New Detection Tools for Lung Cancer

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Case One

- A 55 year old male smoker reports that he is worried about his risk for lung cancer. He has smoked for 28 years and he smokes 2-3 packs of cigarettes per day. Lung function demonstrates moderate emphysema

- What do you tell this patient about his risk for lung cancer?
- What tests could be considered for the early detection of lung cancer?
Case Two

- 76 year old female former smoker with COPD had a 6mm nodule on initial LDSCT.
- It increases to 9mm on follow up CT. PET scan is negative.
- What do you recommend?
Case Three

• 52 year old former smoker who was cured of lung cancer five years ago undergoes routine Autofluorescence bronchoscopy.

• Small area of “pre-cancer” is detected.

• What would you offer this patient?
Case Four

- A 52 year old male former smoker with COPD, is found to have squamous metaplasia in the lung. His father died from lung cancer.
- What are his management options?
New Tools

• AutoFluorescence Bronchoscopy
• Wang Needle aspiration of lymph nodes
• SuperDimension Electromagnetic Navigation system
Lung Cancer: Who is at Risk?

- Patients that are former (or current) smokers with COPD/Emphysema
- Patients with prior lung, esophageal, head/neck cancers
- Patients with pulmonary fibrosis
- Patients with pulmonary asbestosis
<table>
<thead>
<tr>
<th>Lung Cancer risk factors</th>
<th>Relative Risk</th>
<th>Population Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Cigarette Smoking (&gt;20PY)</td>
<td>10.0</td>
<td>30%</td>
</tr>
<tr>
<td>Passive Cigarette Smoking (&gt;40-80PY)</td>
<td>1.2</td>
<td>90%</td>
</tr>
<tr>
<td>Asbestos Exposure</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>COPD (FEV1&lt;70%)</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Diet (Fruits and Vegetables &gt;5 servings/day)</td>
<td>0.5</td>
<td>33%</td>
</tr>
<tr>
<td>Selenium (&gt;0.63 μg/g)</td>
<td>0.5</td>
<td>20%</td>
</tr>
<tr>
<td>Family History (Parent/Child/Sib)</td>
<td>2.4</td>
<td>4-10%</td>
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</tbody>
</table>
**Squamous Cell Lung Cancer: Perspective**

- Squamous cell is the 2\textsuperscript{nd} most common form of lung cancer in North America and Japan.
- The most common form of lung cancer in Europe.
- \(\sim\) 50,596 cases of squamous cell lung cancer will be diagnosed in the US in 2006.
Squamous cell cancer of the lung is preceded by Intraepithelial Neoplasia, metaplasia, dysplasia, and carcinoma-in-situ.
“Some experts argue that there is no relationship between adenomatous polyps and malignancy, while others believe that progression to malignancy will occur in a high percentage of benign polyps unless they are removed.”

---Harrison’s Principles of Internal Medicine 1980
## Progression Rates of IEN

<table>
<thead>
<tr>
<th>Author</th>
<th>N= lesions</th>
<th>N= patients</th>
<th>Metaplasia progression</th>
<th>Dysplasia progression</th>
<th>Years follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bota</td>
<td>416</td>
<td>104</td>
<td>31%</td>
<td>3-37%</td>
<td>2</td>
</tr>
<tr>
<td>Hoshino</td>
<td>99</td>
<td>50</td>
<td>?</td>
<td>3%</td>
<td>4</td>
</tr>
<tr>
<td>Moro Sibilot</td>
<td>31</td>
<td>27</td>
<td>Not given</td>
<td>63% *</td>
<td>3</td>
</tr>
<tr>
<td>Breuer</td>
<td>134</td>
<td>52</td>
<td>9%</td>
<td>9-32%</td>
<td>8</td>
</tr>
</tbody>
</table>

* Included Cis
Early Detection with Autofluorescence Bronchoscopy
Intraepithelial Neoplasia (IEN)

