Interventional Pulmonology: Minimally Invasive Procedures for the Diagnosis and Management of Pulmonary Disease

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Disclosures

• None
Objectives

• The Current Clinical Scope of Interventional Pulmonology
  – Lung cancer screening
  – Advanced Diagnostic Bronchoscopy
  – Therapeutic Bronchoscopy
  – Minimally Invasive Pleural Procedures

• Central Airway Obstruction
  – Basics
  – Causes and
  – Current and Future Research
The Current Clinical Scope of IP
Lung Cancer Screening: NLST

20% relative reduction in mortality with routine low dose CT scans vs. routine radiography
Early screening infrastructure now in place

National Lung Screening trial results published in NEJM. Low dose CT scanning reduces mortality by 20%.

The United States Preventative Services Task Force Guidelines recommend mandatory screening/payment.

The Center for Medicare and Medicaid Services (CMS) approved NLST Lung Cancer Screening. Covered 1X per year.

The American College of Chest Physicians (ACCP) Guidelines: Electromagnetic Navigated Bronchoscopy is one of the recommended procedures for the diagnosis of peripheral lung nodules.
Who Qualifies for Low Dose CT Screening?

- Adults age 55-80
- 30 pack-year smoking history
- Currently smoke or quit within 15 years
- Willingness to undergo further diagnostic procedures
- No other health problem that substantially limits life expectancy.
Ways to Biopsy Lung Nodules

• **CT Guided TTNA**
  – Higher diagnostic yield
  – Higher rate of pneumothorax ~15-20%
  – Inability to stage the mediastinum

• **Bronchoscopy**
  – Lower diagnostic yield
  – Lower rate of pneumothorax ~5%
  – Can simultaneously pathologically stage the mediastinum with EBUS

• **VATS/Thoracotomy Wedge Biopsy**
  – Highest yield
  – Surgical procedure with morbidity
  – All patients require post operative chest drain and admission
Advanced Diagnostic Bronchoscopy

- Endobronchial ultrasound (EBUS):
- Electromagnetic navigational bronchoscopy
- Electromagnetic virtual CT TTNA
Endobronchial Ultrasound

• The use of ultrasound to visualize mediastinal/hilar lymph nodes and parenchymal lung lesions for biopsy

• Two general types:
  – Radial Probe EBUS
  – Linear/Convex Probe EBUS
Linear/Convex Probe EBUS
Linear/Convex Probe EBUS
Mediastinal Lymph Node Map
EBUS Indications

• Mediastinal Lymph Node Biopsy:
  – Lung cancer staging, diagnosis, molecular marker collection
  – Thoracic lymph node metastasis
  – Lymphoma
  – Lymph node cultures
  – Sarcoidosis

• Central lung mass
EBUS Contraindications

• Absolute:
  – Difficult/Complex/Unstable Airway
  – Active mediastinitis

• Relative
  – Hypoxia (> 6 LNC)
  – Coagulopathy: Plts < 50, INR > 1.7
  – Full dose anticoagulation
  – Clopidogrel/prasugrel
EBUS Complications

- Bleeding
  - Airway
  - Mediastinal hematoma
- Pneumothorax
- Pneumomediastinum
- Vocal Cord Injury
- Infection:
  - PNA/Mediastinitis
- Foreign Body
Radial Probe EBUS

- Small (< 2mm) probe with a rotating ultrasound at the tip that provides a 360 degree view outside of a peripheral airway.
  - Used to localize peripheral lung nodules/lesions
Radial Probe EBUS
Advanced Diagnostic Bronchoscopy

- Endobronchial ultrasound (EBUS):
- Electromagnetic navigational bronchoscopy
- Electromagnetic virtual CT TTNA
Electromagnetic Navigational Bronchoscopy

• The use of a virtual bronchoscopic tree reconstructed from a CT of the Chest paired to a patients’ anatomic bronchial tree to guide biopsy of a peripheral lesion/nodule.
Bronchoscopic Access
- i-Logic™ catheters (LG and EWC) go through the mouth or nose to steer through the bronchial tree to lymph nodes and distal lesions

Patient Sensor Triplets (satellites)
- Placed on the patient and are "tracking sensors" to show LG position and account for patient movement

Location Board
- Creates an electromagnetic field

Extended Working Channel (EWC)
- Lock the EWC in place at the lesion for insertion of endoscopic tools for biopsy and other catheters

Locatable Guide (LG)
- 360° (8-way) steerability for navigation to the lesion and lymph nodes
Electromagnetic Navigational Bronchoscopy

