Navigational Bronchoscopy
- Diagnosis and Therapy

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Masters of Minimally Invasive Thoracic Surgery  Sep 18-20th, 2014
Disclosure

• Industry-sponsored grants
  • Educational and research grants from Olympus Medical Systems Corp.

• Consultant
  • Olympus America Inc.
  • Intuitive Surgical Inc.
  • Covidien
  • Johnson and Johnson

• Research Collaboration
  • Siemens
  • Novadaq Corp.
Solitary Pulmonary Nodules

• More than 150,000 pts per year in the US will present with solitary pulmonary nodules (SPN)

• 1 in 500 CXR demonstrate a lung nodule

• Higher prevalence in CT scans (ELCAP)

Henscke, C, et al. NEJM 2006; 355:1763-71
Prevalence of Malignancy

• Dependant on size:
  • 0-1% for nodules < 5 mm
  • 6-28% for nodules 5 to 10 mm
  • 64-82% for nodules > 20 mm

• Prevalence of at least one nodule: 8-51%

• Prevalence of malignancy in pts with nodules: 1-12%

• Dependant on other radiographic/patient characteristics (www.chestx-ray.com)

Wahidi et al, CHEST 2007; 132:94s
Diagnosis of Peripheral Lung Nodules (<2cm)

- **Surgical Resection**
  - 720/1467 49% Benign  \(Hoffmann\ 2001\)

- **CT Screening**
  - 98% Benign  \(Midthun\ 2003\)

- **Bronchoscopy (Fluoroscopic guidance)**
  - Poor visualization of lesion
  - No pathway imaging
  - Steering of tools difficult
  - Yield 10-50%

Cortese et al, Chest 2000; 117:1049
Nadich et al, 1988; 93:595
Gould et al, Chest 2007; 132:108s
Shinagawa et al, Chest 2004; 125: 1138
Guided bronchoscopy

• Peripheral radial EBUS/guide sheath
• Electromagnetic Navigation bronchoscopy
  • Super Dimension, Veran Medical
• Virtual bronchoscopy guided
  • Lung Point, BF Navigation
• CT guided bronchoscopy
• Ultrathin bronchoscopy
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Improving the Yield: Radial EBUS

UM-3R (O.D. = 2.5mm)

UM-S20-20R (O.D. = 1.7mm)
EBUS-GS
Radial probe EBUS - results

• Meta-analysis of 7 studies using radial probe EBUS for peripheral lesions
  • Pooled sensitivity for lesions < 25 mm was 71%

• One randomized prospective trial has compared radial EBUS with CT guided biopsy
  • Similar diagnostic accuracy
  • Complication rates 3% vs. 27%

_Eur Respir J._ 2011; 37: 902-10
_Resp Med._ 2011; 105: 1704-11
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Electromagnetic Navigation (EMN)

- inReach system, (SuperDimension, Covidien)
Real-time Location Information

Miniaturized sensor

Electromagnetic Location Board

Real-time delivery of information 166/sec

Generation of electromagnetic waves
EMN: Procedural steps

CT scan ➔ DICOM CD

Planning ➔ File export

Navigation ➔ Biopsy
EMN: Access to lesions

- Locatable Guide (LG) Catheter together with the Extended Working Channel (EWC) are inserted into the bronchoscope

- Upon reaching target, the EWC is fixed and the LG is retracted

- Tools and other catheters can be inserted for biopsy and treatment planning
EMN: Access to lesions
EMN results

• Diagnostic yield
  • SPN<30mm: 54-75%

• Limitation
  • registration error (3-8mm)
  • not real-time sampling
  • expensive

Schwartz et al., Chest 2006; 129; 988
Gildea et al, Am J Respir Crit Care Med 2006; 174: 982
Eberhardt et al, CHEST 2007; 131:1800
Eberhardt et al, AJRCCM 2007; 176: 36
Eberhardt et al, AJRCCM 2007; 176: 36
# EMN + EBUS-GS

