the second most typical finding and was present in 88% of cases. The third most frequent finding was a tie between difficulty with correct selection of inversion time and the presence of atrial LGE, both of which were seen in just over 75% of cases. Right ventricular hypertrophy, pericardial effusion, pleural effusion, right ventricular LGE and atrial thrombus were seen in 70.9, 63.5, 53.7, 46.4 and 9.8% respectively. All patients had at least two typical features and 14.6, 31.7 and 53.7% of patients exhibited only 2, 3 and 4 typical features respectively.

Conclusion: The presence of left ventricular LGE, LVH, difficulty with selection of the correct inversion time and the presence of atrial LGE were all ‘typical’ features of cardiac amyloidosis in our cohort. All cardiac amyloidosis patients had at least two typical CMR features. Right ventricular hypertrophy or LGE and presence of effusions were common but not typical. Atrial thrombus occurred rarely.

Cardiac Amyloidosis and Sarcoidosis: CMR Features with Pathologic Correlation

MERGO PJ, Shapiro BP, Parikh PP, Giesbrandt KJ and Bowman AW

An understanding of the underlying pathologic changes in the heart is essential for the characterization of diffuse myocardial diseases using advanced imaging techniques. Using cardiac magnetic resonance imaging (CMR), a variety of cardiomyopathies can be differentiated, potentially obviating the need for invasive testing and biopsy. In this exhibit we present the pertinent imaging findings of cardiac amyloidosis and sarcoidosis and discuss how the imaging features of these entities can be distinguished from other diffuse myocardial diseases, including hypertrophic cardiomyopathy, hypertensive cardiomyopathy, and infiltrative neoplastic disease. Correlation of the key radiologic findings with gross and microscopic pathology is provided, in order to impart the reader with a complete, focused, and in-depth understanding of the pathophysiology underlying each entity and the basis for the corresponding imaging characteristics.
Imaging the Tips of the Ventricles: A Systematic Approach to Apical Pathology

HANNEMAN K, Crean AM, Wintersperger B and Nguyen ET

Objectives:
1. To describe the spectrum of echocardiographic, CT and MRI findings of apical ventricular aneurysms and other pathology.
2. To outline an approach to refining the differential diagnosis of ventricular apical pathology based on imaging findings combined with clinical and biochemical data.

Principal Information:
1. Ventricular apical aneurysms may be true or false aneurysms and are often secondary to myocardial infarction.
2. There are other conditions that cause ventricular apical aneurysmal dilatation and pathology not mediated through epicardial coronary atherosclerosis including Takotsubo cardiomyopathy, apical hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, non-compaction cardiomyopathy, Loeffler myocarditis, endomyocardial fibrosis, Maroteaux-Lamy syndrome, as well as iatrogenic and congenital aneurysms.
3. Distinguishing imaging features include location, size, dimensions, enhancement characteristics and associated complications such as thrombus formation.
4. Sample cases.
5. Key learning points.

Conclusion: While the majority of ventricular apical aneurysms are a result of myocardial infarction, other etiologies should be considered when there is no documented coronary atherosclerosis, taking into account the presence of additional findings as presented in our algorithm outlining an approach to the differential diagnosis.

Cardiac Magnetic Resonance Assessment of Myocardial Iron Overload


Objectives: 1. To review the pathophysiology and imaging features of myocardial siderosis in transfusion-related iron overload.
2. To review the physics of T2* imaging.
3. To explain the role of cardiac MRI T2* imaging in the quantification myocardial iron deposition and assessment of response to iron chelation therapy.

Principal Information: Review of clinical and epidemiologic features transfusion-dependent anemias including thalassemia, pathophysiology of transfusion-related myocardial iron deposition, techniques used in the assessment of myocardial iron, principles of T2* based imaging techniques, cardiac applications of T2* imaging and common imaging findings, iron chelation therapy and response to treatment, extra-cardiac findings including hepatic iron infiltration and extramedullary hematopoiesis.

Conclusions and Key Learning Points: T2* MRI imaging is the current standard for quantification of myocardial iron load and assessment of response to therapy with iron chelators. T2* relaxation refers to decay of transverse magnetization caused by a combination of spin-spin relaxation and magnetic field inhomogeneity. The MRI imaging parameter T2* is typically measured with a region of interest (ROI) within the mid-ventricular septum although a multi-segment approach may lead to improved detection of iron infiltration. Myocardial iron deposition is considered present when T2* values are <20 ms.
Cystic Fibrosis Presenting in Adulthood: What the Radiologist Needs to Know

ZHANG L, Czum JM, Ashare A and Black WC

Objectives: 1. To understand the epidemiology, genetics, pathophysiology, and diagnostic testing for cystic fibrosis (CF) patients who present with pulmonary symptoms in adulthood.
2. When to include adult-diagnosis CF in imaging differential diagnosis.

Principal Information: CF is usually diagnosed at infancy, with the mean age at diagnosis at 5-6 months. However, increasingly adults are being diagnosed with CF. The diagnostic criteria for adult are the same for children: a classic phenotype and cystic fibrosis transmembrane conductance regulator (CFTR) dysfunction. Although the sweat chloride test is the first line test for diagnosis of CF, many adult patients have normal or borderline results. Commercially available panels for CFTR mutations only test for the most common mutations. Up to 20% of CF patients diagnosed at adulthood have atypical mutations not tested for in commercial panels. Thus when clinically suspected a normal sweat chloride test and no mutations identified on panels does not exclude CF as a diagnosis. Relative unfamiliarity of CF presenting in adulthood on the part of many non-pulmonologist physicians may cause significant delay in diagnosis and in access to valuable resources for patients. Respiratory pathologies are the most common presentations in adult-diagnosed CF; such as wheezing, chronic cough, recurrent pneumonia, and hemoptysis. Many adult-diagnosed CF patients have been incorrectly diagnosed with other pulmonary diseases, such as asthma or COPD. The most common imaging finding is bronchiectasis, but findings may be subtle, requiring high-resolution CT for confirmation. However, other imaging findings include persistent atelectasis, consolidation, and hyperinflation. The radiologist may be the first physician to suggest the diagnosis, when findings are appropriate, in patients presenting for CT imaging for non-specific respiratory symptoms.

Conclusion: Radiologists should consider CF presenting in adulthood in patients with appropriate clinical presentations and imaging features in order to expedite diagnoses.

Fat Embolism - Spectrum of Manifestations in an Under Recognized Syndrome

NEWBIGIN K, Marchiori E, Gupta A and Souza C

Objective: The aim of this educational exhibit is to display the spectrum of computer tomography (CT) manifestations in patients with a clinical diagnosis of fat embolism. Although uncommon, fat embolism syndrome is a potentially fatal under-recognized complication of trauma and orthopaedic surgery. The classic clinical triad of respiratory distress, confusion and petechial haemorrhages is often absent, so that clinically it may mimic other more common causes of respiratory distress in the post traumatic or post-operative setting. Medical imaging plays an important role and it is often the first to suggest the diagnosis.

Principal Information: Two CT patterns of pulmonary fat embolism have been described in the literature, with somewhat overlapping appearances. The most commonly recognized pattern is patchy ground-glass opacities, often associated with smooth septal lines. The second less common pattern manifests with peripheral, ill-defined centrilobular nodules and seems to be more common in the earlier phases of the syndrome. The imaging differential diagnosis of pulmonary fat embolism includes infection, pulmonary contusion, haemorrhage and pulmonary oedema. Useful distinguishing imaging characteristics include the absence of airspace consolidation in fat embolism syndrome and the tendency for ground-glass opacities to be sharply demarcated by pulmonary lobules. Complete resolution of ground-glass opacification is the norm in fat embolism, with no reports of chronic sequelae such as interstitial fibrosis.

Conclusion: Pulmonary fat embolism syndrome presents with two main CT imaging patterns. In more severe cases it presents with diffuse, symmetric ground-glass opacities often with associated smooth septal lines. Less commonly, often in milder or earlier presentations, it can present with subpleural centrilobular nodules or lines. Fat embolism syndrome can be difficult to diagnose, both clinically or biochemically, and remains under-recognized. Radiology therefore, plays an essential role in alerting the physician or surgeon to the possible diagnosis.
Pulmonary Drug Toxicities: An Interactive Approach

ANVARI EN, Czum JM, Brandt RJ, Black WC, Delong P and Bond JS


Principal Information: There are at least 380 medications known to cause drug-induced pulmonary drug toxicity, most notably chemotherapeutic and cardiovascular classes of pharmacologic agents. Clinical and imaging manifestations of pulmonary drug toxicity include both acute and chronic forms. A few examples are: diffuse alveolar damage (DAD), nonspecific interstitial pneumonia (NSIP), and bronchiolitis obliterans organizing pneumonia (BOOP). The diagnostic imaging features of pulmonary drug toxicity reflect the underlying histopathologic processes. In this educational poster, we review clinical, histopathologic, and radiologic features of pulmonary drug toxicity in an interactive fashion. The poster will be laid out as a matrix, with selected representative pharmacologic agents along the left-sided row labels and with columns labeled with features, such as clinical, histopathologic, and radiologic. Rather than being pre-populated with relevant factual information and images, except for the mentioned organizing labels along rows and columns, the matrix elements will be left blank. Participants will have the opportunity to select information- and image-containing removable tiles to affix directly onto the poster in appropriate matrix elements, then check their degree of success against a provided sheet of correct answers.

Conclusion: This educational poster exhibit presents an interactive self-directed learning approach to better understanding and organizing factual and image information regarding drug-induced pulmonary toxicity.

Radiologist Performance in the Diagnosis of Birt-Hogg Dube Syndrome

HAGGERTY JE, Chughtai AR, Gross BH, Kazerooni EA and Agarwal P

Objective: CT findings of Birt-Hogg-Dube (BHD) syndrome have been described in retrospective studies in patients known to have the diagnosis. We reviewed our experience with the subsequent diagnosis of BHD syndrome when suggested on a CT/MR examination.

Methods: At our tertiary academic medical center, all radiology reports for the years 2004-2013 were searched for the term “Birt Hogg Dube”. Records were reviewed for renal tumors, pneumothorax, fibrofolliculomas, subsequent genetic testing and a subsequent confirmed diagnosis of BHD. Patients with known BHD prior to imaging were excluded.

Results: 54 patients (mean age 59 yr; 52% male) were included. The first study to suggest BHD was a routine chest CT (34), HRCT (15), abdomen CT (4) and abdomen MRI (1). 7 patients (54%) had a family/personal history of pneumothorax, 51 (94%) had lung cysts (lower lung predominant in 62%, variable size & shape in 76%) and 15 (28%) had renal masses. BHD was suggested as the only possibility in 14 (28%), as the first differential in 11 (20%) and as one among other differentials (but not first) in 29 (53%) patients. Overall 17% patients (9/54) subsequently underwent genetic testing with a higher trend for further testing if BHD was the first or only differential (28% versus 7%, p=0.07). Of those tested, 56% (5/9) were positive for folliculin gene mutation of BHD. All these confirmed cases reported BHD as the first or only possibility. Of these, 3 had both lung cysts & renal tumors, 1 had only lung cysts and 1 had only renal tumors and a family history of pneumothorax.

Conclusion: BHD syndrome as the only or primary radiological differential diagnosis results in a high percentage of eventual diagnosis. Radiologists play an important role in suggesting BHD syndrome using imaging features.
An Update on the Idiopathic Interstitial Pneumonias

HOBB S, Groshong S and Lynch D,

Objectives: An updated classification of the idiopathic interstitial pneumonias (IIP) was released in September 2013. This exhibit informs the viewer of the recent classification changes with an emphasis on radiologic findings.

Principal Information: Utilizing pathology-proven cases, the recently updated ATS and ERS IIP classification scheme will be reviewed and discussed. Key changes include clear recognition of the entity of NSIP, distinguishing major IIPs from rare IIPs, and a new clinical behavior classification. For each disease, the typical patient history, physical examination, laboratory studies, imaging findings, and histopathology will be reviewed and illustrated. Additional unknown quiz cases will be presented.

Conclusions: The idiopathic interstitial pneumonias each demonstrate typical CT-based morphologic patterns, with radiology playing an important role in characterization and diagnosis.

Radiographic Approach to Non-resolving Lung Consolidation

LA ROIA A and Laroia S

Objectives: To review the imaging findings of the various causes of subacute or chronic airspace disease, stressing some of the characteristic radiological signs that may suggest the correct diagnosis.

Principal Information: A pictorial assay of non-resolving lung consolidation will be presented. The causes will be categorized as infectious - including tuberculosis and invasive aspergillosis, inflammatory - e.g. chronic eosinophilic pneumonia, cryptogenic organizing pneumonia cop, sarcoidosis, Wegener’s granulomatosis, alveolar proteinosis and lipid pneumonia. Neoplastic causes such as minimally invasive adenocarcinoma and lymphoma. The iatrogenic causes such as radiation pneumonitis and amiodarone lung toxicity will also be discussed.

Conclusion: Non resolving lung consolidation has a broad differential diagnosis ranging from infection, inflammatory causes to slow growing adenocarcinoma in situ and minimally invasive adenocarcinoma in lung formally known as bronchoalveolar carcinoma. Some of the radiological appearances can suggest the diagnosis while in other cases imaging may narrow down the differential diagnosis and suggest the next step for further work up.
Radiographic Interstitial Lung Abnormalities in Advanced NSCLC Patients During Platinum-based Chemotherapy: A Systematic Study in a Cohort with Wild-type EGFR, ALK, BRAF, and KRAS

NISHINO M, Cardarella S, Araki T, Lydon C, Rabin MS and Johnson BE

Objectives: Investigate the frequency of radiographic interstitial lung abnormalities (ILA) during first-line platinum-based chemotherapy in advanced NSCLC patients who are genomically characterized as wild-type for EGFR, ALK, BRAF, and KRAS, and provide reference data to assess lung toxicity of newer agents targeting specific mutations of lung cancer.

Methods: 65 advanced NSCLC patients (31 males, 34 females; age: 26-76), who underwent genomic characterization between 7/09 and 7/12 and were wild type for EGFR, ALK, BRAF, and KRAS were studied. The patients were treated with first-line platinum-based chemotherapy, and had baseline CT and at least one chest CT during therapy. Baseline and all CT scans during therapy were visually scored for ILA, using a sequential reading method by 3 readers with a 4-point scale [0 = no evidence of ILA, 1 = equivocal for ILA, 2 = suspicious for ILA, and 3 = ILA). Scores 2 and 3 were considered positive for ILA. Development of ILA was defined as score 2 or 3 on CT during therapy in patients with baseline score of 0 or 1.

Results: A total of 311 chest CT scans in 65 patients were scored. On baseline CT before therapy, 9 of 65 patients (14%) were positive for ILA (score 2 in 7, score 3 in 2 patients). Six patients developed ILA during therapy (score 2 in all 6 patients), accounting for 11% of 56 patients without baseline ILA. The median time from the initiation of therapy to the first scan showing ILA was 5.0 months (range: 1.3-7.8 months). Time from the initiation of therapy to the last CT did not differ between patients who developed ILA and those who did not (median: 7.1 vs. 5.0 months, respectively, Wilcoxon p=0.17). Clinical variables including age, gender, stage, smoking, and pathology was not associated with baseline ILA (P>0.07), or development of ILA (P>0.2).

Conclusion: ILA was present at baseline in 14% of the total population. 11% of the patients without baseline ILA developed ILA during platinum-based chemotherapy in genomically characterized advanced NSCLC patients. The data serve as reference for the frequency of ILA in newer anti-cancer agents developed for lung cancer.

Radiological Spectrum of Pulmonary Mycosis

BAXI AJ, McCarthy M, Mumbower A, Katre R and Restrepo C

Objectives: • To study different fungi that affect lungs
• To discuss the role of imaging in the diagnosis and evaluation of pulmonary mycosis and their complications
• To differentiate pulmonary mycoses from diseases having similar radiological appearances

Principal Information: Fungi are opportunistic pathogens that commonly affect the lungs when immune system is compromised. Fungal infections can occur following the inhalation of spores, by hematogenous spread of disease or by reactivation of latent infection. There are many fungi that cause pulmonary manifestations, the most commonly encountered are Aspergillosis, Histoplasmosis, Coccidioidomycosis, Cryptococcus, Candida and Blastomycosis. These patients may present with fever, cough, dyspnea, hemoptysis and chest discomfort. The radiological manifestations of pulmonary mycosis are varied and include consolidation, calcified and non-calcified multiple pulmonary nodules, cavitary lesions, reticulonodular opacities, ground glass opacity, interlobular septal thickening, air crescent sign, adenopathy and pleural effusion. They are also frequently associated with complications like dissemination to extrathoracic sites, blood vessel invasion forming mycotic aneurysms, mediastinitis, osteomyelitis, and rarely pericarditis. Many of these manifestations have distinct radiological appearances. In this exhibit we will discuss the most common radiological appearance of pulmonary mycoses on plain radiography, CT scan and MRI.

