Reliable Lung Nodule Identification During VATS

European Multidisciplinary Conference in Thoracic Oncology
Lugano, Switzerland
May 2013

David R. Jones MD
George R. Minor Endowed Professor of Surgery
Vice-Chair, Department of Surgery
Division Chief, Thoracic & Cardiovascular Surgery
University of Virginia
I have no disclosures related to this talk.
Definition of Early Stage Lung Cancer (ESLC)

- **T1 lesions**
  - Less than or equal to 3cm
  - Surrounded by lung tissue
  - No invasion into proximal lobar bronchus

- **Node-negative lesions**

- **Often peripherally located**

Diagnosis of Suspected ESLC

- Serial imaging studies (i.e. CT scans)
- CT-guided biopsy
  - FNA vs core needle
  - Size and location of lesion
- Navigational Bronchoscopy
- Pre-op localization followed by VATS resection
  - Hook wire localization
  - Radiotracer-guided thoracoscopic resection (RGTR)
# Diagnosis of ESLC

**CT-guided Biopsy**

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>N</th>
<th>Size</th>
<th>Bx type</th>
<th>Malignant (%)</th>
<th>False Negative</th>
<th>Diagnostic Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohno</td>
<td>2003</td>
<td>162</td>
<td>&lt;20mm</td>
<td>FNA</td>
<td>64%</td>
<td>14%</td>
<td>77%</td>
</tr>
<tr>
<td>Wallace</td>
<td>2002</td>
<td>61</td>
<td>&lt;10mm</td>
<td>FNA</td>
<td>52%</td>
<td>12%</td>
<td>62%</td>
</tr>
<tr>
<td>Li</td>
<td>1996</td>
<td>27</td>
<td>&lt;15mm</td>
<td>FNA</td>
<td>74%</td>
<td>19%</td>
<td>85%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>61</td>
<td>&gt;15mm</td>
<td>FNA</td>
<td>89%</td>
<td>6%</td>
<td>96%</td>
</tr>
<tr>
<td>Laurent</td>
<td>2000</td>
<td>67</td>
<td>&lt;20mm</td>
<td>Core</td>
<td>71%</td>
<td>8%</td>
<td>91%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;20mm</td>
<td>Core</td>
<td>82%</td>
<td>5%</td>
<td>96%</td>
</tr>
<tr>
<td>Tomiyama</td>
<td>2000</td>
<td>23</td>
<td>&lt;15mm</td>
<td>Core</td>
<td>65%</td>
<td>4%</td>
<td>96%</td>
</tr>
<tr>
<td>Westcott</td>
<td>1997</td>
<td>24</td>
<td>&lt;15mm</td>
<td>Core</td>
<td>67%</td>
<td>5%</td>
<td>95%</td>
</tr>
</tbody>
</table>
Diagnosis of ESLC
CT-guided Biopsy

• FNA
  – Accuracy is 80%
  – False negative rate of 13%
  – Pneumothorax rate of 23%

• Core needle biopsy
  – Accuracy is 95%
  – False negative rate of 5%
  – Pneumothorax rate of 21%
CT-guided biopsy

When is benign really benign?

- 95/836 (11%) CT biopsies over 5-year period were “non-malignant”.
- 21/95 (22%) were confirmed benign at radiographic F/U or at surgery
- 53/95 (56%) were called “benign but non-diagnostic”
  - 13% were ultimately found to be malignant
- 21/95 (22%) were called “non-diagnostic”
  - 29% were ultimately found to be malignant

Total malignancy rate for these two non-malignant diagnoses was 18%!

Savage et al. J Vasc Interv Radiol 2004
20% reduction in lung cancer-specific mortality
25% of patients were screen positive
4% of LD CT screen positive had a surgical procedure
23% false positive rate for surgical procedures
Negative diagnostic rate of 0.9% (164/17,702)
What type of cancer will we find on screening CT scans?  
The NLST Experience

<table>
<thead>
<tr>
<th>Tumor Histology</th>
<th>Tumor Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>“BAC”</td>
<td>IA</td>
</tr>
<tr>
<td>10%</td>
<td>40%</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>IB</td>
</tr>
<tr>
<td>41%</td>
<td>10%</td>
</tr>
<tr>
<td>Squamous cell</td>
<td>IIA</td>
</tr>
<tr>
<td>25%</td>
<td>3%</td>
</tr>
<tr>
<td>Large cell</td>
<td>IIB</td>
</tr>
<tr>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>NSCLC other</td>
<td>IIIA</td>
</tr>
<tr>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Small cell</td>
<td>IIIB</td>
</tr>
<tr>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>22%</td>
</tr>
</tbody>
</table>

What type of cancer will we find on screening CT scans? The NLST Experience

- 50% of patients will have node-negative disease
- 1 in 5 patients will have stage IV disease
- Identification of small cell lung cancer is equivalent to BAC (10% each)
- 80% have non-controversial NSCLC histologies
- Potentially 60% of patients with CT screen identified lung cancer will be candidates for surgery

NLST Research Team N Engl J Med 2011
CT-guided Biopsy of Screen Detected Nodules

- Prospective, single institution study of 108 CT-guided lung FNAB of nodules in 4782 screened high-risk patients
- 22% (24/108) had non-diagnostic biopsy
- 13/24 referred for VATS with 100% diagnostic (9 - malignant, 4 – benign)
- 11/24 receiving continued CT F/U
- Failures often with ≤ 10 mm nodules
- CT FNAB success dependent on institutional strengths and history

Wagnetz U et al. AJR 2012
“The growing use of CT scans fuels medical concerns about radiation exposure.”
What do we do with the small SPN?

