

March 27, 2007

Tuesday

6:30 AM	Continental Breakfast	
7:00 AM	Case of the Day	Rebecca M. Lindell, MD
7:10 AM	Case of the Day	Tan-Lucien H. Mohammed, MD
7:20 AM	Case of the Day	Ritu R. Gill, MD
7:30 AM	Case of the Day	Zenon Protopapas, MD

Scanlon Symposium I – Pulmonary Physiology

Moderator: Jud W. Gurney, MD

7:40 AM	Scanlon Symposium Introduction	Jud W. Gurney, MD
	Scanlon Lecture	
7:45 AM	Thoracic Imaging: Advancing from Structure to Function	Warren B. Gefter, MD
8:30 AM	Basic Lung Physiology for the Thoracic Radiologist	Alexander A. Bankier, MD
8:50 AM	Lung Function Tests: How PFT Results Integrate with CT Findings	Howard Mann, MD
9:10 AM	Contrast Dynamics: Physiologic Clues of Cardiopulmonary Status	Marc V. Gosselin, MD
9:30 AM	Break	

Scanlon Symposium II – Pulmonary Physiology

Moderator: Hiroto Hatabu, MD

9:45 AM	Is Image-based Spirometry Feasible?	Hans-Ulrich Kauczor, MD
10:05 AM	Imaging Gas Exchange	Hiroto Hatabu, MD, PhD
10:25 AM	Functional CT in COPD: Structure vs Function	Jonathan G. Goldin, MBChB, PhD
10:45 AM	Tracheomalacia	Phillip M. Boiselle, MD
11:05 AM	Functional Lung Imaging with Hyperpolarized Helium MRI	Georgeanne McGuinness, MD
11:25 AM	Break	

March 27, 2007

Tuesday

Solitary Pulmonary Nodule

Moderator: Helen Winer-Muram, MD

- 11:40 AM Characterization of SPN Using CT and PET Kyung Soo Lee, MD
- 12:00 PM Developments in CAD: Nodule Detection and Evaluation Ioannis Vlahos, MD
- 12:20 PM Lung Biopsy Elizabeth H. Moore, MD
- 12:40 PM Cryoablation of Pulmonary Malignancies William H. Moore, MD
- 1:00 PM *Lunch (on own)*
- 2:00 PM **ACR Cardiac Imaging Workshops** **Moderator: Robert C. Gilkeson, Jr., MD**
- Presenters: Andre Duerinckx, MD
Robert C. Gilkeson, Jr., MD
Gautham P. Reddy, MD, MPH
Satinder P. Singh, MD
Shawn D. Teague, MD
- 5:00 PM Adjourn for day
- 6:30 PM *Past Presidents Reception & Dinner (invitation only)*

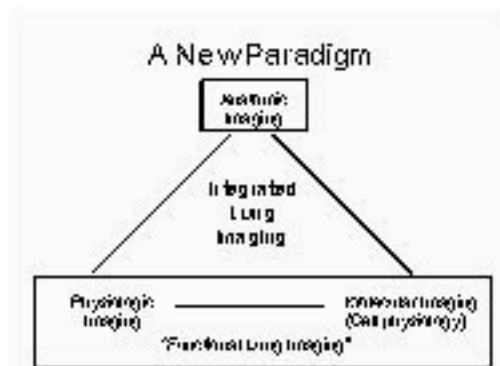
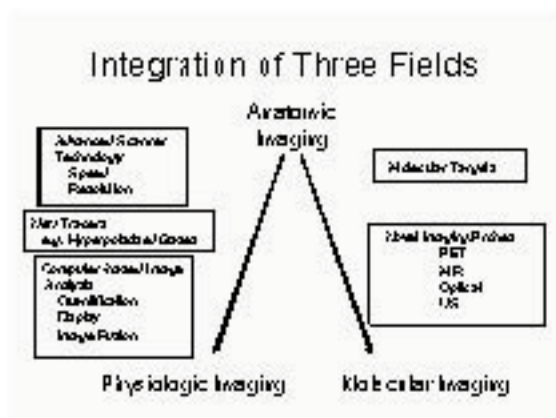
Thoracic Imaging: Advancing from Structure to Function

Warren B. Geftler, M.D.