Conclusion: The incidence of fungal respiratory tract infections is increasing, due to various reasons including excess use of antibiotics, corticosteroids, organ transplantation and rise in HIV cases. It is very important for radiologists to be aware of radiological manifestations of pulmonary mycosis as they closely mimic that of other infections (bacterial, viral), inflammatory processes as well as malignancies. A high degree of suspicion coupled with relevant patient history can have significant impact on diagnosis which can affect treatment and patient survival.
Pulmonary Lobe Segmentation of 3D Thoracic CT Images: Adaptive Rolling Ball and Vector-based Surface Deformation

CHEN P-H, Lin C-T, Lor K-L, Chang Y-C and Chen C-M

Objectives: Increasing evidence suggests that COPD may be characterized by two distinctive structural phenotypes, i.e., airway- and emphysema-predominant. As an essential task for quantitative analysis of COPD, this paper proposed a fully automatic algorithm for segmentation of pulmonary lobes to facilitate quantification of structural phenotypes of a lung in computed tomography (CT) images.

Methods and Materials: The proposed pulmonary lobe segmentation algorithm was composed of lung region segmentation and lung fissures extraction. For lung region segmentation, an adaptive rolling-ball approach was proposed to delineate the chest wall, capable of reasonably excluding the nodules and vessels adhered to the chest wall. For fissure extraction, a novel vector-based surface deformation technique was proposed based on the eigenvectors of Hessian matrices, which deformed the seed patch boundaries into surface patches covering the fissures observable in the CT images. The fissures were then estimated by using the thin plate spline model fitting the surface patches to complete surfaces separating the whole lungs into lobes. For performance analysis, the 3D lung CT images of 32 subjects, each with the slice thickness of 1.25 mm, were employed. To assess the robustness of the algorithm, three categories of image quality were considered, including those with clear fissures, barely visible fissures, and emphysema.

Results: The mean squared distance between the computer- and manually-delineated fissures was less than 1 voxel. Moreover, the mean overlapping ratio of the computer- and manually-delineated lobes was higher than 98%.

Conclusion: The proposed algorithm was shown to be effective in lobe segmentation and fissure detection of different qualities of lung CT images.

Utility of Quantitative and Qualitative CT for Routine Use as an Adjunct to the Clinical Assessment of Chronic Obstructive Pulmonary Disease (COPD)

MOORE AJ, Walsh RR, Creed WG, Lutchmedial S, Kaminsky DA, and Gentchos GE

Objective: This study assessed whether CT is superior to clinical assessment using GOLD criteria in identifying patients with COPD, in particular if patients with normal spirometry have morphological CT abnormalities associated with COPD.

Methods: Retrospective review was performed of thoracic CT between 2007 and 2011 in which emphysema was identified (n=2125). 560 patients had spirometry performed concurrently. Complete quantitative and qualitative CT analysis was performed in 390 patients including percent and distribution of emphysema and large airways disease. One-way analysis of variance (one way ANOVA) and Tukey-Kramer honest significance test (Tukey HSD) were used to compare emphysema distribution, emphysema location and airways thickening to spirometry.

Results: Diagnosis of clinical COPD was determined in 389 patients (69%) using GOLD criteria. In patients with emphysema on CT, 98 (18%) had normal spirometry but demonstrated other clinical features of COPD on chart review. 135 patients (24%) had normal spirometry and no clinical features of COPD despite the presence of emphysema on CT. In patients diagnosed by GOLD criteria, 61% were obese (BMI > 30 kg/m²) and 74% were not obese (p=0.002). All CT variables were predictive of decline in FEV1/FVC (p < 0.001).

Conclusion: Spirometry alone using GOLD criteria has low sensitivity for detection of emphysema. Spirometry failed to detect emphysema in 42% of patients and 24% of patients remained undiagnosed with COPD using clinical criteria. As there was a trend toward a decreased detection of COPD in obese patients, we suspect that obesity may play a role in reducing the sensitivity of the FEV1/FVC ratio to detect obstruction, possibly due to a component of restrictive lung disease. Qualitative and quantitative analysis appears to be useful for assessment of disease severity and patterns that may suggest normal spirometry. A comprehensive assessment of COPD should include CT, particularly in patients with obesity or normal spirometry in whom COPD is suspected.
Post-procedure Radiographic Appearance after Aeriseal Bronchoscopic Lung Volume Reduction
HARRIS AL, Terry NLJ, Sonavane S, Watts JR, Dransfield MT and Singh SP

Objectives: This exhibit will demonstrate the imaging appearance after Aeriseal bronchoscopic lung volume reduction (bLVR) with emphasis on the immediate and long term post-procedure imaging findings in the lungs.

Principal Information: Patients with emphysema that is refractory to medical treatment may benefit from lung volume reduction (LVR) to decrease physiologic dead space, expand areas of functioning lung, and decrease pressure on the diaphragm. LVR can be achieved by resection of affected lung tissue but the surgery has significant morbidity and mortality. Moreover patients may not be surgical candidates due to non-pulmonary co-morbidities. Alternative bronchoscopic systems have been developed to provide LVR in a less invasive manner. Endobronchial delivery of a tissue remodeling foam sealant achieves LVR by reducing volume in the targeted lung segment. This process results in bizarre visible changes in the lungs on radiography and computed tomography which morphologically mimics lung cancer. Our exhibit will display the expected pattern of changes over time and the factors differentiating these changes from other causes of lung pathology in the post-procedure patient.

Conclusion: Bronchoscopic lung volume reduction with the Aeriseal system is a new therapy which results in radiographically identified lung remodeling. This remodeling occurs in a recognizable pattern and should not be confused with lung cancer or other causes of post-procedure symptomatology such as aspiration and pneumonia.

Cartilage Gone Rogue: A Review of Diseases that Affect the Airway Cartilage
TRIVEDI P, Vargas D, Ocazionez D and Restrepo CS

Objectives: 1. Review the pathophysiology, clinical presentation and imaging findings of a wide variety of entities affecting the airway cartilage.
2. Discuss the imaging approach, possible complications and associated findings in these patients.

Principal Information: Tracheal and bronchial cartilage is vital in preventing collapse of these organs caused by changes in intrathoracic pressure that would ultimately limit airflow. A wide range of entities can affect the integrity, shape or surface of the airway cartilage. The most common of these, tracheobronchomalacia, is usually a sequela of prior insult. Other diseases affecting or arising from the airway cartilage are not as common and may occur as a result of inflammation (relapsing polychondritis), intrinsic deficiency (Williams-Campbell syndrome), impaired maturation (congenital tracheobronchomalacia), abnormal growth (complete tracheal ring, tracheobronchopathia osteochondroplastica) or neoplastic process (chondroma, chondrosarcoma). The radiologist must be aware of these entities as imaging evaluation may need to be tailored to answer a particular clinical question or to evaluate the structural soundness of the airway.

Conclusion: A wide range of conditions can affect the airway cartilage, some of which can ultimately result in luminal narrowing or airway collapse. Knowledge of the salient clinical and radiological findings is key in order to provide pertinent differential diagnoses and evaluate for possible complications and/or associated findings.
Tropical and Subtropical Parasitic Infections of the Chest: Spectrum of Imaging Findings

CAPOBIANCO J, Meirelles GSP, Souza Jr AS, Marchiori E and Araujo Neto C

Objectives: The purpose of this exhibit is to:
1. Describe the main tropical and subtropical parasitic diseases in terms of their geographic distribution, with emphasis on South American infections.
2. Demonstrate their most common imaging, clinical and pathological findings.

Principal Information: The authors will focus on the following points:
1. Geographic distribution of tropical and subtropical parasitic diseases
2. Review of clinical, imaging and pathological findings of the following diseases, with sample cases:
   - 2.1 Amebiasis
   - 2.2 Schistosomiasis
   - 2.3 Hydatid lung disease
   - 2.4 Malaria
   - 2.5 Trypanosomiasis
   - 2.6 Strongyloidiasis
   - 2.7 Dirofilariasis
   - 2.8 Paragonimiasis
   - 2.9 Cisticercosis
   - 2.10 Dengue
   - 2.11 Yellow fever
3. Summary of findings and conclusions

Conclusion: The major teaching points of this exhibit are:
1. Parasitic infections are common in tropical and subtropical regions, but their chest imaging findings are unknown to the majority of radiologists.
2. Familiarity with their geographic distribution, besides their clinical and imaging features, may help in the differential diagnosis.

Viral Pneumonias: Patterns of Disease in Immunocompromised and Immunocompetent Patients

SCALI EP and Sedic T

Objectives: The aim of this educational poster is to present the high resolution CT findings of viral pneumonias in immunocompromised and immunocompetent patients. Specific objectives include:
1. To review the role of imaging in the assessment and follow-up of viral pneumonias
2. To present the spectrum of radiographic and high resolution CT features of viral pneumonias
3. To highlight the imaging findings of the most common viral pneumonias in immunocompromised and immunocompetent patients
4. To present examples of viral pneumonias superimposed on underlying chronic lung disease, including interstitial lung disease, heart failure and pulmonary hypertension

Principal Information:
1. Introduction and epidemiology of viral pneumonias in immunocompromised and immunocompetent patients
2. Imaging findings that favour viral pneumonias over other acute pulmonary mimics of viral infection
3. High resolution CT features of the most common viral pneumonias in immunocompetent and immunocompromised patients
4. Role of imaging in differentiating infection from acute exacerbation of underlying chronic pulmonary pathology, including interstitial lung disease, heart failure, and pulmonary hypertension

Conclusion: The imaging findings of viral pneumonias are often non-specific and difficult to distinguish from other infectious and non-infectious processes, which may pose a diagnostic challenge. Familiarity with the spectrum of high resolution CT findings of viral pneumonias, together with knowledge of the patient’s immune status, underlying lung pathology and clinical course, are key to narrowing the differential diagnosis.
Thoracic Non-Tuberculous Mycobacterial Infections


Objective: To illustrate the complete spectrum of non-tuberculous mycobacterial infections in the thorax including epidemiology, pathophysiology and imaging manifestations.

Principal Information:
- Prevalence and epidemiology
- Classification of non-tuberculous mycobacteria
- American Thoracic Society diagnostic criteria
- Specific clinical scenarios that predispose to these infections
- Imaging manifestations, ranging from common to uncommon, and diagnostic pearls. Examples of different species and their unique features will be shown - Management and treatment challenges.

Conclusion: The exhibit will enhance the understanding of non-tuberculous mycobacterial infections in the thorax.

When Strange Bugs Invade: A Pictorial Review of Uncommonly Encountered Lung Infections

BERNHEIM A, Lowry CM and Goyal N

Objectives: The purpose of this exhibit is to review the clinical importance and epidemiology of uncommonly encountered lung infections. The etiology, pathophysiology, radiologic manifestations, and differential diagnoses of several uncommon lung infections will be examined. Discussion will be centered on several example cases on radiography and chest computed tomography.

Principal Information: Etiology, relevant epidemiology, clinical presentation, pathophysiology, radiologic manifestations, differential diagnosis, and synopsis of treatment options for several uncommon lung infections will be reviewed. Examples of infections to be included are strongyloidiasis, mucormycosis, nocardiosis, Rhodococcus infection, H1N1 infection, Legionnaires’ disease, leptospirosis, and babesiosis.

Conclusions: The key teaching points of this exhibit are that uncommon pathogens are an important cause of pulmonary infection, particularly in specific patient populations or in those who have traveled to particular endemic areas. Each type of infection exhibits imaging features on radiography and computed tomography that allow for certain diagnostic considerations to be regarded as more or less likely based on those imaging findings. Early and accurate diagnosis may be crucial in determining treatment decisions and prognosis.
“Teaching an Old Dog New Tricks”: Classic Versus Recent Concepts in Radiographic Interpretation of Primary and Postprimary Tuberculosis

BRANDT RJ, Czum JM, Parker HW, Black WC and Anvari EN

Objectives: 1. To review the historical understanding of the pathophysiologic mechanisms of primary and reactivation pulmonary tuberculosis.
2. To discuss the emerging concept of an immunity based mechanism for pulmonary tuberculosis and its potential impact upon diagnostic imaging interpretation.

Principal Information: The traditional teaching in medicine is that primary pulmonary tuberculosis manifests in the lower lobes and, after a latency period, can reactivate to involve the upper lung zones, called post primary tuberculosis. More recent studies suggest that there is actually no correlation between latency and chest radiograph findings. Rather, the radiographic features of primary tuberculosis in the setting of recent infection and of postprimary TB, when infection is known to be remote, are in fact based on the patient’s immune status. For example, in patients who are immunodeficiency virus (HIV) seropositive, impaired cell-mediated immune status as reflected in CD-4 counts demonstrate different radiographic features than seronegative TB patients.

Conclusion: In this educational poster, we review the classical pathophysiological explanation for chest radiograph findings of primary and reactivation tuberculosis. It is important for the practicing radiologist to be aware of the emerging immunity based mechanism for pulmonary tuberculosis and its effects on imaging interpretation.

The Microbiological and Radiographic Spectrum of Pulmonary Fungal Infections in Bronx, NY

BAFFOUR FI, Latson L, Falamaki M, Zhu C, Gold M and Haramati L

Objectives: To describe the microbiological spectrum of pathogens, risk factors, imaging appearances and clinical course of pulmonary fungal infection in two inner city hospitals in the Bronx, NY, a region lacking endemic fungal infections.

Methods and Materials: Cases of pathology confirmed pulmonary fungal infections in adults were identified by searching databases at two hospitals in Bronx NY from June 2005 till December 2011. Each chart was reviewed for demographics, underlying medical conditions, type of therapy and outcomes. Chest radiographs and CT scans were reviewed.

Results: There were 19 pulmonary fungal infections Aspergillus (n=13), aspergilloma (2), semi-invasive (7), invasive (3), ABPA (1), Zygomycete (n=3), Candida (n=2) and Histoplasma (n=1) species. There were 5 men, and mean age of 50.5 years. The risk factors for fungal infection were HIV/AIDS (n=4), leukemia (n=7), allogeneic bone marrow transplant (n=3), solid organ transplant (n=1), prolonged steroid use (n=3), and history of asthma or chronic obstructive pulmonary disease (n=6). There were 6 patients with acute invasive fungal infection with a mortality rate of 83.3% (5/6). Radiographic and CT findings include focal disease (n=13), multilobar disease (n=6), intracavitary masses (n=8), nodular disease (7), with miliary nodules (1), main pulmonary vascular invasion (n=3), pleural effusions (n=9) and adenopathy (n=5).

Conclusion: Pulmonary fungal infections occur primarily in immunocompromised patients in non-endemic areas, even in areas with a high proportion of immigrants. Immunosuppressive diseases and drugs are significant risk factors and imaging can play a role in early diagnosis allowing prompt antifungal therapy, or even surgical intervention which may be lifesaving.
Chest Wall Infections: Imaging Overview

CALLE S, Rodriguez F, Carrillo J, Vargas D and Restrepo CS

Objective: The purpose of this exhibit is to illustrate the pathophysiology and various imaging manifestations of infections involving the chest wall.

Principal Information: Numerous pathogens may affect the bony and soft-tissue structures of the chest wall, especially in patients with compromised immune response. Pathophysiology varies from direct chest wall infection to hematogenous dissemination. Findings may include inflammatory masses, fluid collections, fistulae, diffuse swelling and fat stranding, and bone destruction to name a few.

Conclusions: Chest wall infections may present with a wide range of findings that many radiologist are often unfamiliar with on imaging studies.

Thoracic Complications of Abdominal Interventional Radiology Procedures

FINTELMANN F, Digumarthy S, Shepard JO, Hahn PF, Mueller PR and Sharma A

Objective: Demonstrate the variety of abdominal interventional radiology procedures that can result in thoracic complications.

Principal Information:
1. Review anatomy of upper abdomen in relationship to pleural space and mediastinal structures.
2. Illustrate fundamentals of abdominal procedures with potential chest complications:
   • Ablation of liver, kidneys or adrenal glands
   • Biopsy of liver, kidneys, adrenal glands or retroperitoneum
   • Biliary drainage, nephrostomy, and right and left subphrenic abscess drainage
3. Examples of thoracic complications such as pneumothorax, hemothorax, empyema, pericardial tamponade, and leak of bile, lymph or urine into the pleural space.
4. Discussion of detection and management of said complications.

Conclusion: Awareness is key to detecting complications from abdominal interventional radiology procedures in a busy clinical practice.
Larger Vessel Size in Small Subsolid Nodule is Associated with More Severe Bleeding Complication in CT-guided Percutaneous Transthoracic Biopsy

TSENG Y-H and Chang Y-C

Objectives: To investigate whether larger vascular diameter within small (<2cm) subsolid nodule is associated with increased risk of major bleeding complication in CT-guided percutaneous transthoracic biopsy.