- More and more CT scans
- Increasing numbers of small, often subcentimeter, pulmonary nodules
- Anxious patients, referring doctors
- Options
  - Serial imaging studies
  - Attempted CT-guided needle biopsy
  - Thoracoscopic resection ± localization
  - Thoracotomy
- Often have difficulty localizing lesion thoracoscopically (or open)
Nodule is too small
Nodule is too deep
Surgeon’s finger not long enough
Percutaneous Hook Wire Technology
Percutaneous Hook Wire Technology

Depth gauge
Hook Wire-Guided Resection
# Percutaneous Hook Wire
## Results of Published Studies

<table>
<thead>
<tr>
<th>Study</th>
<th># Nodules/# Patients</th>
<th>Nodule Diameter</th>
<th>Distance from nearest pleural surface</th>
<th>Localization Failure</th>
<th>Ptx</th>
<th>Wire Dislodged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shepard et al 1994</td>
<td>10/10</td>
<td>2-15mm Mean 10</td>
<td>0-20mm Mean 7.5</td>
<td>20%</td>
<td>50%</td>
<td>20%</td>
</tr>
<tr>
<td>Shah et al 1993</td>
<td>17/14</td>
<td>3-20mm Mean 10</td>
<td>0-25mm Mean 9</td>
<td>12%</td>
<td>36%</td>
<td>6%</td>
</tr>
<tr>
<td>Ciriaco et al 2003</td>
<td>53 patients</td>
<td>4-24mm</td>
<td>0-27mm</td>
<td>8%</td>
<td>7.5%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Bernard &amp; The French Thorax Group 1996</td>
<td>17 patients</td>
<td></td>
<td></td>
<td>47%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Radiotracer-guided Thoracoscopic Resection (RGTR)
Radiotracer-guided Thoracoscopic Resection (RGTR)

A Novel Technique for Localization and Excisional Biopsy of Small or Ill-Defined Pulmonary Lesions

Clinical Experience With Radiotracer-Guided Thoracoscopic Biopsy of Small, Indeterminate Lung Nodules

Radiotracer-Guided Thoracoscopic Resection is a Cost-Effective Technique for the Evaluation of Subcentimeter Pulmonary Nodules

Thoracoscopic localization techniques for patients with solitary pulmonary nodule: hookwire versus radio-guided surgery

Alessandro Gonfiotti a,*, Federico Davini a, Luca Vaggelli b, Agostino De Francisci c, Adele Caldarella d, Paolo Maria Gigli a, Alberto Janni a

a Thoracic Surgery Unit, University Hospital Careggi, Florence, Italy
b Division of Nuclear Medicine, University Hospital Careggi, Florence, Italy
c Department of Radiology, University Hospital Careggi, Florence, Italy
d Department of Human Pathology and Oncology, University Hospital Careggi, Florence, Italy
Technique of Radiotracer Placement: Intraoperative Localization & Excision

- Conscious sedation of patient in Radiology suite
- Fluoroscopic CT-guided placement of 22 gauge needle in or near lesion as a marker
- Subsequent thoracoscopic excisional biopsy guided by sterile gamma probe with 30-degree angle
Radiotracer

- Injection of Tc99m MAA
  - 0.3 millicuries
  - 0.1 ml volume
  - Flush with 0.3 ml of saline
Technique

- CT - fluoroscopy guided placement
- 22 gauge needle
Intraoperative Localization

- Thoracoscopic localization with gamma probe
- Specially designed probe with angled tip
Thoracoscopic Gamma Probe
(Daniel Probe)
Case Follow-up

- 44 yo F with 40 pk-year smoking history
- RGTR – 8mm lesion
- Lesion not visible or palpable by finger
- Wedge resection
- Path c/w adenocarcinoma
- RLL lobectomy/MLND
- pStage IA
Advantages of RGTR

- Ready availability of tracer, CT technology, gamma radio-probe in most hospitals
- Stability of isotope for 12 hours.
- No known hazard to patient/hospital personnel
- Can mark nodules located in any region of the lung
- Anatomic resection and complete pathologic staging is done when cancer is found
Clinical Results of RGTR
University of Virginia

- Over 150 patients at present
- Approximately 55% malignant
- 88% are stage IA NSCLC
- Mortality is 0%
- Morbidity is 16%
Caveats for RGTR

- Requires coordination between interventional radiology and thoracic surgeons
- Schedule RTGR as second case of the day
- Radiotracer placed slightly “deep” to the nodule
- Beware of transfissural injection of radiotracer
- No patient has complained about “two procedures” – combined diagnostic and therapeutic
Identification of Pulmonary Nodules at VATS

Conclusions

- Serial CT scanning is not for all patients
- Push for earlier diagnostic techniques for small, indeterminate nodules
- Localization techniques necessary for minimally invasive resectional techniques
- RGTR appealing to surgeons and many patients
- Strategies will depend on institutional expertise and collaboration with other disciplines