We are witnessing the emergence of an exciting new era in thoracic imaging, in which both structural as well as functional information are integrated. This is occurring from the molecular and cellular to the macroscopic scale. Recent advances in the fields of anatomic imaging, physiology, and molecular biology have stimulated the development of “functional lung imaging”. The new hybrid PET/CT scanners being used to evaluate patients with lung cancer and inflammatory lung disease are emblematic of this coupling of structure and function in imaging. New methods to image regional ventilation, perfusion, V/Q, alveolar oxygen, gas exchange and other important physiological parameters using CT, MR, and PET are now available.

New targeted molecular and cellular-based imaging (and therapeutic) probes, combined with advances in scanner technology and image processing tools, will lead to new multi-dimensional multi-parametric imaging with important applications in the early detection, diagnosis, staging, therapy planning and optimization, and monitoring of patients with lung disease. In addition, these new imaging techniques provide important tools to study the pathogenesis of lung disease, from the underlying cellular/molecular level to the resultant alterations in pulmonary physiology and morphology.

multi-dimensional multi-parametric imaging with important applications in the early diagnosis, staging, therapy planning and optimization, and monitoring of patient disease. In addition, these new imaging techniques provide important tools to study the pathogenesis of lung disease, from the underlying cellular/molecular level to the resultant alterations in pulmonary physiology and morphology.



Basic Lung Physiology for the Thoracic Radiologist

Alexander A. Bankier, M.D.

Lung characterized by regional differences in

- Perfusion
- Ventilation
- Lymphatic flow
- Metabolism
- Mechanics

Central-peripheral organization of the lung

Perfusion

Three zone model

- Zone I: $P_A > P_a > P_v$
- Zone II: $P_a > P_A > P_v$
- Zone III: $P_a > P_v > P_A$
- (Zone IV: $(P_a - P_v) / (R_{a+v})$)

Ventilation

- Conducting airways – respiratory airways
- Asymmetric dichotomous pattern
- Branching pattern important for distribution of inhaled particles
- Particles follow “straightest way” through the lung (=to the lung periphery)
- Particles $< 5\mu$ can deposit in the respiratory bronchioles within centrilobular regions
- Turbulent airflow in larger airways directs particles $> 5\mu$ against ciliated airways where they can be cleared from the lungs

Lymphatic flow

- Periphery of lung is drained “outwards”, central lung is drained “inwards”
- Lymphatic function depends on pulmonary artery pressure and respiratory motion
- Pulmonary artery pressure is highest in the dependent lung zones
- Least respiratory motion in dorsal upper lung zones
- Chronically deposited particles tend to accumulate in these lung zones
- Appears paradoxical because majority of particles are deposited in lower lung zones, but better removed by lymphatic flow

Metabolism

- Ventilation and perfusion heterogeneities result in regionally different oxygen uptake, carbon dioxide elimination, and pH
- Higher pH at the apex of the lungs
- High oxygen tension at the lung apex
- May explain the distribution of secondary and miliary TB

Mechanics

- Lung must support its own weight
- In upright position: higher strain at the apex than at the base
- Mechanical factors predisposing to upper lung disease may be amplified by heterogeneity of ventilation, perfusion, and lymphatic flow

Lung Function Tests: How PFT Results Integrate with CT Findings

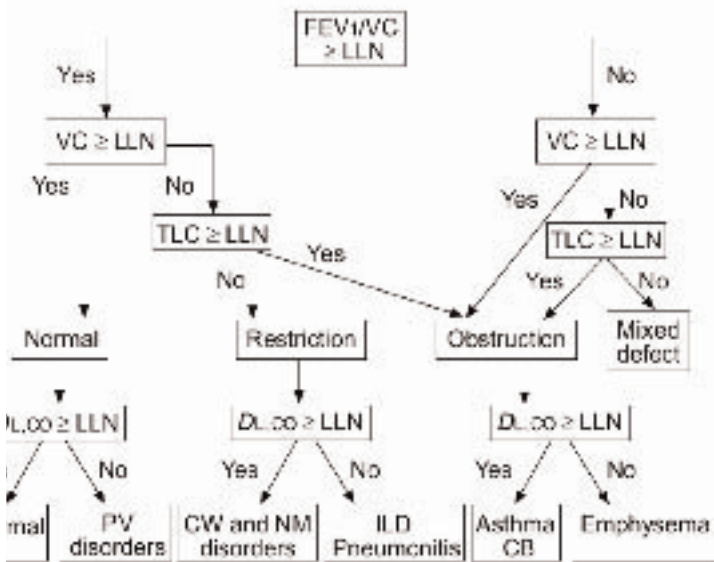
Howard Mann, M.D.