Methods/Materials: Between 2008/1 to 2012/12, 75 patients with small, subsolid, and GGO predominant nodule (defined as solid portion less than 50%) was referred for CT-guided percutaneous transthoracic biopsy. A coaxial technique with a 19G guiding needle and a 20G semi-automatic biopsy needle was used. Major bleeding complication was defined as any degree of hemoptysis or moderate to severe intrapulmonary hemorrhage. The vessel sizes within the nodule are measured on axial CT images using commercial PACS, and are correlated with the major bleeding complication.

Results: There are total 13 episodes of major bleeding complications (13/75, 17.3%). One patient with desaturation requires short-term endotracheal intubation, but all cases are self limited with no needs of further endovascular or surgical intervention. The vessel size is 1.3+/−0.5mm (mean+/−SD), range: non-identifiable to 2.3mm. Using cut-off value of 1.2mm vascular size, there is significant correlation of major bleeding complication with larger vessel size (p=0.005).

Conclusions: In CT-guided percutaneous transthoracic biopsy for small subsolid nodule, larger vessel size within the lesion is associated with higher risk of major bleeding complications and should be considered when selecting patients for CT-guided percutaneous transthoracic biopsy.

Thoracic Interventions for the Noninterventionalist: What the Diagnostic Radiologist Should Know

DICKS DL, Ingraham CR, Ocazionez D, Killam JL, Kwan SA and Reddy GP

Objectives: 1) To discuss intrathoracic therapeutic procedures performed by interventional radiologists
2) To describe expected post-procedural imaging findings and potential complications

Principal Information:
1) Introduction
2) Pictorial review of common intrathoracic therapeutic procedures, their indications, expected post-procedural imaging appearance, and potential complications that must be recognized by diagnostic radiologists
   a. Pleural drain placement
   b. Transpleural drain placement
   c. Bronchial artery embolization
   d. Lung radiofrequency ablation (RFA)
   e. Pulmonary arteriovenous malformation coiling
   f. Pulmonary embolus transcatheter therapy
      i. Thrombolysis
      ii. Mechanical clot retrieval

Conclusion: Thoracic interventions are commonly performed. While pleural catheter migrations are often easily recognized, other potential post-procedural complications (such as tube, catheter or coil malposition/migration; air embolism; or esophageal necrosis) should be understood and recognized by diagnostic radiologists.
Utility of PACS-Based CT Volumetric Analysis in Estimating the Volume of Pleural Effusions Prior to Image-Guided Thoracentesis

CHIAO D and Olazagasti J

Objectives: Image-guided thoracentesis is one of the most frequent procedures that the radiologist is asked to perform. Prior to thoracentesis, the clinician often wants to know the size of the pleural effusion in order to gauge if drainage would result in resolution of symptoms. Terms such as “small,” “moderate,” or “large” are vague and inconsistently utilized. Formulas that claim to calculate pleural effusion volume based on two or three dimensions are simplistic and assume certain geometries, which are often invalidated in cases of complex effusions. With the advent of advanced PACS-based tools, CT volumetric analysis of pleural effusions is quick and straightforward. The objective of this study was to assess the accuracy of PACS-based CT volumetric tools in estimating the volume of pleural effusions prior to image-guided thoracentesis.

Methods: An IRB approved, HIPAA-compliant, retrospective review of 67 subjects from a single institution treated with therapeutic image-guided thoracentesis was performed. Inclusion criteria included having a chest CT performed within two weeks prior to therapeutic image-guided thoracentesis. Exclusion criteria included the premature termination of the thoracentesis. CT volumetric analyses of the pleural effusions were performed on all 67 subjects using Carestream VuePACS v11.3.2.4051 (Rochester, NY, U.S.A). The calculated volumes were compared to the volumes obtained at thoracentesis.

Results: The average pleural effusion volume in the 67 subjects was 900 cc. In the majority of patients, image-guided thoracentesis yielded a volume within 30% of the CT calculated volumes. In contrast, subjective evaluation of pleural effusion size varied widely depending on the interpreter. The average time between CT and thoracentesis was 3.2 days.

Conclusion: PACS-based CT volumetric tools are valuable in estimating the size of pleural effusions and can provide important clinical information to the referring providers.

Pre-Surgical Lung Nodule Localization: Past and Emerging Techniques

KHA L-C, Chung TB and Nguyen ET

Objective: To describe various pre-surgical lung nodule localization techniques and their advantages and disadvantages.

Principal Information: Pulmonary nodules are detected with increasing frequency with the use of computed tomography (CT) in lung cancer screening. Video-assisted thoracoscopic surgery (VATS) is frequently used for resection of small peripheral lung neoplasms. However, difficulty palpating certain nodules can pose challenges during VATS assisted lung resection. In particular, ground-glass opacities, lesions less than 1 cm in size, lesions located greater than 1 cm from the pleura and those within the posteriomedial aspect of the lung are more difficult to localize. Three common pre-surgical lung nodule localization techniques include a) pre-operative percutaneous placement of hookwires and microcoils, b) pre-operative percutaneous injection of agents such as dyes, radiopaque media or radionuclides, and c) intra-operative pulmonary sonography. In an era of CT lung cancer screening where VATS resection is used in the management of indeterminate peripheral lung lesions and early stage cancers, a comprehensive understanding of these localization strategies is essential. We will review various pre-surgical localization techniques and their advantages and disadvantages.

Conclusions: Understanding of pre-surgical lung nodule localization techniques is important as smaller and more ground glass nodules are detected with increasing frequency with the use of CT for lung cancer screening. The radiologist can help localize these nodules to aid VATS resection by thoracic surgeons.
Newer Embolization Agents for Pulmonary Arteriovenous Malformations

SURI R, Lamus D, Haq A, Restrepo CS, Lopera J and Garza A

Objective: To illustrate with cases the newer devices available for the endovascular treatment of these lesions.

Principal Information: Pulmonary vascular malformations are rare vascular anomalies of the lung with a wide spectrum of clinical manifestations ranging from totally asymptomatic to severe cyanosis and paradoxical arterial embolism. The treatment of these lesions could be either surgical resection or endovascular occlusion and indications include progressive enlargement of the lesions, paradoxical embolization, symptomatic hypoxemia and the presence of feeding vessels of 3 mm or above. Due to the relatively high morbidity associated with surgical procedures, embolization is now regarded as the treatment of choice for these lesions. The development of several technologic advances in the last few years, have brought refinement of the endovascular techniques yielding better results while minimizing the complications. Advances in image guidance with flat panel detectors allow for creation of intra-procedural cross sectional images as well as 3D reconstructions in real time. This has facilitated better understanding of the hemodynamics of these lesions (inflow and outflow vessels) allowing for increased effectiveness in their treatment. The adoption of devices originally designed for intracranial interventions like detachable coils (GDC, Interlock, Concerto) and liquid embolic agents (Onyx and nBCA) as well as the development peripheral vessel versions of the Amplatzer cardiac septal occluder, have allowed interventional radiologists to be more aggressive in the treatment of pulmonary AVMs while maintaining a high level of procedural safety teaching points. The accelerated development of new materials and devices has significantly changed the treatment approach of pulmonary AVMs, positioning the endovascular techniques as the premier method in most cases. Adequate knowledge of the newer devices is paramount, not only for the interventional radiologist, but also for the diagnostic radiologist that will be involved in the diagnosis and follow up of these patients.

Expected and Unexpected Imaging Findings Following Lung Tumor Ablation

ISAMAH N and Healey T

Objectives: The goal of this educational exhibit is to illustrate the expected and unexpected CT findings following image-guided thermal ablation of lung tumor.

Principal Information: There has been increasing use of image-guided thermal ablation as an alternative therapy for treatment of lung cancer in poor surgical candidates. Contrast enhanced CT is the primary imaging modality for post ablative surveillance. Understanding the evolution of post ablation changes is essential for differentiating normal post ablative changes from local recurrence or tumor necrosis. Post ablative imaging features, patterns of contrast enhancement and unusual growth patterns will be reviewed.

Conclusion: Knowledge of post ablation imaging characteristics is critical for determining treatment efficacy and need for retreatment.
Safety and Efficacy of CT Guided Fine Needle Aspiration of Nodules Up to 8 mm in Size

MAY BJ, LEE KS and Pua BB

Objectives: To review the technique, diagnostic results, and complications of CT-guided percutaneous biopsy of pulmonary nodules equal to or less than 8 mm.

Methods/Materials: After approval by the institutional review board, we performed a retrospective review of patients with pulmonary nodules 8 mm or smaller who underwent CT-guided percutaneous biopsy from January 2011 to April 2012. The size of the nodule, type of needle(s) used and technique were recorded. The pathology database was searched for biopsy results as well as any surgical pathology. Post-biopsy pneumothorax and chest tube placement rates were also recorded.

Results: Of 495 biopsies performed during the study time period, 26 patients underwent CT-guided percutaneous biopsy of 26 pulmonary nodules measuring 8 mm or less. The average size of the lesion was 6.7 mm, with 8 nodules (31%) measuring 8 mm and 18 nodules (69%) less than 8 mm. An average of 2.2 needle passes were used per lesion. Twenty-three patients (88%) underwent fine-needle aspiration biopsy only - 7 patients utilizing a 22 Gauge needle in a tandem manner and 16 patients utilizing the coaxial technique. Three patients (12%) underwent both core and fine needle aspiration biopsies utilizing the coaxial technique. The biopsy result was malignant in 15 patients (58%), with 12 primary lung cancer and 3 metastases. The biopsy result was benign in 11 patients (42%): four patients demonstrated stability on follow-up CT after one year or more; six patients had no follow-up imaging or demonstrated size stability on CT at less than one year; one patient had malignancy on subsequent surgery. Post-biopsy pneumothorax was seen in 2 patients (8%) with neither patient requiring a chest tube.

Conclusions: CT-guided percutaneous biopsy of pulmonary nodules 8 mm or less is safe and high-yield for obtaining an accurate/concordant pathologic diagnosis.

Prospective Clinical Study to Compare Two Iterative Reconstructions in Sub milli-Sievert Chest CT

POURIJABBAR S, Singh S, Kulkarni N, Muse V, Digumarthy S and Kalra M

Objective: To evaluate diagnostic acceptability of chest CT acquired at sub milli-Sievert(Sub-mSv) and processed with 2 different iterative reconstruction techniques (IRT).

Materials and Methods: In an IRB approved prospective study, 22 patients (60±14 years, M: F13:9, BMI: 27.4±6.5) gave written informed consent for acquisition of extra Sub-mSv series on 128-MDCT (Definition FLASH, Siemens, Germany). Dose Length Product of 70 mGy.cm was targeted by lowering the tube current. Sub-mSv images were reconstructed with SafeCT (MedicVision, Israel) C4, L1, L2 settings and Safire (Siemens) S1, S2, and S3 settings. 3 radiologists assessed 6 low dose image series per patient for comparison of lesion margin, visibility of normal structures and diagnostic confidence. Objective image noise in low dose SafeCT and Safire images was: C4 = 22, L1 = 28, L2 = 24, S1 = 28, S2 = 25, and S3 = 24 versus 22 in SOC chest CT. NSD curves showed that SafeCT follows non-linear spectral weighting changes over frequency, whereas Safire demonstrates linear trend over frequency. In addition, analysis of a large patient data showed that SafeCT C4 and L4 have almost same spectral signature as Sub-mSv FBP whereas Safire has consistent spectral weighting changes in both average and large size patient.

Conclusion: Routine Sub-mSv chest CT reconstructed with IRT can provide similar diagnostic information in terms of lesion detection, margin and diagnostic confidence as compared to SOC.

STR Funded Research
Feasibility of Ultra Low Dose Chest CT: Going Back to Filtered Back Projection

KHAWAJA RDA, Singh S, Madan R, Sharma A, Digumarthy S and Shepard J

Objective: To assess lesion detection and diagnostic quality of traditional filtered back projection (FBP) at ultra low doses (ULD) compared to standard-of-care (SOC) chest CT.

Materials and Methods: 15 female and 12 male patients (71±10 years) gave written informed consent for the acquisitions of ULD series in addition to their SOC chest CT exam in this IRB-approved prospective study. SOC exams (CTDIvol, 4-8 mGy; estimated effective dose, 2-5 mSv) were followed by three ULD series: 0.5mSv (0.9 mGy), 0.25mSv (0.4 mGy), 0.1mSv (0.2 mGy). The SOC and ULD series were reconstructed with FBP at 2.5 mm thickness (SDFBP, 0.5FBP, 0.25FBP, 0.1FBP). For analysis, patient cohort was divided into three subgroups based on body-mass-indices (≤25 kg/m², n=10; 25-30, n=6; >30, n=11). Objective image noise was measured with 2.5cm² ROI in descending thoracic aorta. Four chest radiologists independently assessed for lesion detection and diagnostic quality on a discrete 2-point scale (1= SD-FBP equivalent; 0= unacceptable).

Results: Of the 503 abnormal chest findings (156 pulmonary; 347 mediastinal), only 20 lesions (0.25FBP n=4; 0.1FBP n=16) were missed. In patients with BMI ≤30, most lung nodules (39/41), GGOs (16/17), consolidation (16/16), and emphysema (24/27) in 0.5FBP images were equivalent to SDFBP. Both bronchial airways and lung fissures were optimal in 0.5FBP images in patients with BMI ≤30. Enlarged mediastinal, hilar and axillary lymph nodes were deemed optimal in 0.5FBP images irrespective of patient BMI. For patients with BMI ≤30 (1/35 lung artifacts) and those with BMI ≤25 (1/33 mediastinal artifacts) were suboptimal in 0.5FBP images. Objective noise was significantly lower in FBP0.5 images (65 ± 29 HU) compared to FBP0.1 images (66 ± 29 HU), and significantly higher than SDFBP (26 ± 7 HU; P <.0001).

Conclusion: Dose reduction in chest CT to 0.9 mGy is feasible with noniterative traditional FBP for optimal evaluation of lung findings in non-obese patients (≤30 kg/m²).

The Effects of Iterative Reconstruction Algorithms from Four Different Vendors on Coronary Calcium Scoring at Reduced CT Radiation Dose

WILLEMINK MJ, Takx RAP, Prokop M, de Mey J, Das M and de Jong PA

Objective: Iterative reconstruction (IR) can potentially reduce the radiation dose of CT for coronary calcium scoring (CCS). However, the effects of IR algorithms from different vendors on CCS acquired at reduced radiation doses are currently unknown. Therefore, we evaluated the CCS at multiple radiation dose levels with standard filtered back-projection (FBP) and IR algorithms from four different vendors.

Methods: An anthropomorphic chest phantom was used to scan 15 ex-vivo human hearts with state-of-the-art CT scanners from four different vendors. Unenhanced prospectively ECG-triggered step-and-shoot protocols were performed at four CT dose indices of 4.1mGy (reference dose), 3.0mGy, 1.9mGy and 0.8mGy. Tube-current differed between the protocols and tube voltage was 120 kV. Raw CT data of the reference protocol were reconstructed with FBP, and the reduced dose CT data were reconstructed with FBP and IR (iDose4, AIDR 3D, ASIR, SAFIRE). Slice thickness and an increment were 3mm for CCS with semi-automatic software from the same vendor as the CT hardware. Differences were assessed with the Friedman-test (significance level P0.05). Maximum differences per vendor in Agatston scores were 76, 26, 51 and 161 points, in calcification volume 97, 27, 42 and 162 mm³, and in calcification mass 23, 23, 20 and 48 mg, respectively. Agatston scores and calcification volume scores decreased with the use of IR, with significant Agatston score differences for one vendor and calcification volume scores for two vendors (P<0.05). There was no clear trend for IR on calcification mass scores.

Conclusion: Our ex-vivo multivendor-study showed that radiation dose reduction did not affect CCS with standard FBP, even at 80% dose reduction. Potentially, even further radiation dose reductions can be achieved without affecting CCS. Agatston scores and calcification volume scores decreased with IR.
Lung Nodule Detection with Micro-Dose CT

CHRISTE A, Ebner L, Landau J and Roos JE

Objectives: The aim of this study was to test lung nodule detectability of radiologists and Computer Aided Detection (CAD) at micro-dose level compared to standard dose CT.

Methods/Materials: An anthropomorphic lung phantom and two sets of artificial lung nodules (5, 8, 10, 12 mm; each +100 HU and -630 HU) were used for screening CT-examination on a SOMATOM Definition Flash CT with Stellar detectors (Siemens, Forchheim, Germany). Standard dose CT (100mAs, 100kVp) was compared to a micro-dose CT (lowest tube current possible of 6mAs at a 80kVp setting). Reconstruction kernel I70f for standard dose, I30f for micro-dose CT and I50f for CAD evaluation was used (for highest sensitivities according to the pilot study). 55 lung phantom scans were performed using 117 solid and 111 ground glass nodules. Image analysis was performed by 3 radiologists.

