Multidisciplinary Approach to Thoracic Tissue Sampling: Lung Biopsy

Leslie E. Quint, M.D.
How Can We Sample That Lung Lesion Seen on Imaging?

- Lung lesions often first detected and localized at CT
- Use CT to direct best method of tissue sampling
LUNG BIOPSY

- Conventional bronchoscoposcopic biopsy
  - Add endobronchial ultrasound (EBUS)
  - Add electromagnetic navigation
- CT guided biopsy
- Video assisted thoracoscopic biopsy (VATS)
LUNG BIOPSY

• Conventional bronchoscopic biopsy
  • Add endobronchial ultrasound (EBUS)
  • Add electromagnetic navigation
• CT guided biopsy
• Video assisted thoracoscopic biopsy (VATS)
LUNG: Conventional Bronchoscopic Biopsy

- For central lesions, out to level of segmental bronchus
- If bronchial branch leads to nodule
- Large lesions (> 2-3 cm)
- Endobronchial lesions
- Biopsy under direct vision or with fluoro for more distal lesions
Bronchoscopic Biopsy

- Large
- Central
- Bronchus leads to nodule
LUNG: Conventional Bronchoscopic Biopsy

- Cytologic sampling: forceps and brush biopsy, BAL
- Rapid onsite cytological evaluation helpful
- Sensitivity
  - >2 cm ~67%
  - <2 cm ~33%
- Complications: <<3% ptx
LUNG BIOPSY

• Conventional bronchoscopic biopsy
  • Add endobronchial ultrasound (EBUS)
    • Add electromagnetic navigation
• CT guided biopsy
• Video assisted thoracoscopic biopsy (VATS)
LUNG: Bronchoscopic Biopsy with Endobronchial Ultrasound

• EBUS
• To biopsy lesions adjacent to a bronchus
• Radial ultrasound transducer must be removed before biopsy
• Curvilinear transducer used during biopsy
7.5 MHz
• 76 F
• Chest pain
• Incidental lung nodule
• 76 F
• Chest pain
• Incidental lung nodule
• Difficult location for bronchoscopic biopsy without guidance
• EBUS biopsy
• NSCLC
LUNG BIOPSY

- Conventional bronchoscopic biopsy
  - Add endobronchial ultrasound (EBUS)
  - Add electromagnetic navigation
- CT guided biopsy
- Video assisted thoracoscopic biopsy (VATS)
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

- GPS system for bronchoscopy
- For small, peripheral lesions not accessible via routine bronchoscopy
- New technique
- Not yet in widespread use
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

- Bronchial landmarks on CT data set are entered into computer system (e.g. carina, bronchial bifurcations)
- Target nodule entered
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

• Patient lies on magnetic field generator plate in bronchoscopy suite

Courtesy of Doug Arenberg, M.D.
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

• Same internal airway landmarks are electronically marked using a location sensor at the distal tip of the bronchoscope
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

- Two data sets are fused (CT & bronchoscopic landmarks)
- Computer system then shows location of bronchoscopic catheter tip superimposed on CT images
- Watch in real time on CT map as bronchoscopic catheter navigates out to nodule
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy
On target in 3 planes
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

- After nodule is reached on computer screen, location sensor is removed
- US probe inserted to confirm nodule
- Then biopsy device inserted (needle, brush or forceps)

20-MHz radial probe from Yasufuku K. J Thoracic Oncology. 2007;2:970

Courtesy of Doug Arenberg, M.D.
• 61 F
• COPD, worsening SOB, smoker
• Incidental nodule on HRCT to evaluate etiology for SOB
Electromagnetic navigation used to reach nodule
EBUS probe in nodule
Biopsy: squamous cell cancer
Treatment: stereotactic RT
LUNG: Electromagnetic Navigation Bronchoscopic Biopsy

- Diagnostic yield
  - ~ 63-74% for peripheral lesions
  - ~ 88% with endobronchial ultrasound
- Complications: ~5% ptx
  - Tiny catheter may penetrate pleural surface
LUNG BIOPSY