Knowledge of basic lung physiology and commonly performed pulmonary function tests allows one to anticipate the diseases that may be producing a patient's symptoms, and signs of disease.

A useful interpretive strategy, proposed by the American Thoracic Society/European Respiratory Society (ATS/ERS), and reproduced below, requires knowledge and integration of commonly measured parameters (vital capacity; forced expiratory volume in one second; total lung capacity; and diffusing capacity for carbon monoxide) to enable an initial distinction between obstructive, restrictive, and mixed obstructive-restrictive patterns:

In this talk, I will briefly describe the components of basic pulmonary function tests, and then review the ATS/ERS interpretive strategy for pulmonary function tests. Applying this simplified algorithm in a particular case also allows the radiologist to integrate and correlate findings on CT (particularly high-resolution, thin-section CT; with images obtained after an expiratory maneuver to evaluate possible air-trapping) with the results of pulmonary function testing.

I will illustrate the application of this approach with several clinical cases.



[PV pulmonary vascular; CW Chest wall; NM neuromuscular; ILD interstitial lung disease; LLN lower limit of normal]

Contrast Dynamics: Physiologic Clues of Cardiopulmonary Status

Marc V. Gosselin, M.D.

Objectives:

- Review the normal contrast dynamics in a pulmonary CTA.
- Discuss the significance of a continuous column of contrast reflux into the IVC and potential associated abnormalities/pulmonary pressures.
- Evaluate the contribution of cardiac chamber changes on the contrast flow dynamics.

Introduction: Pulmonary CTA is a very common imaging examination and an understanding of the anatomy and potential pitfalls of the exam is crucial for the radiologist. The rapid acquisition of information provides a snapshot of the central vascular flow dynamics, giving an indication of the patients underlying cardiopulmonary status. The radiologist can unveil subtle abnormalities when this abnormal flow of contrast is recognized.

Altered contrast dynamics is defined as an **abnormal direction of preferential contrast flow, unanticipated delay in contrast arrival to the pulmonary arteries and any circuitous routes of flow**. Altered flow dynamics are often seen with an underlying abnormality, either anatomic or physiologic.

Normal pulmonary CTA contrast dynamics:

Contrast rarely refluxes into the IVC, except potentially when the injection rates are very high, > 5cc/se (if present, it is usually a **discontinuous column** of contrast). Commonly there is a decrease in density, from unopacified blood extending flowing from the IVC into the right atrium soon after inspiration. This interruption of the contrast bolus is quite variable, ranging from barely detectable to a severe transient decrease in the density. It will briefly lower the contrast opacification in the pulmonary arteries and may give the radiologist difficulty in their evaluation. However, it strongly correlates with normal or minimally elevated pulmonary arterial pressures and normal cardiac output (forward flow).

Contrast dynamics with elevated right heart and pulmonary artery pressures: With elevation of right heart pressures, there is **continuous column** of contrast reflux into the IVC and potentially the hepatic veins. The IVC and hepatic veins are often distended and secondary signs of passive hepatic congestion may be seen on delayed images. Other causes of reflux include tricuspid regurgitation, decreased cardiac output and constrictive pericardium. Cardiac changes can often clarify the specific cause.

Elevated right heart/pulmonary arterial pressures: Hypertrophy of Right ventricle (chronic), dilatation of right ventricle and straightening of the interventricular septum.

Tricuspid Regurgitation: Dilated right atrial chamber with normal rightward convexity of interventricular septum.