Results: Standard CT sensitivity for solid lung nodules was 97.1%, 99.1%, 77.8% and 100% for reader 1, 2, 3 and CAD, respectively. The micro-dose CT sensitivity dropped to 89.9%, 97.3%, 74.4% and 100%. Only the sensitivity loss of reader 1 was significant (p=0.016). Sensitivity for GGN was 100%, 100%, 87.2% and 100% at standard dose level and 100%, 100%, 68.4%, 99.1% at micro-dose level. Only the sensitivity change of reader 3 was significant (p=0.00006). The average effective dose of standard and micro-dose CT was 1.75mSv and 0.056mSv, respectively.

Conclusions: Using an anthropomorphic lung phantom, micro-dose chest CT renders comparable accuracy in the detection of pulmonary nodules at dose levels similar to chest radiographs and the achieved image quality is sufficient to allow robust CAD implementation.

Primary Thoracic Sarcomas - Pictorial Review

WEVER D, Sonavane S, Terry N, Watts J, Crowe DR and Singh S

Objective: Intent of our exhibit is to review various primary thoracic sarcomas.

Principle Information: Sarcomas are highly aggressive tumors affecting all age groups. Metastatic sarcomas to the chest are far more common than the primary sarcomas. Primary thoracic sarcomas are rare malignancies that may arise from mediastinal or pulmonary vasculature (leiomyosarcoma, angiosarcoma), pericardium (synovial sarcoma), lung (Kaposi sarcoma, carcinosarcoma), pleura (fibrosarcoma, sarcomatoid mesothelioma), mediastinal fat (liposarcoma), nerve sheath (neurofibrosarcoma), bones (osteosarcoma, chondrosarcoma), chest wall (Ewing’s sarcoma). We plan to discuss these conditions with illustrative examples and histopathological correlation.

Conclusion: Primary sarcomas in the chest have varied appearances and sites of origin. Though rare in occurrence, understanding their imaging features is important for cardiopulmonary and general radiologists.
Dynamic-contrast-enhanced (DCE) Magnetic Resonance Imaging for Response Assessment of Lung Cancer Treated with Stereotactic Body Radiation (SBRT): An Initial Experience

NISHINO M, Lewis JH, Mamata H, Tokuda J, Hatabu H and Mak R

Objective: Investigate the feasibility of DCE-MRI for detection of early decrease of tumoral perfusion in lung cancer patients treated with SBRT.

Methods: The study prospectively enrolls patients with histologically proven stage I non-small-cell lung cancer (NSCLC) with lung lesion (≥10mm) who are treated with SBRT using 3-5 fractions of 12-18 Gy targeted radiation. Patients undergo pulmonary DCE-MRI at baseline before SBRT, during treatment (1-2 days after first fraction) and post-treatment (at 1-2 weeks and at 3-4 months). DCE-MRI protocol includes T2-weighted HASTE, T1-weighted VIBE, and 3D turbo FLASH sequences. The pharmacokinetic parameters are obtained using a two-compartment plasma/extracellular extravascular space (EES) model described previously from our group.

Results: The first patient was enrolled and successfully completed SBRT and 4 DCE-MRI scans without complication. The DCE-MRI images from all 4 time-points were feasible for pharmacokinetic analysis, and the quantitative MR parameters for the tumor were obtained, including kep (rate of transfer of contrast tracer between plasma and EES) and time-intensity curves derived after motion-correction. Marked decrease of Kep of the tumor was noted on MRI performed during SBRT, from 1.09 at baseline to 0.20 after the first fraction. Kep of the subsequent scans were 0.76 at 2 weeks and 1.31 at 3 months from the completion of SBRT.

Conclusion: DCE-MRI was technically feasible in stage I NSCLC treated with SBRT and successfully provided quantitative pharmacokinetic parameters of the tumor during and after SBRT. A marked decrease of Kep was detected by DCE-MRI during SBRT, which will be further evaluated in a larger number of patients for the possible utility of DCE-MRI for response assessment and dose optimization. (Partially supported by Brigham and Women’s Radiology High Field MRI Seed Grant)

A Practical Guide of the International Thymic Malignancy Interest Group (ITMIG) to Measure Thymic Neoplasms by Modified RECIST Criteria

BENVENISTE MF, Carter BW, Truong M, Detterbeck FC and Marom EM

Objective: To create a guide of measurement criteria for thymic epithelial tumors.

Principal Information: The recommended imaging modality for staging and follow-up of thymic epithelial malignancies is CT. Follow-up depends on size measurements. Assessment of tumor burden change is clinically important to determine if treatment, chemotherapy or radiation, should be modified or changed. Tumor size measurements have been described over the years according to the World Health Organization (WHO), RECIST and RECIST version 1.1 criteria. We offer an ITMIG recommendation of a modified RECIST criteria used to guide standard measurement of thymic malignancies and to facilitate collaborative multi-institutional studies.

Conclusion: Ideally tumor response should be centralized in multi-institutional studies but for technical reasons this is not always possible. ITMIG recommendation of modified RECIST criteria can be used in routine clinical practice but is particularly meant for harmonizing thymoma tumor measurements in multi-institutional studies.
Understanding the Role of Immunohistochemistry and Molecular Profiling in the Pathological Classification and Staging of Lung Cancer

KIM N, Shiau M and Suh J

Objectives: Lung cancer is the leading cause of cancer mortality in the United States and worldwide. Non-small cell lung cancer (NSCLC) is the most diagnosed type with an overall 5-year survival rate of 16%. Selective targeted therapies aimed at specific biomarkers and the pathologic classification using immunohistochemistry (IHC) has become mainstream in medical therapy. Furthermore, the radiologic staging of lung cancer can be altered by pathologic classification.

Principal Information: Lung cancer can be classified based on morphology, IHC, and molecular profiling. The most common NSCLC genotypes are KRAS and EGFR mutations, and ALK translocation. In most cases, morphology can differentiate small cell lung cancer (SCLC) and NSCLC however, at times there are suboptimal conditions thus IHC can be of value. SCLCs are usually positive for CKs and neuroendocrine markers such as chromogranin, synaptophysin and CD56. To further differentiate the subtypes of NSCLC, IHC can be utilized. Expression of TTF-1 usually indicates a pulmonary origin thus can be used to identify a primary lung adenocarcinoma versus metastatic disease. Squamous cell carcinoma is usually negative for TTF-1 and positive for p40/p63. Along with an overview of the classification of lung cancers by morphology, IHC and molecular profiling, cases will be presented to demonstrate the significance of pathology results in lung cancer staging.

Conclusions: Morphology is currently the gold standard for the classification of lung neoplasms however further pathological categorization using IHC and molecular techniques plays a vital role in identifying the subtype, staging and management of lung cancer. As radiologists, it is important to collaborate with pathologists and oncologists to determine the correct staging and proper treatment for patients on an individualized basis.

Lung Tumor Markers: What the Radiologist Needs to Know

NEVREKAR D, Restauri N, Mehrotra S, Aisner D, Sachs P and Vargas D

Objectives: Carcinoma of the lung is a leading cause of morbidity and mortality. Recent developments in targeted molecular therapy have both diagnostic and therapeutic implications in the management of lung cancer. The International Association for the Study of Lung Cancer (IASLC) stated “Non small cell lung carcinoma is no longer acceptable as a pathologic diagnosis or as an operational category for clinical management”. Thoracic radiologists and pathologists play a critical role in the multidisciplinary management of lung cancer patients. Knowledge of the pathologic approach to both the diagnosis and molecular characterization of lung carcinoma will empower the radiologist to continue to play an active role in patient care.

Principal Information: We will collaborate with our colleagues in pathology to provide radiologists with an overview of the approach to immunohistochemical and diagnostic molecular testing in lung cancer focusing on 1) The differentiation of small cell and non small cell carcinoma subtypes, 2) Molecular testing in adenocarcinoma and implications for therapy, 3) Specific markers distinguishing primary lung neoplasm from metastatic disease.

Conclusion: Multidisciplinary management of lung cancer patients requires that radiologists are familiar with the pathologist’s role in thoracic tumor management and knowledge of the tools available to guide diagnosis, prognosis, and treatment continue to be vital to patient care. The well-informed radiologist adds value and becomes indispensible to the clinical team.
Imaging and Pathological Features of Complete Treatment Response to Radiation and Neoadjuvant Chemotherapy in Patients who have Undergone Resection of Primary Lung Cancer

**TSAI E, Genshaft S, Wallace WD and Brown K.**

**Objectives:** The purpose of this educational exhibit is to describe the post-treatment imaging and pathological features of primary lung cancers in patients who undergo radiation and neoadjuvant chemotherapy prior to resection. The focus will be on determining which radiological findings correlate most closely to the histopathologic findings of complete treatment response to radiation and neoadjuvant chemotherapy.

**Principal Information:** A brief review of current treatment algorithms for patients with primary lung cancer will be presented, focusing on patients who are surgical candidates based on the 7th edition TNM staging system. Cases which include imaging and pathological specimens will be presented. Imaging modalities reviewed will include CT, PET and MRI. Imaging findings will be correlated with the degree of response to radiation and neoadjuvant chemotherapy as determined by histopathology following resection. Imaging predictors of complete tumor response to neoadjuvant treatment will be discussed.

**Conclusion:** In patients who undergo radiation and neoadjuvant chemotherapy for primary lung cancer prior to resection, correlation of radiological findings with the histopathologic specimens will be useful in predicting which imaging characteristics correspond most closely with complete tumor response to neoadjuvant treatment.

Uncommon but not Forgotten: Unusual Tumors and Tumor-like Lesions of the Lung

**JUDE CM, Patel MK and Tsai E**

**Objectives:** To describe the imaging features of uncommon tumors and tumor-like lesions of the lung. To review relevant clinical factors and provide pathologic correlation.

**Principal Information:** Adenocarcinoma, squamous cell carcinoma, small cell carcinoma and large cell carcinoma comprise over 90% of primary lung tumors. The remainder of lung neoplasms consist of uncommon histologic types of non-small cell lung carcinomas, as well as airway, lymphopoietic and mesenchymal tumors. The purpose of this exhibit is to review CT findings and clinical characteristics, as well as provide pathologic correlation for the following categories of uncommon lung neoplasms: non-small cell lung carcinomas (adenosquamous, sarcomatoid, carcinoid, salivary gland-type tumor), airway (laryngotracheobronchial papillomatosis), lymphopoietic (angiocentric lymphoma, bronchus-associated lymphoid tissue lymphoma) and mesenchymal (inflammatory myofibroblastic tumor, solitary fibrous tumor, benign metastasizing leiomyoma) tumors. Non-neoplastic, tumor-like lesions including lipid pneumonia and amyloidoma are also illustrated.

**Conclusions:** There is a wide spectrum of uncommon benign and malignant tumors and tumor-like lesions of the lung. The imaging characteristics are mostly non-specific, however CT is useful for documenting extent of disease, associated findings, and planning diagnostic and therapeutic approach.
Hypervascular Mediastinal Masses - Action Points for Radiologists and Surgeons

MADAN R, Cabral F, Bair RJ, Trotman-Dickenson B and Hunsaker A

Objective: To illustrate the cross sectional imaging findings and differential diagnoses of few common and some rare hypervascular mediastinal masses.

Method: CT, MR and PET CT findings of a spectrum of hypervascular mediastinal masses is reviewed using case based scenarios, emphasizing the role of imaging in guiding further surgical and non-surgical management.

Results: Hypervascular mediastinal masses include a small subset of benign and malignant entities, such as carcinoid tumor, vascular malformations, Castleman’s disease, Kimura’s disease, nodal metastatic spread from hypervascular primaries, synovial sarcoma and rarer entities like ectopic mediastinal thyroid and parathyroid and inflammatory myofibroblastic tumor. Identification of this imaging appearance helps narrow the differential diagnosis to select few entities. Uptake on an Octreoscan can be seen in paragangliomas, carcinoids, and an ectopic parathyroid can be confirmed on a Tc-99m sestamibi scan. Presence of ancillary findings like phleboliths and hypertrophied vessels point towards a vascular malformation, amorphous or punctate calcification may be seen in carcinoids and arborizing calcification though rarely seen is a feature of Castleman’s disease. Further, the presence of hypervascularity is an important finding to be noted prior to surgical biopsy as embolization may be planned by some surgeons to minimize intra-operative blood loss.

Conclusions: Characterization of mediastinal masses as hypervascular is important as this helps to narrow the differential diagnosis to a select few entities. Additional imaging features like pattern of calcification, dilated vessels, known tumor or presence of masses elsewhere further helps decide next step in management which may include diagnostic angiography, embolization, open surgical biopsy or follow up imaging.

Surgical Concepts in Diffuse Pleural Malignancies: What the Radiologist Needs to Know

DE GROOT PM, Godoy MCB, Carter BW, Munden RF and Rice DC

Objectives:
1. Review anatomic and morphological imaging findings of resectable malignant pleural disease
2. Describe and illustrate surgical approaches used in treatment of diffuse pleural disease
3. Review radiologic appearance of normal postoperative findings
4. Show postoperative complications and their imaging appearance using case examples

Principal Information:
1. Thoracic anatomy related to staging of pleural malignancies
2. Surgical planning and techniques used for pleural disease
3. Normal postoperative imaging findings
4. Postoperative complications
5. Potential imaging pitfalls

Conclusions: Multiplanar radiologic imaging, including multidetector computed tomography (CT) and positron emission tomography (PET)/CT, plays a crucial role in determining resectability of primary and secondary pleural malignancy, and helps to inform surgical planning. The cardiothoracic surgeon will tailor the operative procedure and the approach depending on the extent and location of disease. In order to aid appropriate management of these patients, radiologists must be conversant with the staging of pleural neoplasms and with cardiothoracic surgical techniques. The expected postoperative findings on follow-up imaging must be recognized as normal. Radiologists must also be able to identify postsurgical complications that require attention.
Average Non-local Means Filter for Improving Image Quality Validated by Nodule Quantitative Analysis with Low-Dose Pulmonary Computed Tomography Reconstructed by FBP

LOR K-L, Chang Y-C and Chen C-M

Objective: The radiation exposure at chest Computed Tomography (CT) reconstructed by filtered back projection (FBP) is drawing widespread attention for its significant impact on cancer risk. While reducing the tube current is the most effective way of reducing radiation dose, image quality drops inversely proportional to the radiation dose. This study utilizes the developed alternative image denoising filter, namely Average Non-local Means filter (AvgNLM) for improving image quality while achieving higher signal to noise ratio (SNR) and contrast to noise ratio (CNR) of the pulmonary nodules.

Methods/Materials. Both low-dose and standard-dose chest CT datasets were reconstructed by regular filtered back projection for the each patient. Nodule quantitative analysis for both groups was assessed by calculating the area of 30 automatically detected pulmonary nodules. The quantitative result of each solitary nodule and GGN is then compared among three groups: with and without AvgNLM for low-dose CT and those of standard-dose CT.

Results: There were significant positive relationships between the conventional LDCT and SDCT measured nodule size ($r=0.964$, $p<0.0059$), between LDCT with NLM of sigma size 25 and SDCT sigma ($r=0.975$, $p<0.0023$), and between LDCT with NLM of sigma size 40 and SDCT sigma ($r=0.973$, $p<0.012$). Figure 1 shows that LDCT filtered with AvgNLM of different sigma sizes (third column=25, fourth column=40) enhances the conspicuity of solitary (first and third row) and ground glass nodules (second row) of various sizes comparing with SDCT (first column) and LDCT (second column). The results showed that AvgNLM improve not only the visual but also the diagnostic image quality.

Conclusion: This preliminary study compares ROIs of both low-dose and standard-dose Chest CT with and without AvgNLM. The objective analysis confirms that AvgNLM is an effective image denoising filter for obtaining the comparable quantifications of solitary and ground glass nodules between low-dose CT and standard dose CT, yielding potentially improved lesion detection and segmentation.

Texture Analysis of Lung Nodules and its Potential Role in Differentiating Malignant from Benign Lesions

SETHI VA, Dennie C, Bayanati H, Thornhill R, Gupta A and Souza C

Objective: To study the accuracy and potential role of texture analysis in differentiating malignant from benign pulmonary nodules.

Material and Method: A total of 81 biopsy proven pulmonary nodules (42 benign and 39 malignant) measuring between 1 and 3 cm in size were retrospectively reviewed. The malignant category included both primary and metastatic lung cancers. The benign category included the non-calcified lesions with imaging features indistinguishable from a lung cancer. The nodules imaged on both the non-enhanced (NECT) and enhanced CT (CECT) scans were included in the study. A transverse CT image in the lung window setting containing the nodule was selected for texture analysis. Using a region of interest tool, the outer margin of the nodule in the selected CT slice was identified and the contours saved for texture analysis. Textural features related to gray level heterogeneity and distributions were computed for each nodule and ROC curves were generated for each feature.