• Conventional bronchoscoptic biopsy
  • Add endobronchial ultrasound (EBUS)
  • Add electromagnetic navigation
• CT guided biopsy
• Video assisted thoracoscopic biopsy (VATS)
CT- GUIDED BIOPSY

• For lesions not accessible via bronchoscopy

• Higher rate of pneumothorax
  • 20-25% of biopsies
  • 2-5% of biopsies: large or symptomatic ptx requiring tx
  • ↑ risk: small nodules, emphysema

Cham M. Sem Resp Crit Care Med 2008;29:335
CT- GUIDED BIOPSY

Difficult:

- Near diaphragm (resp motion)
- Tiny (<1 cm)
- Very deep
- Subpleural, protected by rib
- Adjacent to vital structure
CT-GUIDED BIOPSY

Accuracy

• Malignant nodule ~95%
• Benign nodule ~88%
• Nodules < 15 mm 74-88%
• 10-15% FN rate

Quint LE. Cancer Imaging 2006;6:163
Cham M. Sem Resp Crit Care Med 2008;29:335
LUNG BIOPSY

- Conventional bronchoscopic biopsy
  - Add endobronchial ultrasound (EBUS)
  - Add electromagnetic navigation
- CT guided biopsy
- Video assisted thoracoscopic biopsy (VATS)
LUNG: VATS

- Video assisted thoracoscopic surgery
- Three ports: thoracoscope, forceps / instruments
- General anesthesia
- Single lung ventilation with double lumen endotracheal intubation
LUNG: VATS

• Wedge resection of nodules in peripheral third of lung
• Outpatient or inpatient
• High sensitivity / specificity for malignancy in solitary pulm nodules
• Low morbidity (~5%):
  • Prolonged air leak, bloody pleural effusion
• Small +/- or deep nodules can be marked preoperatively with dye or radioactive material or microcoils to aid localization
• 2 yrs s/p RULobectomy for NSCLC
• Growth over 2 year interval
• CT biopsy nondiagnostic
• GG nodules hard to feel, see at surgery
• Nodule & overlying pleura marked with indigo carmine using electromagnetic navigation
<table>
<thead>
<tr>
<th>PROCEDURE</th>
<th>OUTPT CHARGES</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBNA</td>
<td>$2,100</td>
<td>-Cheap&lt;br&gt;-No general anesthesia&lt;br&gt;-Can bx mediastinal lymph nodes at same sitting</td>
<td>-Small risk of ptx</td>
</tr>
<tr>
<td>TBNA + EBUS</td>
<td>$5,500</td>
<td>-Confirm location of lesion and needle</td>
<td>-Not widely available&lt;br&gt;-Special training</td>
</tr>
<tr>
<td>TBNA + EBUS + Electromagnetic Navigation</td>
<td>$6200</td>
<td>-Small peripheral nodules accessible</td>
<td>-Not widely available&lt;br&gt;-Special training</td>
</tr>
<tr>
<td>CT guided</td>
<td>$2,600</td>
<td>-Minimally invasive&lt;br&gt;-No sedation/anesthesia&lt;br&gt;-Cheap</td>
<td>-Risk of ptx&lt;br&gt;-Radiation&lt;br&gt;-Special training</td>
</tr>
<tr>
<td>VATS</td>
<td>$18,000</td>
<td>-Can bx mediastinal lymph nodes and pleural lesions at same sitting&lt;br&gt;-Direct visualization&lt;br&gt;-Large tissue sample; lesion resection</td>
<td>-Risks of surg/anesth&lt;br&gt;-$$$&lt;br&gt;-Peripheral lesions only&lt;br&gt;-Chest tube&lt;br&gt;-Poss overnight stay</td>
</tr>
<tr>
<td>PROCEDURE</td>
<td>OUTPT CHARGES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBNA</td>
<td>$2,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBNA + EBUS</td>
<td>$5,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBNA + EBUS + Electromagnetic Nav</td>
<td>$6200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT guided</td>
<td>$2,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VATS</td>
<td>$18,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How Can We Sample That Lesion Seen on Imaging?

Choose method based on
- Anatomy
- Amount of tissue needed
- Cost
- Availability of techniques
- Safety / risks
- Accuracy