Diminished Cardiac Output: A dilated thin walled right ventricle with a normal rightward convexity of interventricular septum. Often, there is an unusually sharp, well-defined appearance of the heart (non-gated).

Constrictive Pericardium: Right ventricle not dilated, anterior wall compressed by pericardium, which is often thickened or may even have calcium.

Correlation of dynamic reflux with pressures: With injection rates between 3-4cc/second, the presence and extent of hyperdense contrast reflux into the IVC and hepatic veins correlates with right heart and *mean* pulmonary artery pressures, which is modified by forward cardiac flow. False negatives can occur when pressures are elevated, but the heart is able to compensate by maintaining forward flow of blood. With contrast reflux into the supra-diaphragmatic IVC only, there is usually mild to moderate increases in right heart pressures. Contrast reflux extending into the infra-diaphragmatic IVC or hepatic veins should suggest moderate to severe elevation of pressures (> 40 mmHg *mean* pulmonary artery pressures). Straightening of the interventricular septum correlates with *systolic* pulmonary pressures > 65 mmHg.

REFERENCES

1. Gosselin M, Rassner U, Thieszen S, Phillips J, Oki A. Contrast Dynamics During CT Pulmonary Angiogram; Analysis of an Inspiration Associated Artifact. J Thorac Imaging 2004;19:1-7.
2. Henk C, Grampp S, Linnau K, et al. Suspected Pulmonary Embolism: Enhancement of Pulmonary Arteries at Deep-Inspiration CT Angiography-Influence of Patent Foramen and Atrial-Septal Defect. Radiology 2003; 226:749-755.
3. Gosselin M, Rubin G. Altered Intravascular Contrast Material Flow Dynamics: Clues for Refining Thoracic CT Diagnosis. AJR 1997;169; 1597-1603.
4. Roeleveld R et al. Interventricular septal configuration at MR Imaging and pulmonary arterial pressure in pulmonary hypertension. Radiology 2005; 234:710-717.

Is Image-based Spirometry Feasible?

Hans-Ulrich Kauczor, M.D.

Learning Objectives

Introduction

Pulmonary function testing (PFT) is a mainstay in the assessment of the ventilatory performance of the lung by quantitative data about volumes and flows. The measurements are performed in sitting position by especially trained personnel, highly standardized and comparable across age and gender. The most important values are total lung capacity (TLC), vital capacity (VC), residual volume (RV) and functional residual capacity (FRC) as well as forced expiratory volume in one second (FEV1). As the normal range is broad these global results are not very sensitive to detect early disease but PFT is well suited for intraindividual follow-up.

The idea of using imaging to combine assessment of structure and spirometry is very appealing as it might provide quantitative regional lung volumetry. However, procedures, acquisition, and analysis of imaging are challenging. At the same time image-derived data will always be compared to PFT primarily by simple correlation but finally also by comparison of the agreement of the absolute numbers.

Obviously, CT and MRI can be used for image-based spirometry. Since the early days of CT it is known, that even the cross-sectional lung area, as measured by planimetry has a high correlation with lung volumes. Density analysis looking at emphysema also reveals good correlation with PFT, especially the values indicative for hyperinflation, such as TLC, FRC and obstruction, such as FEV1.

Since the advent of spiral and multidetector CT volumetric evaluation of the lung is clinical routine. Segmentation of the lung enables the calculation of lung volumes, which reflect TLC when the acquisition was performed in maximum inspiration or FRC or even RV if imaging was performed in maximum expiration. Two major drawbacks persist: (1) imaging is performed in supine position in contrast to sitting position in PFT leading to a systematic reduction of lung volumes; (2) radiotechnicians are not trained in PFT and the PFT guidelines are not followed during imaging.

Nevertheless, spirometric gating is available for CT and on-line spirometry for MRI. As such there is direct control and comparability between imaging results and global spirometry measurements at the mouth. Beyond the comparison of global volumes, imaging has more to offer, namely regional assessment of volumes and density based analysis of emphysema, hyperinflation and atelectasis, as well as novel dynamic imaging during continuous tidal and forced breathing maneuvers. They also allow for the assessment of respiratory mechanics. Such techniques are extremely helpful in elucidating the physiological basis for planning and effects of lung volume reduction surgery, endobronchial valve placement, radiotherapy and artificial ventilation in ARDS. A major advantage of imaging is to provide split lung function, i.e. details which might go undetected by global measurements due to compensation by the contralateral lung.