Results: Quantitative CT image texture features delineated malignant nodules with a sensitivity of 79% and specificity of 82% (AUC: 0.76, $p=0.001$). The non-enhanced studies were found to be superior in differentiating malignant from benign nodules (AUC NECT: 0.76 vs CECT: 0.53).

Conclusion: Texture analysis has the potential to differentiate malignant from benign nodules. NECT images were found to be superior to CECT images for analyzing the textural features.
Panorama of Primary Thoracic Sarcomas: Radiological Spectrum with Emphasis on Cross Sectional Imaging

KATRE R, Baxi A, Restrepo CS and Mumbower A

Objectives: 1. To identify and illustrate radiological spectrum of primary thoracic sarcomas on CT and MRI.
2. To differentiate them from diseases with similar radiological spectrum.

Methods: Primary sarcomas of the thorax are rare and constitute a large heterogeneous group of tumors classified according to their histologic differentiation. Although they commonly manifest as large, heterogeneous masses, they have a wide spectrum of radiologic manifestations including solitary pulmonary nodules, central endobronchial masses, and intraluminal masses within the pulmonary arteries. Contrast enhanced CT and MRI are the imaging modalities typically used for detection of these lesions, describe the exact anatomic location and planning for surgical approach. CT imaging is also helpful in overall staging of the disease.

Results: Some of the entities covered in this group are angiosarcoma of the heart, leiomyosarcoma of lungs and pulmonary artery, rhabdomyosarcoma, primitive neuroectodermal tumors, Ewing sarcoma, chondrosarcoma, malignant fibrous histiocytoma, osteosarcoma, and synovial sarcoma.

Conclusion: The different histologic types of sarcomas are frequently indistinguishable at radiologic analysis. However, differences in clinical presentation, the location of the tumor, morphologic features such as calcification within the mass or rib involvement, and occasionally imaging characteristics can be useful in suggesting the appropriate diagnosis.

Multiple Pulmonary Nodules: Looking Beyond Metastasis

BAXI AJ, Restrepo C, Betancourt S, Vargas D, Ocazionez D and Katre R

Objectives: 1. To study the differential diagnosis of multiple pulmonary nodules.
2. To review the etiopathogenesis and imaging spectrum of common causes of multiple pulmonary nodules other than metastasis.

Principal Information: Knowledge of imaging the appearance of multiple pulmonary nodules is important for accurate diagnosis and treatment. Though similar in radiological appearance, they differ in epidemiology, clinical outcome, management and prognosis. Given the potential significant morbidity of metastatic lung nodules, it is important to understand and recognize non-metastatic nodules. Some common pathologies leading to non-metastatic multiple pulmonary nodules include tuberculosis, histoplasmosis and other fungal diseases, aspergillosis, sarcoidosis, hypersensitivity pneumonitis, granulomatosis with polyangiitis (GPA), talc granulomatosis, nodular pulmonary amyloidosis, rheumatoid nodules, multiple small tumorlets, multiple carcinoids, multiple nodular angiofollicular hyperplasia, plasma cell granulomata and benign metastatic leiomyomas.

Conclusion: The main aim of this presentation is to describe the disease entities presenting with multiple pulmonary nodules, as it is very important for radiologists to have broad clinical and radiological approach when considering differential diagnosis pulmonary nodules, as non-metastatic causes of this appearance are very important to remember and understand.
An Overview of Uncommon Primary Pulmonary Tumors: An Imaging Spectrum Beyond Lung Cancer with Histopathological Correlation


Objectives: 1. To identify and illustrate spectrum of primary pulmonary tumors on CT and MRI other than lung cancers
2. To review the pathogenesis
3. To describe and illustrate the typical and atypical CT (and MRI imaging) appearances of primary pulmonary tumors
4. To differentiate them from the conventional lung cancer

Principal Information: Knowledge of imaging appearance of primary pulmonary tumors is important for accurate diagnosis and treatment. Though the uncommon primary pulmonary tumors have similar radiological appearance as that of conventional lung cancer, they differ in epidemiology, clinical outcome, and management. Given the potential significant morbidity of these tumors, it is important to understand and recognize these disease entities. We did retrospective analysis of histologically proven primary pulmonary tumors which were diagnosed during CT examination of the lung. Some of these patients who underwent PET CT and MRI, which were also analyzed. We also reviewed clinical features and laboratory work up of these patients. The CT scans were reviewed for the following features: lesion location; size, contour, and number; contrast enhancement; mass effect; invasion of surrounding structures and presence or absence of calcification and metastasis. The primary pulmonary tumors other than lung cancer which we came across were carcinoid, sarcoma, chondroma, blastoma, chemoductoma, pericytoma, synovial sarcoma, epitheloid hemangioepithelioma and inflammatory fibroblastic tumor, tracheo-bronchial papillomas.

Conclusion: We reviewed our experience of uncommon primary pulmonary tumors. We also identified CT features that might aid in distinguishing these neoplasms from conventional lung cancer. This exhibit illustrates imaging spectrum of uncommon primary pulmonary tumors.

RECIST 1.1: Response Evaluation Criteria in Thoracic Malignancies

BETANCOURT SL, Palacio D, de Groot P, Marom EM, Truong MT and Erasmus JJ

Objectives: To review the RECIST 1.1 guideline. To illustrate with representative examples the use of RECIST 1.1 in the assessment of therapeutic response in thoracic malignancies. To discuss limitations of RECIST 1.1 in the assessment of therapeutic response.

Principal Information: Accurate assessment of the change in tumor size is important in the evaluation of therapeutic response. RECIST (Response Evaluation Criteria in Solid Tumors) has recently been reviewed and modified. The revised guideline (RECIST 1.1) is currently the most common methodology used in the determination of therapeutic response and provides a standardized anatomic measurement of change in tumor size. RECIST 1.1 is based on using a single measurement of the largest tumor diameter in the axial plane. The time interval between imaging studies is usually 6- to 8-weeks corresponding to the time period following two cycles of conventional chemotherapy in order to assess therapeutic response. RECIST 1.1 specifies the selection of five target lesions with two target lesions per organ. Lymph nodes with a short axis ≥ 15 mm can be considered as target lesions. A sum of the diameters (longest for non-nodal lesions, short axis for nodal lesions) of all target lesions are calculated and reported as the baseline sum diameters. Treatment response is defined as complete response, partial response, stable disease and progressive disease. Potential limitations in using RECIST in the determination of therapeutic response relate to considerable inter- and intra-observer variability in tumor measurements, particularly for tumors with irregular or spiculated borders.

Conclusion: RECIST 1.1 provides an improved standardized evaluation of therapeutic response. A potential limitation in using CT in the determination of therapeutic response is that there can be considerable variability in tumor measurements. Knowledge of RECIST 1.1 and an awareness of its potential limitations are important in interpretation as well as assessment of treatment regimens in clinical trials.
Patient Lifestyle Modification Resulting from a Multidisciplinary Community Based Low-Dose CT Lung Cancer Screening Program

JOHNSON CM, Hasham H, Matthees N, Drosten R, Trahan A and Kuo E

Objective: To demonstrate ancillary patient benefits in the form of lifestyle modifications from a multidisciplinary low-dose lung cancer screening program.

Methods: Enrollment of over 150 patients in our low-dose CT lung cancer screening program began in September 2011. Referred participants signed a waiver of informed consent for data collection and completed an initial questionnaire that took into account their age, gender, race, smoking history, and family history of lung cancer to assess eligibility for our screening program. CT scan images were then reviewed and interpreted by a multidisciplinary team in the fields of thoracic radiology, pulmonology, thoracic surgery, infectious disease, and primary care. Participants were provided with a consultation to review CT scan images and discuss recommendations made by our multidisciplinary panel of physicians. Smoking cessation counseling and treatment was also provided. A short-term and long-term follow-up telephone questionnaire was conducted inquiring about changes in smoking, exercise, and dietary habits after CT screening. Questionnaire data on patients screened continues to be collected on patients entering the program.

Results: 43.2% of the initial 74 patients interviewed were smokers at the time of CT scan. After participating in a low-dose lung cancer screening program, 28.1% indicated they had quit smoking at the time of follow up, 50% indicated they had decreased the number of cigarettes they smoked per day, 18.7% indicated no change in their smoking habit, and 3.1% indicated they increased the amount they had smoked since the screening. Of the 74 subjects interviewed, 37.8% had modified their diet into a health consciousness diet of low fat foods. 59% of the patients interviewed reported exercising at time of pre-screen and 70% were exercising at follow-up after low-dose CT scan.

Conclusion: Multidisciplinary lung cancer screening programs result in positive patient lifestyle modifications such as smoking cessation, improved diet, and increased exercise in addition to reducing lung cancer mortality.

Imaging of the Vascular Thoracic Inlet

OCAZIONEZ D, Restrepo CS, Vargas D, Lamus D and Lopera J

Objectives: 1. Illustrate the vascular anatomy of the thoracic inlet
2. Review the traumatic and non-traumatic conditions that affect the vascular structures of the thoracic inlet
3. Discuss the role of CT, MR and conventional angiography in the evaluation and management

Principal Information: 1. Anatomy and normal imaging appearance
2. Arterial:
   a. Congenital anomalies
   b. Traumatic/iatrogenic lesions (partial or complete occlusion, pseudoaneurysm, dissection, extravasation and fistulas)
   c. Thrombosis and extrinsic compression
   d. Arteritis
3. Venous:
   a. Congenital anomalies
   b. Traumatic/iatrogenic lesions
   c. Thrombosis and extrinsic compression
   d. Infectious conditions (Lemierre’s syndrome)
4. Management

Conclusion: CT and MR angiography are vital in the evaluation of traumatic and non-traumatic conditions involving the vascular structures of the thoracic inlet. The radiologist must be familiar with the normal vascular anatomy and should be aware of these conditions in order to provide appropriate guidance for management. There is also a role for conventional angiography, as some of these entities may require further evaluation and/or may benefit from endovascular management.
Vascular Aspects of Sarcoidosis: A Single Center Retrospective Review

KADOCH MA, Rivaud Y, Marchione J, Edwards M, Ward TJ and Jacobi AH

Objectives: Pulmonary arterial hypertension (PAH) is a serious potential complication of sarcoidosis with poor prognostic implications. Dilatation of the main pulmonary artery (MPA) is suggestive of PAH. Sarcoidosis is often accompanied by dyslipidemia and increased oxidative stress, implying an increased predisposition to cardiovascular disease (CVD). Coronary artery calcification (CAC) is a strong predictor of CVD. The purpose of this study was to retrospectively assess for the prevalence of CAC and MPA dilatation on chest CT performed in patients at all stages of sarcoidosis.

Material and Methods: 231 noncontrast chest CT scans performed in patients with sarcoidosis above the age of 40 from 2003-2013 were available for analysis. The presence or absence of CAC was recorded. The CT section through the MPA bifurcation was magnified to full screen and the MPA diameter was measured with calipers perpendicular to its long axis. The radiologic stage of sarcoidosis was determined by an experienced thoracic radiologist using a combination of radiography and CT.

Results: The female/male ratio of patients in the study group was 1.7. Patient age ranged from 41-83 with a mean of 58.6. The average age of patients with stages 0 (n=27), 1 (n=16), 2 (n=54), 3 (n=54), and 4 (n=80) sarcoidosis was 58.2, 56.1, 57.2, 58.9, and 60.1, respectively. CAC prevalence was 46.3% among sarcoidosis patients. CAC prevalence among patients with stage 4 sarcoidosis was 55.0% as compared with 41.7% among patients with stages 0-3 sarcoidosis. The average MPA diameters for stages 0, 1, 2, 3, and 4 sarcoidosis were 2.76 (95% CI: 2.62-2.89), 2.95 (95% CI: 2.66-3.23), 2.77 (95% CI: 2.66-2.89), 2.97 (95% CI: 2.86-3.08), and 3.18 (95% CI: 3.06-3.30), respectively.

Conclusions: The prevalence of CAC was 46.3% among sarcoidosis patients. The average MPA diameter among patients with stage 4 sarcoidosis was 3.18. Both MPA diameter and CAC prevalence appear to follow a positive stage-response relationship with the radiologic stage of sarcoidosis.

Missed Pulmonary Embolism on Abdominal Computed Tomography

LIN CT, Lim KY, Kligerman S and White CS

Objectives: To evaluate a series of missed pulmonary emboli (PE) identified on abdominal CT and describe their characteristics and the clinical scenario.

Methods/Materials: The study was approved by our IRB and is HIPAA compliant. All reports of chest CT scans performed during a 12-month period were searched for keywords indicative of pulmonary embolus. In those with positive PE, patients who also underwent an enhanced abdominal CT within three months were assessed for missed PE. Three radiologists reviewed the abdominal CT to confirm the presence of any missed PE. Missed PE were classified as unknown or known. Each study was assessed for characteristics of the missed PE and image quality of the PE study. The electronic medical record was used to document the clinical context in which the PE occurred.

Results: 18 patients (12 men, average age - 58.8 years) were identified with missed PE on abdominal CT. In seven (38.9%), the PE had not been previously diagnosed. A majority of the missed PE was segmental but three missed emboli occurred in lobar vessels. In a slight majority of the cases, the reviewing radiologists judged the contrast bolus as good. The abdominal CT on which PE was overlooked was obtained for a variety of reasons, most commonly due to abdominal pain or to follow-up a pre-existing condition.

Conclusions: This study demonstrates that missed PE can occur on abdominal CT. It is recommended that interpretation include a careful search of the lower pulmonary arterial vasculature on contrast enhanced abdominal CT scans.
How Much Contrast Enhancement Is Needed to See a Pulmonary Embolus on CT Pulmonary Angiography?

SCALZETTI E

Objective: Circulation time images obtained during CT pulmonary angiography (CTPA) were used to investigate the magnitude of pulmonary artery (PA) enhancement required to detect pulmonary embolism (PE).

Methods: This retrospective study received a waiver from the local IRB. CTPA reports during an 18 month study period were reviewed for the diagnosis of PE involving the main PA, right or left PA. For each such patient, images were retrieved to see if the PE was present on the circulation time images. Patients with excessive motion artifact were excluded. Circulation time images were made every 1-2 seconds at the level of the main PA during infusion of 75 cc of contrast—a blend of 25 cc 350 mgI/ml nonionic contrast agent and 50 cc saline—at 5 ml/s using a dual-headed injector, followed by a saline bolus, to determine the prescan delay for the CTPA. PA attenuation was measured on each circulation time image, as well as the attenuation of thrombus. The difference between PA attenuation and thrombus attenuation (A-diff) was calculated. An experienced chest radiologist subjectively assessed the visibility of the thrombus on each circulation time image, using a scale of 0-4 (not visible to definitely visible).

Results: 37 patients met eligibility criteria. Thrombus attenuation ranged from 29-73 (median 54) HU. There was a good correlation between A-diff and visual score (Pearson product moment correlation=0.60). For each visual score, the median (95% confidence interval) values of A-diff were: score 0, 23 (-21 – 147) HU; score 1, 56 (0 - 133) HU; score 2, 79 (26 - 160) HU; score 3, 100 (36 - 213) HU; score 4, 131 (66 - 272) HU.

Conclusion: Pulmonary artery thromboemboli can be detected with confidence (visual score of 3 or 4) when the attenuation difference between the thrombus and the contrast-enhanced PA exceeds 160 HU. Given that thrombus attenuation may be as high as 73 HU, CTPA contrast enhancement should exceed 233 HU.

Systemic Venous Anomalies of the Thorax

CHUGHTAI A and Agarwal P

Objectives: To present and discuss the imaging spectrum of systemic venous anomalies encountered on thoracic imaging using radiographs, multi detector CT and MRI.

Principal Information: Systemic venous anomalies in the thorax can be isolated and found incidentally or may be associated with other vascular abnormalities. We present a review of systemic venous anomalies including their imaging appearance and clinical significance. A brief outline is given below:

Abnormalities of the Superior Vena Cava:
- Persistent Left SVC draining into coronary sinus
- Left SVC with unroofed coronary sinus
- Left or right SVC draining into left atrium
- Aneurysmal dilatation of right SVC
- Levoatriocardinal vein

Retroaortic Innominate vein anomalies of suprahepatic IVC Azygos vein Azygos continuation of IVC, isolated or with congenital heart disease Hemiazygos continuation with drainage into azygos vein, left or right SVC Azygos lobe.