Squamous dysplasia:
Hyperchromic cells, columnar shape altered; loss of epithelial architecture

Carcinoma-in-situ:
Mitotic figures, pleomorphism, preservation of the basement membrane.
**Stage** | **TNM System**
---|---
IA M0 | T1 N0
IB M0 | T2 N0
IIA M0 | T1 N1
IIB M0 | T2 N1
M0 | T3 N0
IIIA M0 | T3 N1
M0 | T1-3 N2
IIIB M0 | T4 N0-2
M0 | T1-4 N3
IV M1 | T1-4 N1-3

*Figure 1. Kaplan-Meier survival estimate for the whole cohort (1986 patients) by stage of disease. (1986 classification)*

*Stage 0*

29% of all lung cancer will pass this way

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Buccheri 2000
Why is conventional Bronchoscopy for Early Squamous Cell and its precursors so challenging?

• “Suspicious lesions” are often advanced: Nodular/polypoid lesions, or irregularities of the bronchial mucosa appear after cartilage invasion.

• Early stage lesions are a few cell layers thick and may be few mm in surface diameter

• Mucosal changes of early lesion may be subtle on normal bronchoscopy.
AutoFluorescence compared with normal bronchoscopy

- Studied in over 3000 patients in over 50 studies:
- Relative sensitivity for early stage lesions increases an average of two-fold (1.5 – 6.3).
- The addition of AutoFluorescence to normal bronchoscopy doubles the number of patients classified as positive.
Autofluorescence Imaging Systems

- Exploit the natural "autofluoresence" of the bronchial epithelium
- Do not require the use of photosensitizers
Normal, RML  Carcinoma in situ, trachea

OncoLIFE images
ACCP Guidelines: Indications for Autofluorescence Bronchoscopy

- Investigation of abnormal sputum cytology
- Post–resection surveillance for metachronous primary lung cancers
- Secondary chemoprevention
- Pre-PDT assessment
- Primary screening in high risk patients (surveillance)
Enlarged Lymph Nodes

• Now What?
• Do I need an operation?
Regional Nodal Stations for Lung Cancer Staging

Superior Mediastinal Nodes
- 1 Highest Mediastinal
- 2 Upper Paratracheal
- 3 Pre-vascular and Retrotracheal
- 4 Lower Paratracheal (including Azygos Nodes)

\[ N_2 = \text{single digit, ipsilateral} \]
\[ N_3 = \text{single digit, contralateral or supraclavicular} \]

Aortic Nodes
- 5 Subaortic (A-P window)
- 6 Para-aortic (ascending aorta or phrenic)

Inferior Mediastinal Nodes
- 7 Subcarinal
- 8 Paraesophageal (below carina)
- 9 Pulmonary Ligament

N\(_1\) Nodes
- 10 Hilar
- 11 Interlobar
- 12 Lobar
- 13 Segmental
- 14 Subsegmental
TBNA Anatomy
TBNA of 4R / Primary Mass
TBNA Anatomy
TBNA: HISTOLOGY
• Over 2/3 of target lesions are outside bronchoscope’s reach and vision

• Tool then pushed out without video image and only under two dimension x-ray guidance

• Most peripheral lesions are too small to be seen

• Current method: "integration" of current tool position (from fluoro) and pre-operative CT images is performed only in the physician's mind
Superdimension:

• Before the bronchoscopy, a 3D roadmap is generated by defining standard airway branch points and target lesion on a virtual bronchoscopy generated from a high resolution CT scan.

• At beginning of procedure, the CT roadmap is correlated to current body position

• The Locatable Guide is ‘steered” to the target lesion, overlaid in real time on the CT roadmap

• Now any standard bronchoscopic tool can be used at the target
Superdimension- Case
Registration

Place the tip of the Locatable Guide at the actual body location of the selected Registration Point, as marked in the Virtual Bronchoscopy image and press the "Acquire" button.
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