Imaging Gas Exchange

Hiroto Hatabu, M.D., PhD

Diffusion is how gas gets across the blood-gas barrier. In fact, the lung had been believed to secrete oxygen into the capillaries before 1920's. The rate of transfer of the gas through the sheet of tissue is proportional to the tissue area and the difference in gas partial pressure between two sides, and inversely proportional to the tissue thickness. In addition, the rate of transfer is proportional to a diffusion constant, which is proportional to the solubility of the gas and inversely proportional to the square root of the molecular weight (ref 1.). The diffusion capacity of the lung D_L is made up of two components:

$$1/D_L = 1/D_M + 1/V_C$$

where M means membrane, λ is the rate of reaction of oxygen or carbon dioxide with hemoglobin, and V_C is volume of capillary blood. (ref. 1)

Oxygen-enhanced MRI provides a unique opportunity to observe regional oxygen transfer, which is observed as

T1 shortening by the weak paramagnetic effect of the molecular oxygen. The published data indicate there is a very good correlation between the degree of oxygen enhancement and diffusion capacity. Moreover, Hyperpolarized xenon-129 imaging provides the method to visualize $1/D_M$ component with much less influence of $1/V_C$ component.

In combined with morphometric data derived from volumetric CT, we have the opportunity to further investigate regional gas exchange of the lung.

REFERENCE

1. West JB. Respiratory Physiology (5th Ed.). pp21-22, 1995. Williams & Wilkins.

Functional CT in COPD: Structure vs Function

Jonathan G. Goldin, M.D., MBChB, PhD

The techniques for CT evaluation of Chronic Obstructive Pulmonary Disease (COPD) are directed at improving both the detection and measurement of structural changes as well as providing quantitative measures of function. The increasing interest in novel surgical, interventional and drug treatment for the treatment of COPD has made imaging an increasingly important biomarker for this disease. With the introduction of the latest generation of sub-half second Multi Detector Computed Tomography (MDCT) scanners, scanning the entire lung at a static lung volume, as well as dynamic imaging during a breathing maneuver, is now possible. Imaging protocols can be tailored to specifically assess the airway and parenchyma and to assess function to at least the level of an individual lung segment.

The quantitative information obtained with HRCT can advance our understanding of pulmonary pathophysiology and offer insight into the potential mechanisms involved in the spectrum of COPD. The relative role of the airways and the parenchymal destruction in patients with apparent clinical emphysema can, in fact, be great. More importantly such variations may influence the response to treatment. The advances in functional imaging of the airways have become clinically useful and most likely these techniques will become increasingly utilized, complementing and potentially replacing conventional lung function tests. Unlike conventional lung function tests the ability of CT measures of airway structure function to assess not only individual lungs but also individual lung segments and even smaller regions makes these techniques very powerful and useful.

Tracheomalacia

Phillip M. Boiselle, M.D.

The trachea normally dilates slightly with inspiration and narrows during expiration as a reflection of the difference between intrathoracic and intraluminal pressures. Tracheomalacia refers to weakness of the airway walls and/or supporting cartilage and is characterized by an accentuation of this physiological process, resulting in excessive expiratory collapse. Tracheomalacia has only recently been recognized as a relatively common and potentially treatable cause of respiratory symptoms.

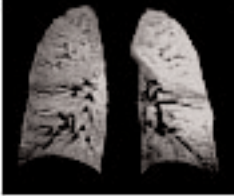

Tracheomalacia may be congenital or acquired. The acquired form is associated with a variety of risk factors and co-morbidities, most notably COPD and prior intubation. Because tracheomalacia cannot be detected with routine end-inspiratory imaging studies, it is widely considered an under-diagnosed condition.

