The Lung Nodule

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The SPN
Peripheral Lung Nodule

- Small focal, round or oval opacity, may be solitary or multiple surrounded by parenchyma
- May be solid, part solid or non-solid
- Less than 3 cm in maximum diameter, >3 cm are Lung Masses
- Not associated with atelactasis, pneumonia

Prevalence

- Prevalence of SPNs in screening trials of populations at high risk for lung neoplasm:
  - 8-51%
- Prevalence of malignancy in patients with SPNs:
  - 1.1-12% in screening trials
  - 46 - 82% in PET trials

Wahidi MM, CHEST 2007;132:94s
Types of Nodules

Why Worry?

- Malignant SPN may be potentially curable
  - Stage A survival: >60% at 5 years

- Diagnosis of a benign nodule may involve unnecessary procedure and surgery with resultant morbidities
Risk Assessment

- Clinical history
- Comparison with older films
- Morphology on CT
- Calculate Pre test probability
- Imaging: PET scan, Enhanced CT
- Diagnostic procedure: Bronchoscopy, TTNA
SPN

- Determine nodule growth
  - Obtain old films and compare sizes
- When an indeterminate SPN is seen on CXR a follow up Chest CT should be performed

Growth Rate in Malignancy

- Volume doubling time (VDT):
  - Diameter increases by 26% with doubling of volume
- Average VDT for malignant nodules: 20-300 days
- VDT for malignant SPN usually 300 days, 2-year radiographic stability suggests a benign process

Gould MK. CHEST 2007;132:108s
Growth Rate

- 56 y o male with h/o Colon Ca
- Follow up CT in 6 months

Growth Rate

One month apart
Infection
Growth Rate

6 WEEK Follow UP CXR
Pneumonia or infection
Calculate Pre Test Probability of Malignancy

- Review Clinical History
- Use a validated prediction model
- To facilitate the selection and interpretation of subsequent diagnostic tests

Gould M, CHEST 2007;132:108s
### High Risk Nodules

- Size
- Calcification
- Attenuation
- Border
- Morphology

### Size & Risk of Malignancy

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Risk of Malignancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 mm</td>
<td>0.2%</td>
</tr>
<tr>
<td>4-7 mm</td>
<td>0.9%</td>
</tr>
<tr>
<td>8-20 mm</td>
<td>18%</td>
</tr>
<tr>
<td>&gt;20 mm</td>
<td>50%</td>
</tr>
</tbody>
</table>

*MacMahon H. Radiology. 2005;237:295*
*Midthun DE. Lung Cancer 2003;41:S40*
Calcification Patterns

- SPNs calcified in a clearly benign pattern do not warrant additional diagnostic evaluation.

Benign Calcifications

- Diffuse
- Central
Malignant Calcifications

- Eccentric
- Speckled

Attenuation

- Pure ground glass or sub solid lesion
- Could be infection or adenocarcinoma-in-situ
- Formerly BAC
- Volume doubling 3-5 years
- Part Solid more likely malignant
- Solitary GGO < 5mm - Atypical alveolar hyperplasia
- No follow up

**Solitary GGO > 5mm**

- Obtain 1mm thin section
- Initial follow up in 3 months
- If unresolved, yearly CT for minimum of 3 years
- PET not useful
Border

- Smooth borders: 20-30%
- Scalloped or lobulated: 60%
- Spiculated: 90%
- Corona Radiata: 95%

Risk of malignancy is 33-100% in nodules with irregular, lobulated, or spiculated borders

Rigler LG. Semin Roentgenol 1977;12:161
Risk Factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Risk of cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Diameter of nodule (cm)</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>Age (years)</td>
<td>&lt;45</td>
</tr>
<tr>
<td>Smoking status</td>
<td>Never smoked</td>
</tr>
<tr>
<td>Smoking-cessation status</td>
<td>Quit ≥7 years ago or never smoked</td>
</tr>
<tr>
<td>Characteristics of nodule margins</td>
<td>Smooth</td>
</tr>
</tbody>
</table>