Conclusions: Systemic venous anomalies can be encountered unexpectedly. Recognition of these anomalies is important to prevent misinterpretation of the imaging findings and unnecessary further imaging. Imaging features of these anomalies on plain radiography, MDCT and MRI will be presented and discussed.
Postoperative Imaging of Transcaval and Transapical Transcatheter Aortic Valve Replacement

SHAIKH SH, Reeser N, Nelson C, Wang DD, Greenbaum A and Song T

Objectives: The purpose of this educational exhibit is to review the indications, procedural technique, and postoperative computed tomography (CT) findings of transcaval (TC-TAVR) and transapical (TA-TAVR) transcatheter aortic valve replacement (TA AVR).

Principal Information: TAVR is a minimally invasive procedure used to treat symptomatic severe aortic stenosis in patients deemed inoperable or of high surgical risk. In cases with advanced ilio-femoral disease, safe femoral arterial placement of the introducer sheath may not be possible. A transapical approach could offer a reasonable alternative. However, this approach is limited in patients with increased epicardial fat or significant comorbidities. On July 3, 2013, Henry Ford Hospital became the first in the world to perform a TC-TAVR. TC-TAVR is performed by femoral vein access, followed by IVC puncture into the aorta for sheath placement followed by standard retrograde aortic valve implantation. Post valve implantation, the tract is closed with commercially available nitinol devices. Postoperative CT findings include an occluder device between the aorta and IVC at the level of the puncture. Imaging can be used to assess for leakage at the occluder device and other associated findings such as retroperitoneal hemorrhage and vascular injury. TA-TAVR is performed by a small anterolateral thoracotomy with direct left ventricle apical puncture, followed by antegrade aortic valve implantation. Post-operative CT findings include suture material within the apex of the left ventricle and a small anterolateral thoracotomy. Imaging can be used to assess for associated findings, such as hematoma or seroma at the surgical site.

Conclusion: TC-TAVR and TA-TAVR are procedures used to treat the subsegment of patients unable to safely undergo transfemoral TAVR. Their frequency in clinical practice is likely to rise with increasing operator experience. It is important for the radiologist to be familiar with these approaches to provide accurate and meaningful reports to the referring clinician.

“From Gene to Aneurysm” - Genetic Mutations that Predispose to Thoracic Aneurysm Formation

SIGAKIS C, Vargas D, Agarwal S, Ocazionez D, Javidan-Nejad C and Restrepo CS

Objectives: 1. Review the most common genetic mutations associated with aneurysmal dilatation of the thoracic aorta.
2. Revisit the clinical presentation, symptomatology, and imaging findings of these aortic aneurysm syndromes.
3. Discuss the role of the radiologist in the follow-up and management of these patients.

Principal Information: Unlike the older adult population in which atherosclerosis and hypertension play a major role in the development of thoracic aortic aneurysms, young patients presenting with this pathology often have underlying conditions predisposing them to vascular weakness and dilatation. Today, many of these syndromes may be identified by a specific gene mutation. Common genetic mutations resulting in aortic aneurysms include those seen in Marfan syndrome, Turner syndrome and bicuspid aortopathy. Other less common conditions include Beal, Loeyes-Dietz, and Ehlers-Danlos syndromes. In addition to understanding that the risk of developing a thoracic aortic aneurysm differs across this spectrum of syndromes, the radiologist must also be aware of associated findings and their clinical importance. These include, but are not limited to, aortic dissection, aortic coarctation, bicuspid aortic valve, aortic regurgitation, hypertrophic cardiomyopathy and other aneurysms. Familiarity with these syndromes, their genetic underpinnings, risk for thoracic aortic aneurysms and associated pathology is of particular importance in the follow up of these patients, as surgical management may be considered at a much smaller caliber than the normal population.

Conclusion: The radiologist plays a crucial role in the evaluation and follow-up of patients with genetic conditions that predispose to aortic aneurysm formation. As such, knowledge of the clinical presentation, associated findings and possible complications is vital, as management is often based solely on radiologic criteria.
Pulmonary Arteries Great and Small: Imaging Approach to the Differential Diagnosis

CARTER BW, de Groot P, Gilman MD, Sharma A, Abbott GF and Wu CC

Objective: The purpose of this educational exhibit is to illustrate the specific congenital and acquired disease process that may result in dilatation and narrowing of the pulmonary arteries.

Principal Information: Specific abnormalities of the pulmonary arteries, including congenital anomalies and acquired pathologies, will be presented on chest radiography, CT, PET/CT, and MRI performed on adult patients that result in vessel dilatation and narrowing. Pathophysiology, diagnosis, and treatment of presented entities will be discussed.

Conclusions: Abnormalities of the pulmonary arteries are relatively uncommon, but have been encountered more frequently in the adult population secondary to the widespread utilization of radiologic studies. Many congenital anomalies and acquired abnormalities may result in vessel dilatation, such as pulmonic valve stenosis, pulmonary arterial hypertension, and aneurysms/pseudoaneurysms, or vessel narrowing, such as chronic pulmonary emboli, vasculitides, and extrinsic compression. It is important for the radiologist to be familiar with the myriad of anomalies that may affect the pulmonary arteries on imaging studies and convey the clinical importance of these entities.

AMPLATZER Occlusion Devices – Beyond Atrial Septal Defect (ASD) Closure

WEVER D, Sonavane S, Terry N, Watts J, Nath H and Singh S

Objective: AMPLATZER occlusion devices such as septal occluders, vascular plugs are now increasingly used for vascular embolization with varied indications. We intend to display our institutional experience with the use of these devices.

Principal Information: In the current era of minimally invasive procedures, the field of percutaneous embolization therapy is evolving and gaining wide acceptance. However, traditional embolization materials such as gel foams, coils, and detachable balloons may not be adequate or safe for medium to larger sized vascular abnormalities with high flow. In recent past we have seen increasing use of these transcatheter AMPLATZER occlusion devices in several usual and unusual situations with excellent results. Aim of the exhibit is to share our experience of utilization of AMPLATZER occlusion devices in successful treatment of pulmonary arteriovenous fistula (AVM), coronary artery fistula, postoperative fistula, patent ductus arteriosus (PDA), post myocardial infarction (MI) ventricular septal defect (VSD), and post MI ventricular wall rupture with illustrative cases.

Conclusion: With expanding role and utilization of AMPLATZER occlusion devices, it is important for cardiopulmonary and general radiologists to be aware of evolving indications and appearances of these devices on imaging.
**Aortic Arch Dissection: Prevalence and Clinical Significance**


**Objective:** To determine the prevalence and clinical outcome of patients with dissection originating in the aortic arch, an area of uncertainty in dissection classification.

**Methods:** We retrospectively assessed electronic medical records and CT angiography in patients who presented to our institution from January 2000 to December 2012. We excluded patients with trauma, prior aortic surgery and those without an initial CT at our institution. Imaging findings and final reports were analyzed and patients categorized as having classic type A, B or aortic arch dissection. Aortic arch dissection was defined as involving the aortic arch and/or great vessels at its proximal extent. Dissection was characterized by morphology (intimal flap or intramural hematoma), demographics and treatment.

**Results:** Of 250 patients with aortic dissections, 47 patients (18.8%) had an arch dissection, 85 (34%) had type A dissection, 128 (51.2%) had type B dissection. There were no age and gender differences between the patients with arch dissection (58.91 years +/- 12.49 and 26 males, 55%) and other dissections (62.26 years +/- 14.46, p=0.081 and 130 males, 64%, p=0.266). Of the 47 patients with arch dissection, medical treatment, surgery and endovascular treatment were performed in 21, 10 and 10 patients, respectively. The medical records were unavailable in six patients. To date, slightly more than half of patients remain under imaging surveillance.

**Conclusion:** Aortic arch dissection is not rare and is different from classic aortic dissection due to variable approaches to its treatment based on the clinical context and specific imaging findings.

**Varied Appearance of Internal and External Hernias Pulmonis**

**MILNER D, Terry NLJ, Sonavane S, Watts JR, Nath PH, Singh SP**

**Objectives:** The exhibit will present a pictorial review of various external and internal lung herniations demonstrating appearance, complications and follow-up.

**Principal Information:** Acquired external lung herniation is an uncommon occurrence, though more common than congenital, and it is most often secondary to blunt or penetrating trauma to the chest wall, including surgical changes. More atypical are spontaneous herniations which occur secondary to cough, heavy lifting or other Valsalva maneuvers that increase intra-thoracic pressure. Rarely lung herniations are secondary to a primary pathologic process involving the chest wall such as abscess or neoplasm. Internal lung herniation can also occur after single lung transplant or pneumonectomy. Lung herniation can be symptomatic, secondary to pain or palpable mass, or asymptomatic with incidental discovery at imaging. Complications include strangulation and incarceration. While lung hernias can be seen on chest radiography, computed tomography (CT) is more sensitive for detection. CT also facilitates accurate depiction of the size and location of the defect, associated abnormalities of the chest wall and signs of strangulation. We will share our experience with several illustrative cases.

**Conclusion:** Thoracic radiologists need to be aware of the conditions that may result in acquired lung herniation and the potential complications. Computed tomography increases detection and allows for detailed assessment of the defect and any complications.
Factors Leading to Precipitation of Peri-Breast Implant Gas Following Airline Travel to High Altitude

BROWN MA, Nevrekar D, Cox C and Chung J

Objectives: To determine the factors associated with precipitation of gas in and around breast implants (peri-breast implant gas) following airline travel to altitude.

Materials and Methods: This study was approved by our institutional review board. Retrospective review of chest CT scans acquired at a tertiary/quaternary pulmonary specialty hospital was performed for 343 female patients with breast implants. Scans were evaluated for presence or absence of gas, implant type, implant rupture, associated capsular/axillary abnormalities and correlated with patients’ home zip code as a proxy for recent commercial airplane travel.

Results: Of the 343 patients included in the analysis, peri-breast implant gas was significantly associated with recent commercial airplane travel (p<0.0001), silicone implant type (p<0.0001) and rupture (p<0.0001). Of the 70 patients positive for peri-implant gas, 86% resided outside of Colorado, 86% had silicone implants, and 31% were ruptured, versus 35%, 49%, and 11%, respectively, for 273 patients without peri-implant gas. No association was found with the presence of capsular calcification or axillary clips.

Conclusion: Peri-breast implant gas is likely due to multiple factors including atmospheric pressure, composition of the implant, and integrity of the implant. In patients with history of recent airplane travel, peri-breast implant gas should be considered incidental and requires no further work-up. Moreover, patients with breast implants who experience odd sensations around their implants during airplane travel should be reassured that this is a common occurrence likely related to precipitation of gas.

Recurrent Respiratory Papillomatosis (RRP): A Review

LAROIA A, Mueller J and Laroia S

Objective: We will present a pictorial review of the radiological appearance of pulmonary and tracheo-bronchial recurrent respiratory papillomatosis (RRP).

Principal Information: RRP is caused by infection of the upper aerodigestive tract with the human papillomavirus (HPV) types 6 and 11. Passage through the infected birth canal is thought to be the mode of infection. The tracheo-laryngeal form of papillomatosis occurs in 2-17% of cases that eventually spreads to the lungs in 1% of the patients. Lobulated intraluminal lesions are seen in the trachea and bronchi. Pulmonary involvement is characterized by enlarging solid nodules with eventual cavitation. Complications include airway obstruction, atelectasis, pneumonia or pneumothorax. Malignant degeneration to squamous cell carcinoma is a long-term sequel of RRP. CT with 3-D reformation including virtual bronchoscopy is the modality of choice for non-invasively evaluating the overall extent of the disease. Bronchoscopy has become increasingly reserved for the lesions that cause obstruction. Radiographic features of histologically proven cases of recurrent respiratory papillomatosis in a tertiary care referral hospital are presented in this exhibit.

Conclusions: The course of RRP ranges from isolated laryngeal/airway disease to progressive pulmonary involvement with a potential malignant degeneration. Current management focuses on surgical debulking with or without concurrent adjuvant therapy with antiviral drugs. CT provides an accurate non-invasive assessment of overall disease severity which critical in determining therapy and prognosis.
MDCT of the Large Airway Disease
LAROIA A and Laroia S

Objectives: To provide a pictorial review of MDCT images of normal and abnormal large airways.

Principal Information: A wide spectrum of diseases can cause focal or diffuse narrowing or dilatation of the large airways. MDCT with post-processing techniques have revolutionized the ability to noninvasively image the large airways. This exhibit will provide a radiologic review of normal anatomy, followed by various large airway diseases, ranging from congenital tracheobronchial lesions, benign and malignant causes, focal and diffuse narrowing of the trachea, tracheobronchomegaly, tracheomalacia, infiltrative and infective diseases. We will also discuss the technique of MDCT for dedicated imaging of the large airways. MDCT is complementary to direct visualization by bronchoscopy. In severe stenosis it may surpass the benefits of bronchoscopy by its ability to “see” beyond the narrowing.

Conclusion: MDCT is now the modality of choice for diagnosis and management of large airway pathology. Knowledge of CT features of large airway disease would help making an accurate diagnosis and help in planning the further management.

The Interventricular Septum - A Multimodality Analysis of Anatomy and Pathology
LICHTENBERGER III JP, Millard-Hasting B, McQuillan BF and Carter BW

Objectives: As imaging of the heart increases in both frequency and quality, knowledge of its intricate anatomy and location-specific pathology on the part of the radiologist must equally increase. The interventricular septum (VS) is a particularly compelling example of a complex piece of anatomy with clinically relevant pathology. Ventricular septal defects (VSD’s) are one of the most common congenital cardiac defects affecting 1-2 out of every 1,000 births. Other diseases affecting the interventricular septum range from aneurysms to tumors and from infection to cardiomyopathy. The goal of this exhibit is to review the anatomy and pathology of the interventricular septum.

Principal Information: Our primary teaching objectives are to:
1. Illustrate the clinical anatomy of the ventricular septum, emphasizing important landmarks and diagnostic challenge areas
2. Review the most common congenital and acquired forms of ventricular septal defects and associated cardiac anomalies
3. Discuss the repair of VSD’s, including complications
4. Examine the spectrum of other diseases involving the VS, including aneurysms, neoplasms and cardiomyopathies
This exhibit will incorporate radiography, echocardiography, fluoroscopy, CT and MRI. A focus of this exhibit will be on the optimum imaging modalities for evaluating disease in this structure.

Conclusions: The spectrum of congenital anomalies and diseases affecting the VS is vast and complex, and therefore it is important for diagnosticians to be knowledgeable about both the optimal imaging modality and image characteristics of each condition. This exhibit will help to increase this knowledge.
Prim er on Correlative Value of Laboratory Tests and CT in Diagnosis of Collagen Vascular Disease and Vasculitis


Objective: To educate radiologists on the value of correlating specific lab values and CT in the diagnosis of collagen vascular disease and vasculitis.

Principle Information: Correlating imaging characteristics with lab values helps limit or adjust differential diagnoses when collagen vascular disease or vasculitis is suspected. This exhibit will showcase radiologic features and laboratory values associated with conditions such as polymyositis/dermatomyositis, rheumatoid arthritis, systemic lupus erythematosus, and granulomatosis with polyangiitis.

Conclusion: When radiologists combine imaging patterns with laboratory values in suspected collagen vascular diseases or vasculitides, a more specific diagnosis can often be made compared to simple reliance on CT appearance.

Incidental Breast Findings on Chest CT: You Can’t Diagnose What You Don’t See!

RATANAPRASATPORN L, Ratanaprasatporn L, Lourenco A and Healey T

Objectives: To illustrate commonly encountered CT findings in the breast, both benign and malignant, and correlate with dedicated breast imaging and pathological findings.

Principal Information: While CT is not the imaging modality of choice for evaluating diseases of the breast, radiologists must be familiar with the CT appearance of malignant and benign tumors of the breast. CT findings of benign and malignant breast disease, including cyst, fibroadenoma, gynecomastia, male breast cancer, metastatic disease and primary insitu and invasive breast carcinoma will be shown along with the corresponding mammogram, ultrasound, MRI and pathology results when available. Additionally, abnormal CT findings in the breast without corresponding mammographic or sonographic abnormality will be demonstrated to illustrate the difficulties of evaluating breast tissue on CT.

Conclusions: While evaluation of breast tissue on CT can be very challenging, it is important to assess all tissues included on chest CT imaging and recognize when additional imaging work-up is necessary.
Accessory Bands in the Heart: A Radiological Spectrum

BAXI AJ, Restrepo C, Katre R, Marmol A, Ocazionez D and Vargas D

Objectives: 1. To study accessory bands within cardiac chambers and differentiate them from normal muscular bands, accessory chordae tendineae and papillary muscles. 2. To discuss the role of echocardiography, CT and MRI in the evaluation of accessory bands with emphasis on clinical outcome.