Although bronchoscopy with functional maneuvers can reliably detect tracheomalacia, it is not clinically feasible or desirable to perform this invasive test in all patients who present with chronic cough and other non-specific respiratory symptoms. Fortunately, recent advances in multidetector-row CT (MDCT) imaging afford the opportunity to noninvasively diagnose tracheomalacia with similar sensitivity to conventional bronchoscopy. This lecture reviews the technical aspects of performing and interpreting MDCT to assess for tracheomalacia.


Functional Lung Imaging with Hyperpolarized Helium MRI

Georganne McGuinness, M.D.

Functional Lung Imaging with Hyperpolarized Helium MRI

Georganne McGuinness, MD
New York University School of Medicine

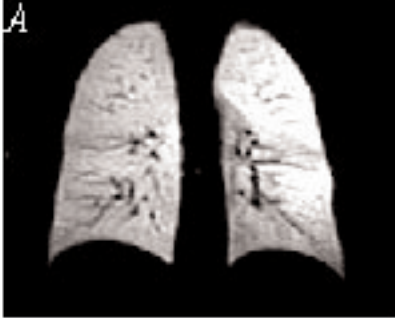


$^3\text{HeMR}$: Imaging Capabilities

- Static ventilation images: spatial resolution
- Dynamic ventilation images: temporal resolution
- Diffusion Imaging: microscopic structural information
- Kurtosis Imaging: microscopic structural information

Localized functional imaging

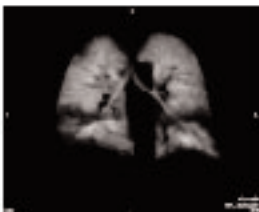

Normal ^3He Ventilation study



NYU $^3\text{HeMR}$ Imaging Project

Comparison of HRCT vs. $^3\text{HeMR}$:

34 y/o male with dyspnea and cough



$^3\text{HeMR}$ also detects peripheral ventilation defects

Comparing normal HRCT to normal $^3\text{HeMR}$

Ventilation Imaging

<p>Investigational Indications</p> <ul style="list-style-type: none"> Emphysema Asthma CF Lung transplant rejection Inhalational airway disease 	<p>Future Indications ?</p> <ul style="list-style-type: none"> PE (Vent/perfusion imaging) Pre-surgical assessment
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Proton Image $^3\text{HeMR}$ Ventilation Image

= Ventilation defect volume

TUESDAY

Characterization of SPN Using CT and PET

Kyung Soo Lee, M.D.

The evaluation of tumor vascularity with dynamic helical CT has proved to be useful in the differentiation of malignant and benign nodules. Various threshold attenuation values (15-30 HU) have been reported to be useful for distinguishing malignant from benign nodules on dynamic helical CT. The threshold attenuation values refer to the cutoff HU units of increased attenuation after contrast injection for differentiating malignant from benign nodules.

In early studies that focused on the early phase of dynamic CT, some overlap was found between malignant and benign nodules—for example, active granulomas and benign vascular tumors. Although the results of previous dynamic studies showed high sensitivity for the diagnosis of malignant nodules, specificities were too low. Evaluation of SPNs by analyzing combined wash-in and washout characteristics on dynamic helical CT allows more precise evaluations of nodule hemodynamics. In addition, the efficacy of tissue characterization has improved, and now sensitivities and specificities of more than 90% are achieved using evaluations of washout patterns in the delayed dynamic phase.

In an effort to improve the diagnostic accuracy of imaging pulmonary lesions, PET with ^{18}F -FDG has been used. Malignant cells have upregulated metabolisms and proliferate rapidly. Comparable enhancements of glucose and ^{18}F -FDG uptake in malignant cells have permitted malignancy to be detected on PET, which is considered an accurate, noninvasive diagnostic test, with a sensitivity of 88-96% and a specificity of 70-90% for malignant nodules. Integrated PET/CT provides more anatomic detail and improved staging accuracy of non-small cell lung cancer versus PET alone or CT alone.

In this talk, this speaker will discuss on the techniques, assessment methods, and diagnostic efficacies of CT and PET for the characterization of SPNs, and then propose most practical algorithmic approach for SPNs.