http://bestpractice.bmj.com/best-practice/monograph/547/diagnosis.html

Solid nodule <4mm

- Risk of malignancy
  - <3mm: 0.2%
  - 4-7mm: 0.9%

- Low risk: No follow up
- High risk: Follow up in one year

### Solid nodule: 5 to 8 mm in size

**Fleischner Society Guidelines**

<table>
<thead>
<tr>
<th>Nodule Size</th>
<th>Low-Risk Patient</th>
<th>High-Risk Patient</th>
</tr>
</thead>
</table>
| >4-6 mm     | Follow-up at 12 mths  
If unchanged, no follow-up | Follow-up at 6-12 mths  
If unchanged, follow-up in 18-24 mths |
| >6-8 mm     | Follow-up at 6-12 mths  
If unchanged, follow-up in 18-24 mths | Follow-up at 3-6 mths  
If unchanged, follow-up in 9-12 and 24 mths |

Should try to perform follow-up scans using low-dose protocol


### >8mm Solid Nodule

- Short follow up in 4-6 weeks
- If unresolved
  - Follow up
  - PET imaging
  - Diagnostic procedure e.g bronchoscopy, TTNA, VATS
First Case

• 62 y o male with COPD presents with a 1.6x2cm RUL spiculated nodule
• 50 PY smoking history

• Best option?
  1. PET scan
  2. CT guided needle core biopsy
  3. VATS
  4. Radiographic surveillance
  5. Bronchoscopy with navigation

CASE ANALYSIS

• RISK FACTORS
  • Likelihood of malignancy is high
    • Age
    • Smoker
    • Size 1.6mm
    • Spiculated

  • Navigation bronchoscopy with EBUS
Second Case

- 57 year old female with post intubation tracheal stenosis found to have 5mm nodule in the LLL.
- Never smoked

Best option?
1. PET scan
2. CT guided needle core biopsy
3. VATS
4. Radiographic surveillance
5. Bronchoscopy with navigation

CASE ANALYSIS

- RISK FACTORS
  - Likelihood of malignancy is low
    - Non-Smoker
    - Size 5mm
    - Smooth rounded border

- Follow up CT Chest in 12 months
Indeterminate Nodules

- Obtain PET scan

- Management options:
  - Radiographic surveillance if clinical probability is low (30-40%) and no activity on PET
  - Sampling by bronchoscopy or TTNA if:
    - Discordance between clinical pre-test probability and imaging tests (high suspicion but lesion is not active on PET)
    - A benign diagnosis that requires specific treatment (e.g., fungal infection)
    - A fully-informed patient desires proof of malignancy diagnosis prior to surgery
    - Surgery is high risk

Gould M, CHEST 2007;132:108S-130S

Choice of Sampling Modality

- TTNA if nodule is peripherally located

- Bronchoscopy:
  - Air-bronchograms or bronchus sign are present
  - Experience with advanced bronchoscopy tools exists:
    - Electromagnetic navigation
    - Radial EBUS
# Small Subcentimeter Pulmonary Nodules (< 8 mm)

- For patients with NO risk factors for lung cancers:
  - Nodules < 4mm
    - No further follow-up
  - Nodules 4 – 6 mm
    - Re-evaluate with a chest CT at 12 months
    - No further follow-up if unchanged at 12 months
  - Nodules 6 – 8 mm
    - Re-evaluate with a chest CT between 6-12 months and between 18-24 months

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### The New England Journal of Medicine

**Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening**

Large Randomized Clinical Trial

- N= 53,454
- High Risk patients
- 20% Relative Risk Reduction of mortality from Lung Cancer
Last Case

- 65 year old female
- 30PY smoking
- Quit 9 years ago
- Maternal aunt breast Ca
- 1.6cm spiculated mass on screening CT

What is the best approach?

1. TTNA
2. Bronchoscopy
3. VATS
4. Radiographic surveillance
Sent for TTNA

- Minute fragments of alveolar parenchyma with focal chronic inflammation

- Next plan
  1. Surgery
  2. Bronchoscopy with navigation
  3. Radiographic surveillance
  4. PET scan

Conclusion

- Careful evaluation of risk factors

- Estimate pre-test probability
  - Size, morphology of nodule
  - Age, smoking status, previous malignancy

- Risk of malignancy
  - Low risk: serial chest CT’s
  - Moderate risk: consider PET scan, diagnostic sampling, or surgical resection
  - High risk: surgical resection