## TABLE 5. DIAGNOSTIC YIELDS BY SIZE, LOCATION, AND DISEASE TYPE, AND PNEUMOTHORAX RATE

<table>
<thead>
<tr>
<th></th>
<th>EBUS, n (%)</th>
<th>ENB, n (%)</th>
<th>EBUS and ENB, n (%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall diagnostic yield</td>
<td>27/39 (69)</td>
<td>23/39 (59)</td>
<td>35/40 (88)</td>
<td>0.02*</td>
</tr>
<tr>
<td>Yield by lesion size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 20 mm</td>
<td>7/9 (78%)</td>
<td>3/4 (75%)</td>
<td>9/10 (90%)</td>
<td>0.02*</td>
</tr>
<tr>
<td>20–30 mm</td>
<td>16/23 (70%)</td>
<td>11/22 (50%)</td>
<td>21/24 (88%)</td>
<td>0.99</td>
</tr>
<tr>
<td>&gt; 30 mm</td>
<td>4/7 (57%)</td>
<td>9/13 (69%)</td>
<td>5/6 (83%)</td>
<td></td>
</tr>
<tr>
<td>Yield by lobar location</td>
<td></td>
<td></td>
<td></td>
<td>0.01*</td>
</tr>
<tr>
<td>Bilateral upper lobes</td>
<td>16/27 (59%)</td>
<td>17/22 (77%)</td>
<td>17/20 (85%)</td>
<td></td>
</tr>
<tr>
<td>Right middle lobe</td>
<td>3/3 (100%)</td>
<td>2/3 (67%)</td>
<td>2/2 (100%)</td>
<td></td>
</tr>
<tr>
<td>Bilateral lower lobes</td>
<td>8/9 (89%)</td>
<td>4/11 (29%)</td>
<td>16/18 (89%)</td>
<td></td>
</tr>
<tr>
<td>Yield for malignant disease</td>
<td></td>
<td></td>
<td></td>
<td>0.009*</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>23/32 (72%)</td>
<td>16/29 (55%)</td>
<td>28/31 (90%)</td>
<td></td>
</tr>
<tr>
<td>Specificity</td>
<td>7/7 (100%)</td>
<td>10/10 (100%)</td>
<td>9/9 (100%)</td>
<td>—</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>23/23 (100%)</td>
<td>28/28 (100%)</td>
<td>28/28 (100%)</td>
<td>—</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>7/16 (44%)</td>
<td>10/23 (44%)</td>
<td>9/12 (75%)</td>
<td>0.16</td>
</tr>
<tr>
<td>Yield for benign disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>4/7 (57%)</td>
<td>7/10 (70%)</td>
<td>7/9 (78%)</td>
<td>0.79</td>
</tr>
<tr>
<td>Specificity</td>
<td>32/32 (100%)</td>
<td>29/29 (100%)</td>
<td>31/31 (100%)</td>
<td>—</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>4/4 (100%)</td>
<td>7/7 (100%)</td>
<td>7/7 (100%)</td>
<td>—</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>32/35 (91%)</td>
<td>29/32 (91%)</td>
<td>31/33 (94%)</td>
<td>0.90</td>
</tr>
<tr>
<td>Pneumothorax rate</td>
<td>2/39 (5%)</td>
<td>2/39 (5%)</td>
<td>3/40 (8%)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

For definition of abbreviations, see Table 3.

* p < 0.05.

**Eberhardt et al, AJRCCM 2007; 176: 36**
VBN/EMN: Spin Drive (Veran Medical Technologies)

Multiple Pathway Views
- CT Views: Enables physicians to visualize the instrument location in multiple views
- Virtual Bronchoscopic Fly-Through: Provides a high quality interior lumen view and the target lesion
- 3D Bronchial Airway: Automatic pathway planning and global visualization of instrument location

EM Field Generator

Always-On Working Channel – Tip-tracked Steerable 3mm instrument w/ 2mm working channel that is navigated to the lesion

Patient 4D Tracker
Respiratory gating for optimal accuracy

ig4 Plug-n-Play Navigation Screen
Spin Drive Planning

Select Target: Autopath
Spin Drive Planning

Virtual flythrough evaluation
Spin Drive Navigation

Steerable Catheter (OD 3mm, 2mm working channel)
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LungPoint - Broncus

William E et al. Computerized Medical Imaging and Graphics, 2008; 32, 732
LungPoint - Broncus

Yield 80%

Eberhardt et al. JTO. 2010; 5(10):1559-1563
Virtual Bronchoscopy Navigation (VBN)

- Olympus BF Navigation
Olympus BF Navigation

Courtesy Dr. Fumio Asano
VBN+EBUS-GS vs EBUS-GS (V-NINJYA Study)

• Multicentre, randomized control study
  • Small peripheral nodules (≤ 3cm)
  • Dx yield higher in VBN group
    80.4% vs 67.0% (p=0.032)
  • Shorter time in VBN group
    24.0min vs 26.2min (p=0.016)

Asano et al, Thorax 2011; 66: 1072
Guided bronchoscopy – Meta-analysis

### Table 2—Inverse Weighted Diagnostic Yield Overall and by Modality

<table>
<thead>
<tr>
<th>Technology</th>
<th>Studies, No.</th>
<th>Weighted Proportion, %</th>
<th>95% CI</th>
<th>Q Statistic</th>
<th>Q P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VB</td>
<td>10</td>
<td>72.0</td>
<td>(65.7-78.4)</td>
<td>21.0</td>
<td>.01</td>
</tr>
<tr>
<td>ENB</td>
<td>11</td>
<td>67.0</td>
<td>(62.6-71.4)</td>
<td>13.3</td>
<td>.21</td>
</tr>
<tr>
<td>GS</td>
<td>10</td>
<td>73.2</td>
<td>(64.4-81.9)</td>
<td>63.8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>U</td>
<td>11</td>
<td>70.0</td>
<td>(65.0-75.1)</td>
<td>15.2</td>
<td>.12</td>
</tr>
<tr>
<td>R-EBUS</td>
<td>20</td>
<td>71.1</td>
<td>(66.5-75.7)</td>
<td>84.2</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>All</td>
<td>39</td>
<td>70.0</td>
<td>(67.1-72.9)</td>
<td>119.4</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

*Wang et al, Chest 2012; 142*
Why do TS need to do Transbronchial Biopsies?

- Bronchoscopic RFA
- ENB-guided VATS wedge resection of peripheral nodules

_Chest_ 2010 Apr;137(4):890-7
_Seminars in Thoracic and Cardiovascular Surgery, Vol 22 (2), 2011_
Navigational bronchoscopy - Summary

• Continues to evolve
• Registration error
• Moderate yields
• Not real-time sampling
• Expensive (1K/forceps)
• Highest yield with combination of radial probe EBUS
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Thank you