Developments in CAD: Nodule Detection and Evaluation

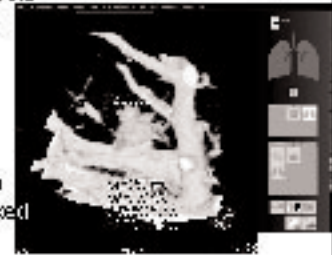
Ioannis Vlahos, M.D.

Indications for Nodule CAD

- Improve sensitivity
 - Early detection
- Minimize inter-observer variability
- Complement lack of trained observers
 - “Experienced second reader”
- Eliminate/simplify repetitive/tedious tasks
 - Automatic Nodule Registration
- Evaluate complex imaging features
 - Nodule Characterization: shape, density, perfusion growth

Missed Nodule/Cancer Detection - CAD

- 38 missed lung cancers
 - low-dose CT studies
 - Screening program
 - 10mm/10mm
 - 38 cancers
- CAD detected
 - 32/38 cancers (84%)
 - Missed 4 GGO, 2 mixed
 - 1 FP/slice



Annals. Radiology 2002; 225:68

CAD: How sensitive is it?

- CAD developers – FDA interaction
 - FDA wants CAD to be a second reader
 - FDA concerned about false positives
 - Vendors develop CAD to be a second reader
 - Emphasis is not on sensitivity but on additional findings
- Which software vendor is better ????
- Overall
 - Reader Sensitivity 50-65%
 - CAD Sensitivity 65-75%

CAD Studies: Current Limitations

- Inter-observer variation
 - Patient selection; Number of patients; Scan technique
- Definition of Nodule (ground truth)
 - Interpretative guidelines
 - Size criteria
 - Morphology criteria – solid, calcified, GGO
 - Pathological criteria
 - Number and experience of readers
 - Methodology for Interpretation

CAD Studies: Current Limitations

- Reliance on “expert readers”
- Variations in reporting
 - Theoretical improvement vs genuine CAD improvement
 - Variations in reporting of FP (per case/slice)
 - Absence of consensus optimal statistical methodology
 - QTRAC ROC analysis
- Assessment of clinical impact
 - Location of nodules

Gur. Radiology 2004;23

CAD Clinical Impact: “Normal” CT

- 100 “normal” CTs
 - PE (n = 33); Screening (n = 28); Fup cancer Hx (n = 39)
- Lesion significance characterized by size
 - 3 experienced radiologists
 - High (≥ 10 mm); medium (5 – 9 mm) or low (< 5 mm)
- CAD detected nodules in 33% of patients
 - 53 nodules (mean 1.6 lesions/case)
 - 5 (9.4%) high; 21 (39.6%) medium significance.

Pelitschus. Chest 2005;128:1517

Growth Expressed as Nodule Doubling Time

Double in Volume



d

d increase by 1/4d

$$V = 4/3\pi(d/2)^3$$

$$VDT = \frac{t \times \log 2}{\log (V_2/V_1)}$$

Comparison of Methods for Assessing Growth of T1 Lesions

Jennings S. Radiology 231;2004

- 83 pts resected T1 tumors – 93 CT FU's
- Criteria for growth:
 - > 2.1 mm diameter - (0.88 mm for electronic calipers); > 9.4% area; > 18.5%
- Diameter and area measurements disagreed with volume measurements: 37%, 28% (calipers) and 27%, respectively
- 30% of handheld measurements proved false negative

In Vivo Reproducibility: Volumes

- Same scan, multiple measurements
 - > 6.38% change significant (95% time)

Revel Radiology 200
- Different scan, same day
 - > 25% change significant (95% time)

Worawats. Eur Radiol 12
- Different scan, different day
 - SD up to 27.4%

Kosik et al. Radiology 2

CT Volumetric Evaluation: Limitations

- Size (< 3 mm)/ morphology (GGO's)
- Acquisition parameters
- Methodologic variations
- Motion artifacts
- Segmentation artifacts
 - Adjacent vessels, pleura; atelectasis
- Temporal resolution
 - Scan technique; respiratory variations

Lung Biopsy

Elizabeth H. Moore, M.D.