• Allows increased accuracy for smaller peripheral lesions.
• Used in conjunction with radial EBUS and Fluoro
• Generally done under general anesthesia
• Guides peripheral biopsy for path/cyto/micro using:
  – Cyto/Micro Brushing and Washing
  – FNA
  – Forceps
  – Shaving tool
Electromagnetic Navigational Bronchoscopy

• Contraindications:
  – Same as standard bronchoscopy:
    • Hypoxia
    • Coagulopathy
    • Hemodynamic instability
    • Airway compromise
  – Initially presence of a pacemaker/AICD considered an relative contraindication.
Electromagnetic Virtual CT TTNA
Lung Nodule Workflow

Begin with EBUS guided TBNA of any Enlarged Mediastinal Lymph Nodes

Proceed to EMN Guided Bronchoscopic Biopsy

Proceed to EMN guided TTNA

If positive on ROSE procedure is complete
Therapeutic Bronchoscopy

- Can be performed with flexible or rigid bronchoscopy
Central Airway Obstruction

• Definition: Narrowing of the lumen of the trachea, or mainstem bronchi causing air flow limitation

• Etiologies:
  • Malignant
  • Idiopathic
  • Lymphadenopathy
  • Infection
  • Vascular compression
  • Post transplant
  • Amyloid
  • GPA
  • Mucus plug
  • Sarcoidosis
  • Relapsing polychondritis
  • Iatrogenic
    – stents
    – stenosis post-intubation or tracheostomy
Symptoms/Diagnosis

• Symptoms:
  – Chronic, sub-acute or acute
  – Wheezing: Potential for misdiagnosis
    • Refractory to bronchodilators
  – Dyspnea:
    • Exertion: airway < 8 mm
    • Rest/stridor: airway < 5 mm

• Diagnosis:
  – Exam, PFT’s, CT, bronchoscopy

Hollingsworth, Clin Chest Med 1987; 8: 231
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Management of Non-Malignant CAO

- The only definitive management is tracheal resection
Tracheal Resection

- Review of 901 patients over 28 years at MGH
  - Death: 11 patients (1%)
  - Re-stenosis: 37 patients (4%)
    - Dilation: 2
    - Tracheostomy: 7
    - T-tube: 20
    - Re-operation: 16
Non-Surgical Management of CAO

• Rigid and Flexible Bronchoscopy with:
  – Balloon dilation
  – Laser resection
  – Argon plasma Coagulation
  – Electrocautery
  – Cryoprobe therapy
  – Covered Metal Stenting
  – Topical or injectable anti-proliferative/fibrotic agents

• Rigid Only:
  – Micro-debrider
  – Rigid dilation and tumor coring
  – Silicone Stenting
Therapeutic Bronchoscopy

- Rigid bronchoscopy
  - Central airway obstruction (CAO)
    - Dilation
    - Tumor excision, destruction
    - Airway stenting
  - Foreign body removal

- Non Surgical Modalities for endoscopic treatment of CAO
  - Majority can be done with flexible or rigid bronchoscopy
Metallic Airway Stenting
Advanced Airway Management with Silicone Stenting
Silicone Stenting
Advanced Airway Management Case
Non-Surgical Management of CAO

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Blowfish Transbronchial Micro-Infusion Catheter

- Sterile, single use catheter
- Advanced down flexible bronchoscope
- Uninflated: micro-infusion needle is sheathed by balloon
- Inflation: causes needle to project perpendicular to plane of catheter
- Originally developed for endovascular injection
Blowfish Transbronchial Micro-Infusion Catheter

- Animal pilot study
- Injection of methylene blue
- 60% circumferential spread of agent through tracheal wall
- No peri-operative morbidity

BROADWAY Trial:

• Promising Preliminary Results:
  – 49 yo w/ stage IV NSCLC at diagnosis
  – 3rd Patient Enrolled
  – Right hilar mass: 95% RMSB obstruction
  – 6/2014: Diagnosed
  – 8/2014: BROADWAY
  – Today: Still alive, doing well!
BROADWAY Trial:

Day of Injection

6 Months Post
Minimally Invasive Pleural Procedures

• Medical thoracoscopy
  – Pleural biopsy
  – Pleurodesis
• Closed pleural biopsy
• Tunneled pleural catheters
• Pigtail and surgical chest tube insertion
• Thoracentesis
• Intrapleural thrombolytics for complex pleural infection