Principal Information: The number, size and morphology of chordae tendineae and papillary muscles is variable. Accessory bands may be asymptomatic and incidental findings. However at times they can cause with hemodynamic alterations. Although accessory bands have similar radiological appearances to that of normal muscular bands, they may be pathological and can have adverse clinical implications. Accessory chordae tendineae in particularly can restrict mobility and cause outlet obstruction. Ruptured accessory chordae tendineae can cause mitral regurgitation. Echocardiography is one of the most widely used modality for initial evaluation of these bands. But it has certain limitations like poor window and interobserver variation. MDCT offers excellent visualization of accessory bands. Radiation exposure and use of iodinated contrast are its short comings. MRI on the other hand offers excellent tissue characterization, multiplanar imaging and has less interobserver variation.

Conclusion: Echocardiography, CT scan and MRI can be used for evaluation of accessory bands. Each modality has its own advantages and short comings. Radiologists should be familiar with the imaging appearances of these bands and understand their clinical significance. An attempt is made in this exhibit to discuss accessory bands within the cardiac chambers, their pathogenesis, and clinical significance.

Esophageal Cancer Staging: PET/CT Imaging, A Pictorial Review of Technique, Strengths, Limitations & Pitfalls

BIJAN B, Doroudinia A, Shelton DK and Moore EH

HIGHLIGHTS: Sensitivity of FDG-PET for detection of primary tumor in esophageal cancer is better than CT alone(69–100%vs67–92%). EUS is superior to PET/CT for T-staging and identifying loco-regional lymph nodes, while PET/CT provides superior M-staging. EUS and integrated PET/CT appear to independently affect treatment decisions.

T-STAGING: Detects the primary tumor: Adenocarcinoma or SCCA.
High FDG uptake correlates with:
1-Depth of tumor invasion.
2-Likelihood of lymph node metastases.
3-Overall prognosis.

N-STAGING: Reduces false positive results of CT & EUS by 50%

M-staging: Superior assessment of distant metastasis:
1-Appropriate up-staging by detecting more distant metastasis.
2-Avoiding unnecessary surgery in 38% of cases.
3-Assist selecting most accessible lesion for biopsy.
4-Detection of synchronous tumors: 2% (Thyroid, Lung, Colon)
5-Characterize equivocal hepatic lesions.

PET/CT is now indicated for the initial workup of all patients with GEJ cancer.

Conclusion: Incidence of esophageal carcinoma is increasing and refinement of staging techniques is needed to understand prognosis and tailoring the therapy for individuals to achieve the best possible outcome. It is hoped that PET/CT will lead to therapeutic benefit for patients with localized disease by identifying nonresponders to induction therapy so that they can be switched to an alternate treatment regiment. Improvement in PET resolution will potentially improve T-staging by improving the depth of invasion assessment, also will potentially improve N-staging by better differentiation of nearby lymph nodes from primary tumor and detection of small nodal viable tumor cells. Introduction of new PET tracers to improve detection of subtle viable tumor foci is an interesting area for further research.
Pitfalls in the Interpretation of PET/CT Findings in the Chest

CARTER BW, Truong MT, Viswanathan C, Marom EM and Erasmus JJ

Objectives: 18-F-FDG PET/CT has emerged in recent years as a powerful tool for diagnosing metabolically-active malignancies, the staging and re-staging of disease, and evaluating response to therapy. Within the chest, PET/CT is effective at distinguishing between benign and malignant pulmonary nodules, and evaluating malignancies such as lung cancer and malignant pleural mesothelioma. With the increasing utilization and availability of PET/CT, it is important for the radiologist to be familiar with the numerous processes that may simulate disease in the chest and the potential pitfalls that exist in the interpretation of these studies.

Principal Information: Representative cases will be presented that highlight potential pitfalls of which the radiologist should be aware in order to avoid the misinterpretation of PET/CT examinations. Discussion of individual pitfalls, their etiology, and ways to avoid them will be presented.

Conclusion: Utilization of 18-F-FDG PET/CT for diagnosing and evaluating thoracic malignancies continues to increase as radiologists become more proficient at interpreting the examinations and the availability of the modality increases. There are numerous potential pitfalls in the chest with which the radiologist should be familiar in order to correctly and accurately interpret PET/CT examinations.

When the Pump Will Not Pump: Contemporary Imaging of the Common Heart Failure Treatment Devices and Pre-Transplant Evaluation

DICKS DL, Ocazionez D, Kicska GA, Rubinowitz AN, Godwin D and Reddy GP

Objectives: 1) To discuss cardiac devices and surgical procedures the radiologist will encounter in the management of heart failure
2) To depict the imaging appearance and complications of these devices

Principal Information:
1) Overview of the common causes of congestive heart failure
2) Pictorial review of commonly used devices in the management of heart failure, and imaging evaluation of potential complications
   a. Implantable cardiac pressure monitors
   b. Cardiac resynchronization devices
      i. Pacemakers
      ii. Defibrillators
   c. Intra-aortic balloon pumps
   d. Left and bi-ventricular assist devices
      i. Percutaneous
      ii. Surgically placed
   e. Total artificial heart replacement
3) Cardiac transplantation
   a. Indications/Exclusions
   b. Immediate complications and imaging assessment
   c. Long-term complications and the role of imaging
4) On the horizon

Conclusion: 1. Devices used for the management of acute and chronic congestive heart failure continue to be developed.
2. The radiologist should recognize newer devices/procedures for treating heart failure such as percutaneous left ventricular assist devices and total artificial heart replacement, with special attention to evidence of malfunction.
Hypertrophic Cardiomyopathy from A to Z: Genetics, Pathophysiology, Imaging and Management

BAXI AJ, Restrepo C, Murillo H, Vargas D, Ocazionez D and Marmol A

Objectives: 1. To study patterns of myocardial involvement in hypertrophy cardiomyopathy (HCM).
2. To review the genetics, pathophysiology and imaging findings in HCM.

Principal Information: HCM is a genetic cardiac disease caused by dominant mutations in sarcomere genes with remarkable heterogeneity. It causes diffuse or segmental left ventricular hypertrophy with hyperdynamic nondilated chamber leading to stiffening of walls and abnormal aortic and mitral valve function, impeding normal blood flow out of heart. It can be completely asymptomatic and incidental. However some patients develop minor symptoms which progress as heart function worsens. Symptoms may include chest pain, shortness of breath, fatigue, fainting, palpitation and sudden death. The clinical manifestations and electrocardiographic findings are nonspecific. Noninvasive imaging plays pivotal role in detecting HCM and understanding its pathophysiology. Echocardiography is the most widely used modality for initial evaluation. It can access gradient across LVOT which is one of the criteria for risk assessment. But it has certain limitations like poor window and interobserver variation. MDCT offers high-quality multiplanar reconstructions, gives dynamic evaluation of left ventricular function. Radiation exposure and use of iodinated contrast are its short comings. It cannot depict areas of fibrosis. Nevertheless, it can be used in patients with pacemakers in whom MRI is contraindicated. MRI offers multiplanar imaging, gradient analysis and assess distribution of LV hypertrophy and gives unparallel tissue characterization thus accurately depicting areas of fibrosis manifesting as delayed enhancement. It is the imaging modality of choice for patients considered for alcohol ablation.

Conclusion: HCM is a complex but relatively common genetic heart muscle disease. Echocardiography, CT scan and MRI can be used for evaluation of HCM. Each modality has its own advantages and short disadvantages. Radiologists should be familiar with the imaging appearances of HCM and understand clinical significance.

Radiation Dose during Thoracic CT: Influence of Ethnicity and Gender

JAFARI M, Odedra D, Menezes R, Khak J, Kashani H and Paul N

Objectives: Chest wall fat influences image noise and radiation dose during thoracic CT. The purpose of this study was to determine whether chest wall fat varies with patient ethnicity and gender.

Methods/Materials: A cross sectional study of outpatients referred for thoracic CT to a single institution. 600 patients (316 M), mean age 60y (range 16-93), mean BMI 26.13±5.29 kg/m2 (range 14-49.4) completed a questionnaire to document demographics including ethnicity and had height and weight measurements performed. The following parameters were measured from a single transaxial CT image at the level of the mid left ventricle; AP and LAT thoracic diameter (skin-skin), and cross sectional area of chest wall fat (iNtuition unlimited, TeraRecon). 168 patients were matched for age, gender, BMI (<25, ≥25) and ethnicity; GpA = Caucasian (n=80), GpB = East Asian (n=47), and GpC = South Asian (n= 41). Data analysis was performed using the Kruskal–Wallis and Mann-Whitney tests (P<0.05 was taken as significant).

Results: Cross sectional area of chest wall fat (cm2): BMI < 25: GpA = 86.7 ± 53.9, GpB = 88.9 ± 38.4, GpC = 113.7 ± 43.7; BMI ≥ 25: GpA = 194.3 ± 88.3, GpB = 172.2 ± 113.5, GpC = 238.7 ± 107.5. South Asians had the most chest wall fat, more than Caucasians (P=0.016) at BMI < 25, and more than East Asians (P=0.012) at BMI ≥ 25. This ethnic difference was greater in males than females. Women had more subcutaneous fat in Caucasians (P<0.0001), East Asians (P=0.024), and South Asians (P=0.0033) than males in all ethnicities.

Conclusion: Female sex and South Asian ethnicity is associated with increased subcutaneous fat which causes increased image noise and results in increased radiation dose during thoracic CT. Gender and ethnicity need to be considered when optimizing CT image quality and radiation dose.
Thoracic Findings in Patients with Multiple Sclerosis

KADOCH MA, Edwards M, Ward TJ, Stern J, Cham M and Jacobi AH

Objectives: Multiple sclerosis (MS) is an autoimmune disease targeting the central nervous system. Epidemiologic studies have suggested higher rates of cardiovascular disease and respiratory infections in patients with MS. The objective of this study is to retrospectively assess for the prevalence of positive cardiovascular and pulmonary findings in MS patients who received a CT scan of the chest at our institution, which maintains a large dedicated MS treatment center.

Materials and Methods: The imaging records for all patients with multiple sclerosis were reviewed. A group of 43 documented MS patients older than the age of 45 with an unenhanced non-EKG gated chest CT scan were available for analysis. The chest CT scans were independently reviewed by two experienced thoracic radiologists. The CT scans were also analyzed for coronary artery calcification (CAC) based on the Agatston scoring system using software-assisted analysis.

Results: The female/male ratio of patients in the study group was 2.3, which is compatible with the disproportionately higher prevalence of MS among women in epidemiologic studies. Patient age ranged from 45-84 with a mean of 60. Prevalence of CAC (Agatston score >0) was 40% among MS patients, which represents a significant burden of subclinical atherosclerosis that appears on par with that of an age-, gender-, and race-matched control group from the Multi-Ethnic Study of Atherosclerosis (MESA) trial. Small airway disease as manifest by tree-in-bud nodularity and peribronchial thickening was present in 23.3% of patients. Consolidations, many of which were suspicious for aspiration pneumonia, were present in 25.6% of patients. Parenchymal scarring and bronchiectasis, suggestive of prior infection, were present in 58.1% and 23.3% of patients, respectively. Pulmonary nodules were present in 60.5% of patients.

Conclusions: In this first large retrospective study of CT scans of the chest in patients with multiple sclerosis, there is suggestion of an increased prevalence of small airway disease, aspiration pneumonia, parenchymal scarring, and bronchiectasis in these patients as well as a significant burden of subclinical atherosclerosis that appears on par with that of an age-, gender-, and race-matched control group from the MESA trial.

The How To of Lung Cancer Screening

FINTELmann F, Digumarthy S, Lennes IT, Muse V, Kalra M and Shepard J

Objective: Provide pointers for the implementation of a Lung Cancer Screening program.

Principle Information: We will present pointers for a successful Lung Cancer Screening program.
- Strategies to obtain referrals from community, hospital administration and other specialties
- Chest CT scanning technique with emphasis on low dose protocols and image enhancement techniques
- Optimization of workflow in radiology departments including the use of computer aided tools
- Standardized reporting and adoption of simple nodule classification to streamline management
- Algorithms to manage positive findings based on the latest NCCN guidelines
- Techniques to improve communication with patients and referring physicians
- Organization of a multidisciplinary clinic with Oncology, Thoracic Surgery and Radiation Oncology

Conclusion: The exhibit will offer useful and practical tips for starting a lung cancer screening program.
Diverse Appearances of Coccidioidomycosis - An Institutional Experience

ARTEAGA VA, Knox K and Malo J

Objective: The purpose of this exhibit is to elucidate the radiographic presentations of pulmonary Coccidioidomycosis based on 5 year experience at The University of Arizona.

Methods: Patients with a diagnosis of pulmonary Coccidioidomycosis were identified by positive Coccidioides serology or culture from the University of Arizona Pathology Laboratory. CT and plain film imaging featuring the spectrum of classic and non-classic manifestations of Coccidioidomycosis infection were identified among these cases.

Results: The patterns of pulmonary Coccidioidomycosis are variable, diverse, and often nonspecific, including cavities, consolidation and nodules. Findings may mimic potentially more ominous disease, such as malignancy.

Conclusion: The spectrum of radiographic findings in pulmonary Coccidioidomycosis is wide, and our institutional experiences, given the unique Southwestern location, provides additional insight in understanding the common and uncommon presentations of disease in addition to potential complications and management considerations.

Incidental Musculoskeletal Findings on Cross-sectional Imaging of the Chest

STEDMAN D, Restrepo CS, Bean G, Mumbower A, Deuel B and Loredo R

Objectives: The intent of this exhibit is to present examples of common and unusual incidental musculoskeletal findings that may be seen on cross-sectional imaging of the chest.

Principal Information: MR and CT of the chest are performed for a variety of complaints. In many cases, incidental findings related to the musculoskeletal system are observed. Examples of incidental musculoskeletal findings observed on cross-sectional imaging of the chest include atrophy of the rotator cuff muscles, septic arthritis involving the sternoclavicular, glenohumeral or acromioclavicular joints, bone tumors, chest wall soft tissue tumors, and others. Various cases of incidental musculoskeletal pathology observed on chest imaging will be presented and analyzed.

Conclusion: The radiologist charged with interpreting cross-sectional imaging of the chest should recognize and understand musculoskeletal pathology about the thorax.
Acute and Chronic Complications of Lung Transplantation: Pictorial Essay and Review of the Literature

SIMPSON S and Barbosa E

Objective: The purpose of this exhibit is to demonstrate the spectrum of abnormalities occurring in the post lung transplant state both in the acute and chronic setting.

Methods: A large cohort of post lung transplant chest radiographs and CT’s will be reviewed and correlated with clinical findings and pathology results, and then evaluated within the contextual time frame following surgery. The current literature will be reviewed and correlated with the key imaging diagnoses radiologists should be cognizant of, highlighting their interpretation and clinical significance.

Results: The spectrum of imaging abnormalities in the post lung transplant setting is as complex as it is vast spanning from post-surgical impediments and reperfusion injury to infections and immunologic complications. Oftentimes these abnormalities will coexist. Knowledge of the time frame since surgery is crucial. In the acute setting these can include re-implantation response, bronchial anastomotic dehiscence, and pleural complications. Infections can occur both early and later on, with the etiologies varying with respect to the surgical time-frame. In the chronic setting, radiologists can encounter such abnormalities as chronic rejection (bronchiolitis obliterans), bronchial stenosis, PTLD, and recurrence of the primary disease.

Conclusion: With the increasing number of patients receiving and living longer with lung transplants it is imperative that radiologists have a clear conceptual framework and understanding of the broad spectrum of clinical and imaging diagnoses, both in the acute and chronic setting.

Imaging Characteristics of Pathologically-Proven Thymic Hyperplasia: Identifying Features that can Differentiate True Versus Lymphoid Hyperplasia

ARAKI T, Sholl LM, Gerbaudo VH, Hatabu H and Nishino M

Objectives: Investigate imaging characteristics of pathologically-proven thymic hyperplasia, and identify features that can differentiate true hyperplasia versus lymphoid hyperplasia.

Materials and Methods: Thirty-one patients (9 males, 22 females; age: 20-68) with pathologically confirmed thymic hyperplasia (18 true and 13 lymphoid) who had preoperative CT (n=27), PET/CT (n=5), or MRI (n=6) were studied. The length and thickness of each thymic lobe and the transverse and anterior-posterior diameters and attenuation of the thymus were measured on CT. Thymic morphology and heterogeneity on CT and chemical shift on MRI were evaluated. SUVmax were measured on PET. Imaging features between true versus lymphoid hyperplasia were compared.

Results: No significant differences were observed between true versus lymphoid hyperplasia in thymic length, thickness, diameters, morphology and other qualitative features (P>0.16). The length, thickness, diameters of thymic hyperplasia were significantly larger than the mean values of normal gland in the corresponding age group (P41.2) as the optimal threshold for differentiating lymphoid hyperplasia from true hyperplasia, with 83% sensitivity and 89% specificity. Decrease of signal intensity on opposed-phase images was present in all 4 cases with in/opposed phase imaging. The mean SUVmax was 2.66.