Technical Aspects of Percutaneous Lung Biopsy

Elizabeth H. Moore, MD
University of California
Davis Medical Center

Indications

- Diagnose a nodule or mass
- Diagnose infection
- Stage thoracic or extrathoracic malignancy ("up-stage" as much as possible)
- Results should affect treatment plan
- Favorable risk / benefit ratio, technically feasible

Relative Contraindications

- Uncooperative patient
- Severe bullous emphysema at puncture site
- Bleeding diathesis
- Severe pulmonary hypertension
- Highly vascular mass
- Hypertrophied bronchial arteries

Aspiration needle vs. core biopsy gun

- Aspiration more accurate for carcinoma
- Core usually needed for non-carcinomatous malignancies and benign neoplasms
- Coaxial system flexible:
 - Begin with aspiration
 - Add core if necessary upon review of cytology

Avoiding Aerated Lung

LUNG LESIONS

- Directly into nodule
- Trajectory to lung's collapsed lobe or post obstructive pneumonia

MEDIASTINAL LESIONS

- Mediastinal tail
- Mediastinal window
- Parasagittal approach (AP or lateral table)
- Lateral pneumothorax
- Pleural fluid window

Puncturing Aerated Lung

- Avoid fissures, large vessels, superficial liliis
- HRCT of proposed puncture site
- Perpendicular puncture into large peripheral mass
- Oblique approach into small peripheral nodule

Improving a suboptimal trajectory

- Bevel steering
- Redirect by torque, changing respiration and/or chest wall shifting
- Trajectory improvement during sampling
- If first puncture cannot be salvaged, leave this needle in place and place second needle

Accuracy of Needle Biopsy Depends on:

- Accurate needle placement
- Appropriate specimen (aspirate vs. core)
- Availability and skill of pathologist
- Malignancy 95 - 97%
- Benign 40 - 70%

Accuracy of FNA vs. Core Biopsy (Boiselle et al, 1997)

Malignant lesions

FNA 94%

Core 59%

Benign lesions excluding acute infections

FNA 12%

Core 75%

Acute infections

FNA 50%

Core 83%

Methods to reduce air leakage after lung biopsy

- Puncture site down positioning after procedure (positional precautions)
- Blood patch placement (coaxial technique only)
- Pressure precautions
- Oxygen administration

Pneumothorax Treatment

- Oxygen
- Aspiration
 - Easy, fast, temporizing measure
 - Obviates need for chest tube in 70% of patients
- Small bore catheter
 - Trocar
 - Selinger technique

Hemorrhage

- Most common cause of death from lung biopsy
- Bronchial artery > pulmonary artery
- Treatment
 - decubitus position, affected lung down
 - allow cough
 - double lumen intubation
 - bronchoscopic occlusion
 - embolization
 - surgery
- Systemic arterial hemorrhage from chest wall

Cryoablation of Pulmonary Malignancies

William H. Moore, M.D.

The objectives of this talk are to discuss the history of cryotherapy. Review several of the indications for lung cancer ablation. Discuss the technique of cryoablation. Review the concepts/cryobiology of cellular death after cryoablation and finally, to present follow-up data.

Lung cancer is the number one cause of cancer related deaths in the United States. This accounts for a total of 150,000+ deaths each year. Many patients are not surgical candidates because of other underlying medical conditions, such as COPD, heart disease and many other diseases.

Although, the current standard of care for patients with early stage malignancy is full surgical resection with lobectomy many patients are not able to tolerate such a procedure because of their underlying medical conditions. Traditionally, radiation therapy has been used, but recent data suggest that there is limited success with external beam radiation therapy.

New methods of treating lung cancer have emerged in the last several years. These include radiofrequency ablation and cryoablation. Both of these modalities have been shown to be safe and effective. Long term data for either of these modalities is still not available.

Cellular death related to cryoablation is well understood and is related to the manner in which the freezing is performed. The currently available systems all use fast cooling. Within a few seconds the tip of the probe is – 150 C. When there is this rapid of a decrease in the temperature ice forms in the extracellular matrix. To maintain an osmotic gradient ice then forms in the intracellular matrix. This results in severe damage to the endothelium. Additionally, there is damage to the endothelium of adjacent small blood vessels this results in stasis and decreased perfusion to the tumor. The end result of these direct and indirect effects is coagulative necrosis.

Notes

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