Conclusion: CT attenuation of the thymus was significantly higher in lymphoid hyperplasia than in true hyperplasia, with the optimal threshold of >41.2 in this pathologically confirmed cohort of thymic hyperplasia. [Am J Roentgenol AJR in press].
Thymic Measurements in Pathologically Proven Normal Thymus and Thymic Hyperplasia: Intra- and Interobserver Variability

ARAKI T, Sholl LM, Gerbaudo VH, Hatabu H and Nishino M

Objective: Determine the intra- and interobserver variability of thymic measurements on computed tomography (CT) in patients with pathological diagnosis of thymic hyperplasia or normal thymus.

Materials and Methods: Thirty-three patients with pathological diagnosis of thymic hyperplasia (n=25) or normal thymus (n=8) who had identifiable thymus gland on CT were retrospectively studied. Two radiologists independently measured thymic size and CT attenuation. Concordance correlation coefficients (CCCs) and Bland-Altman plots were used to assess intra- and interobserver agreements.

Results: The intra- and interobserver agreements of thymic diameters and the lobe length were moderate, with CCCs ranging 0.73-0.89 and 0.72-0.81, respectively. Higher agreement was noted among patients whose measurements were performed on the same CT image in two independent measurements, with intraobserver CCC ≥0.95 for diameters and length. After providing readers with an instruction for consistent selection of CT image for measurements, the intra- and interobserver agreement improved, resulting in CCCs ranging 0.81-0.92 and 0.77-0.85 for diameters and length, respectively. Thymic lobe thickness had the least agreement. CT attenuation measurements were highly reproducible, with CCCs ranging 0.88-0.97. In patients with thymic CT attenuation >30HU, the attenuation measurements were more reproducible with narrower 95% limits of agreement.

Conclusion: Thymic size measurements had moderate to high intra- and interobserver agreement, when the instruction for consistent selection of images were provided to the readers. CT attenuation was highly reproducible, with higher reproducibility for thymic glands with >30HU. Awareness of thymic measurement variability is necessary when interpreting measured values of normal thymus and thymic pathology on CT.

More than Meets the Eye: Thoracic Manifestations of Ocular Disorders

LEE MH, Yamanuha J, Kanne J, Chen Y and Meyer C

Objectives: Describe various conditions that affect both the eye and the chest. Illustrate the characteristic ophthalmic lesions and chest imaging findings in conditions that affect both the eye and chest. Demonstrate how awareness of particular ocular manifestations of disease can inform the chest imaging findings, limiting the differential diagnosis.

Principal Information: Profile each disease including a brief overview, a discussion of characteristic ophthalmic manifestations, and a discussion of typical imaging findings, with particular attention to implications on diagnosis and prognosis. Examples include: infection (orbital cellulitis with septic emboli, tuberculosis), non-infectious inflammatory (sarcoidosis), congenital/hereditary (Marfan Syndrome, Hermansky-Pudlak), collagen vascular disease (SLE), autoimmune (myasthenia gravis, granulomatosis with polyangiitis), neoplastic (ocular melanoma with lung metastases, Pancoast tumor with Horner syndrome), acquired immunodeficiency (Kaposi sarcoma), drug related (talcosis from intravenous drug abuse).

Conclusions: A variety of conditions have ocular and thoracic manifestations. Recognition of potential associations between ophthalmic lesions and thoracic imaging findings can be of utility to both the radiologist and the ophthalmologist in establishing a specific diagnosis or limiting the differential diagnosis.
Invasive Diseases of the Chest Wall, A Pictorial Review

OCAZIONEZ D, Dicks D, Oldham SAA, Kicska G, Mohammed T-L and Reddy G

Objectives: Review and familiarize radiologists with the spectrum of invasive neoplasms and infections involving the chest wall. Discuss the role of diagnostic imaging modalities, including CT and MR.

Principal Information: Invasive neoplasms and infections of the chest wall may pose a challenge to the radiologist on imaging studies. This exhibit will review the CT and MR appearance of these conditions which include:
1. Primary invasive neoplasms (sarcomas, PNET’s and aggressive desmoid tumors)
2. Secondary invasive neoplasms from direct extension (lung cancer, breast cancer, mesothelioma and lymphoma) or metastasis
3. Bacterial infections (primary necrotizing fasciitis, osteomyelitis, actinomycosis, tuberculosis and nocardia)
4. Fungal infections (invasive aspergillosis and coccidioidomycosis)

Conclusion: Secondary invasive chest wall neoplasms are more prevalent than primary chest wall neoplasms. The most common malignant primary invasive chest wall neoplasms are sarcomas. Certain bacterial and fungal infections can lead to chest wall invasion, and some of them demonstrate classic imaging characteristics. Once familiarized with these conditions the radiologist will confidently identify them and recommend an appropriate clinical evaluation.

Estimation of Pleural Fluid Volumes on CXR using CT Volumetric Analysis

MAMMARAPPALLIL JG, Anderson SA, Danelson KA, Stitzel JD and Chiles C

Objective: Determine the volumes of pleural fluid (PF) required to produce a visible meniscus in the lateral and posterior costophrenic angles (CPA), and to obscure the hemidiaphragms (HD) on upright frontal and lateral chest radiographs (CXRs), using volumetric analysis of chest CTs.

Materials/Methods: Word recognition software was used to review chest CT reports for pleural effusions described as “small”, for which upright 2-view CXRs were obtained within a 24-hour interval. 98 patients were selected for retrospective analysis, for a total of 196 hemithoraces. PF within each hemithorax was quantified using a semiautomatic method of image segmentation. The volume of PF in mL was the sum of the areas obtained on each axial image multiplied by the scan slice thickness (.5 - 2.5mm). A cardiothoracic radiologist, blinded to the CT findings, scored each hemithorax on each CXR from 0-3 (0- normal CPA, 1- fluid meniscus below the level of the HD, 2- fluid meniscus at the level of the HD, 3- fluid opacity obscures the HD). Comparison with prior CXRs was allowed. Each CXR category was correlated with CT–determined PF volumes.

Results: For hemithoraces scored as 0 (N=124-frontal, 103-lateral), frontal and lateral CXR mean volumes were 19.76 mL (SD 25.70) and 17.23 mL (SD 22.92), respectively. For hemithoraces scored as 1 (N=38-frontal, 57-lateral), frontal and lateral CXR mean volumes were 139.72 mL (SD 218.07) and 101.81 mL (SD 185.59), respectively. For hemithoraces scored as 2 (N=20-frontal, 22-lateral), frontal and lateral CXR mean volumes were 266.02 mL (SD 237.20) and 248.68 mL (SD 234.01), respectively. For hemithoraces scored as 3 (N=14-frontal, 14-lateral), frontal and lateral CXR mean volumes were 642.66 mL (SD of 377.1) and 642.66 mL (SD 377.12), respectively.

Conclusion: In our analysis, 20 mL of PF was present on CT without a visible correlate on CXR. A meniscus below the level of the HD on CXR correlated with roughly 100 mL of PF on both frontal and lateral CXRs, and a meniscus occurring at the level of the HD correlated with roughly 250 mL of PF, with large standard deviations.
How Small is Small? The Utility of the Chest Radiograph in Quantifying the Size of a Pleural Effusion – A 2013 Perspective, Updated with CT Volumetric Analysis.

CHIAO D and Olazagasti J

Objectives: The first objective of this study was to revisit the utility of the chest radiograph in quantifying the volume of a pleural effusion. The second objective was to find out what volume corresponds to a “small,” “moderate,” and “large” pleural effusion.

Methods: An IRB approved, HIPAA-compliant retrospective study of 67 subjects from a single institution treated with therapeutic image-guided thoracentesis was performed. Inclusion criteria included having a chest radiograph and a chest CT within 2 weeks prior to thoracentesis. Subjective interpretation of pleural effusion size (ie, “small,” “moderate,” and “large”) were determined by experienced radiologists based on chest radiography. CT volumetric analysis of the pleural effusions was performed using Carestream VuePACS v11.3.2.4051. Subjective interpretation of pleural effusion size was compared to CT volumetric analysis as well as to the actual volume obtained at thoracentesis.

Results: The mean thoracentesis volume of a “small,” “moderate,” and “large” sized pleural effusion (based on chest radiography) was found to be 600 +/- 436 cc, 812 +/- 566 cc, and 1267 +/- 527 cc. The mean CT calculated volume of a “small,” “moderate,” and “large” pleural effusion was found to be 636 +/- 328 cc, 887 +/- 468 cc, and 1099 +/- 927 cc. The average time between chest radiograph and thoracentesis was 1.9 days. The average time between CT and thoracentesis was 3.2 days.

Conclusion: The chest radiograph remains a useful examination for the everyday evaluation of a pleural effusion. However, the subjective interpretation of pleural effusion size is crude, with wide variance depending on the interpreter. A “small,” “moderate,” and “large” pleural effusion was found to be approximately 600 cc, 800 cc, and 1300 cc respectively.

Silica-related Thoracic Diseases: Underdiagnosed but Always Here

MEIRELLES GSP, Capobianco J, Napolis L, Bagatin E, Terra Filho M and Nery LE

Objectives: After viewing this exhibit, the viewer should be able to:
1. Recognize the main thoracic diseases related to acute, subacute and chronic silica exposure
2. To discuss the main differential diagnosis of silica-related thoracic diseases
3. To explain the utility of HRCT for the diagnosis and follow-up of these conditions

Principal Information: The authors intend to present the following points:
1. Epidemiological aspects of silica-related thoracic diseases
2. Pathogenesis of thoracic manifestations due to acute, subacute and chronic silica exposure
3. Clinical aspects of silica-related thoracic diseases
4. Role of imaging methods, especially HRCT, for diagnosis and follow-up of:
   4.1. Acute Silicosis (silicoproteinosis)
   4.2 Subacute silicosis
   4.3 Chronic silicosis
   4.4 Silicotuberculosis
   4.5 Lung cancer related to silica exposure
   4.6 Rare diseases (Caplan and Erasmus syndromes)

Conclusion: Although very underdiagnosed, silica-related diseases can be promptly evaluated with radiographs and HRCT. The chest is one of the main sites of disease, especially the lungs. The main clinical forms are acute silicosis (silicoproteinosis) and chronic silicosis, and tuberculosis and lung cancer are potential serious complications. The knowledge of the main thoracic findings of silica-related diseases are crucial, in order to avoid workers’ continuous exposure to silicates.
Post Esophagectomy Diaphragmatic Hernia – An Overlooked Complication

MADAN R and Cabral F

Objectives: To illustrate the imaging findings of postesophagectomy diaphragmatic hernia and its complications following different types of esophagectomy procedures.

Methods: Radiographic and CT findings are described in patients with post esophagectomy diaphragmatic hernia presenting to the esophageal clinic for follow up visits.

Results: Post esophagectomy diaphragmatic hernia is a rare complication after esophagectomy (0.4% to 6%) mostly occurring in the left hemithorax. This can occur in the immediate postoperative period or present as a delayed complication with variable symptoms ranging from non-specific respiratory discomfort to acute abdominal pain. The complication is more commonly seen following laparoscopic procedures. The diagnosis is made on cross-sectional imaging, and coronal and sagittal reformats are very helpful at diagnosing this at an earlier stage. Radiologists tend to underreport this finding, and this may be due to insufficient awareness of this complication in the postesophagectomy setting. Elective repair of this complication has a lower risk of morbidity and mortality compared with an emergency repair.

Conclusion: Postesophagectomy diaphragmatic hernia is a challenging diagnosis clinically due to non-specific symptoms and rarity of the complication, however is usually apparent on cross-sectional imaging. Increased awareness and early diagnosis to this complication is important as the incidence of this complication has increased due to more frequent laparoscopic esophagectomies and improved patient survival.

Axial and Multiplanar CT Analysis of Pulmonary Vasculature in COPD: Correlation with Exacerbation

RHO JY, Sheikh N, Chu J, Zach J, Suh YJ and Lynch D

Objectives: We hypothesized that multiplanar CT measurements of pulmonary artery (PA) enlargement would be more strongly associated with exacerbation of COPD than axial CT measurements.

Methods/Materials: We evaluated data from 662 subjects enrolled in the COPD Gene study that were divided into three groups: subjects without any exacerbation (n=313), those with only non-severe exacerbation (n=59), and those with at least one severe exacerbation (n=290). We measured main PA (MPA) and ascending aorta (AA) both on axial images and on multiplanar reconstructions, and evaluated the relationship between PA parameters (MPA diameter and PA: AA ratio) and exacerbations of COPD. MPA was measured both in its tubular portion and at the bifurcation. Univariate analysis was used to evaluate the relationship between PA diameters and exacerbation group.

Results: On axial imaging, MPA diameters for bifurcation and tubular segments and PA: AA ratios at both sites were significantly different among the exacerbation groups. On multiplanar reconstruction, MPA minor diameter and PA: AA ratio at the tubular site were significantly different among the exacerbation groups. The strongest association with exacerbation was found with axial PA: AA ratio at the tubular segment: for this measurement, the mean ratio for non-exacerbators was 0.79, compared with 0.82 for those with non-severe exacerbations, and 0.83 for those with severe exacerbations (p=0.0008). Axial MPA diameter at the tubular site and PA: AA ratios at the tubular and bifurcation sites were significantly different between non-exacerbation and any exacerbation. Multiplanar MPA minor diameter and PA: AA ratios at the tubular site were also significantly different. Evaluation of PA: AA ratio cutoff values showed that a cutoff value of 0.8 for axial PA: AA ratio at the tubular site appeared to provide optimal separation between exacerbators and non-exacerbators.

Conclusions: Axial measurements of MPA diameter and PA: AA ratio are significantly different among exacerbation groups. Multiplanar measurements in general were less significant.
Standard Deviation Aorta (SDA): An In Vivo Measurement of Image Noise Useful in Optimizing CT Protocols and Minimizing Dose Across Multiple Vendors and Scanners

WINTER Z., Teel G, Cohrs M, Steinbach A, Cohrs A and Schindler S

Objective: To develop an in vivo measurement of image noise utilizing the blood pool in the descending aorta (SDA, standard deviation aorta), and use this measurement to guide dose reduction strategies in a multicenter setting.

Methods: SDA was measured in images of different quality and these images were evaluated by radiologists to determine maximum allowable noise levels. Phantoms were used to determine scanner settings that could achieve these noise levels. After the protocols were validated on the initial scanner, the same procedure was used to achieve comparable noise levels on multiple other scanners.

Results: SDA less than 35 HU was acceptable for most indications, while SDA less than 25 was needed for some indications such as CT enterography. Image noise was significantly affected by reconstruction field of view, and significantly higher scanner noise settings were used on larger patients. After implementation of this dose reduction strategy, up to a 45% reduction in overall population dose was achieved.

Conclusion: Achieving meaningful dose reduction is a daunting task in a multicenter setting because of the multiplicity of scanners and protocols, and the difficulty of determining acceptable image quality using subjective methods. Developing a quantitative in vivo measure of image noise (SDA), validating this measure by correlation with subjective evaluation of image quality by radiologists, and focusing on achieving maximum allowable noise levels rather than on specific scanner settings and dose, enabled the rapid adjustment of many different protocols on a variety of scanners to achieve biologically significant dose reduction. SDA shows promise as a useful research tool for determining maximum allowable noise levels in CT.

A Pictorial Essay of Mosaic Attenuation: Not a Black and White Issue

PERONE R, Sarmast U, Gaur S, Mikhail G, Glass S and Cunningham R

Objectives: Defined by the Fleischner Society as a “patchwork of regions of differing attenuation seen on CT of the lungs”, mosaic attenuation pattern (MAP) is a CT finding with a diverse differential diagnosis. The purpose of our educational exhibit will be to differentiate emergent etiologies for MAP such as acute infiltrative lung disease or hypersensitivity pneumonitis from more chronic entities such as asthma or chronic thromboembolic diseases. CT plays a critical role in the detection and characterization of MAP and in the identification of the differentiating radiographic features that aid in timely and accurate diagnosis.

Principal Information: In this pictorial essay, we will provide examples of various etiologies, some emergent, of mosaic attenuation pattern, comparing and contrasting their distinguishing features in the hope of aiding the radiologist to arrive at an appropriate differential diagnosis. The varied etiologies of mosaic attenuation pattern will be presented. Their defining radiographic features such as distribution, vascular pruning, bronchial wall inflammation, pulmonary artery dilatation, and ground glass opacities will be illustrated.

Conclusions: After reviewing this pictorial essay, it is our hope that the reader will be more cognizant of mosaic attenuation pattern on CT imaging and the important role it can play in managing acutely ill patients. Understanding the defining CT criteria of the more emergent versus chronic etiologies of this relatively common, though often unrecognized, CT pattern is critical in facilitating the accurate diagnosis of disease and in the prompt institution of appropriate medical care.