The Lung Nodule

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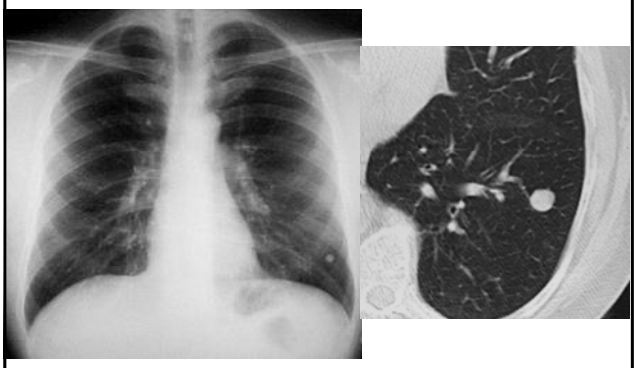
The SPN



Peripheral Lung Nodule

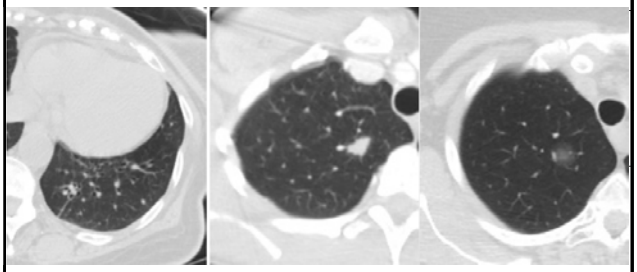
- **Small focal, round or oval opacity, may be solitary or multiple surrounded by parenchyma**
- **May be solid, part solid or non-solid**
- **Less than 3 cm in maximum diameter, >3 cm are Lung Masses**
- **Not associated with atelactasis, pneumonia**

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

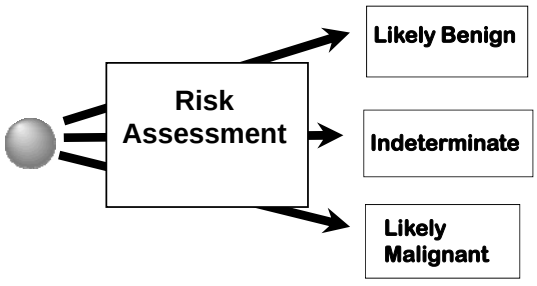
Types of Nodules



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

SPN



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

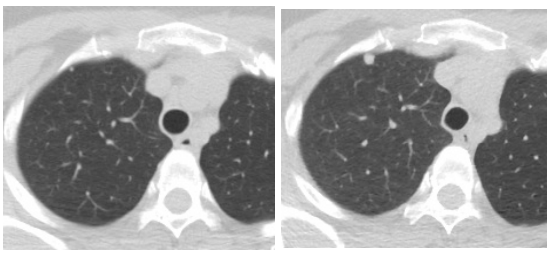
Gould MK. CHEST 2007;132:108s

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

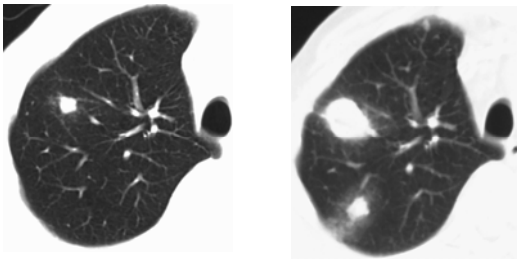
Gould MK. CHEST 2007;132:108s

Growth Rate



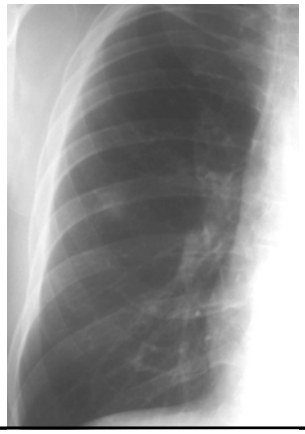
- 56 y o male with h/o Colon Ca
- Follow up CT in 6 months

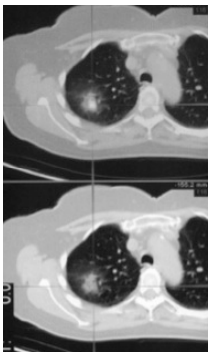
Growth Rate



One month apart
Infection

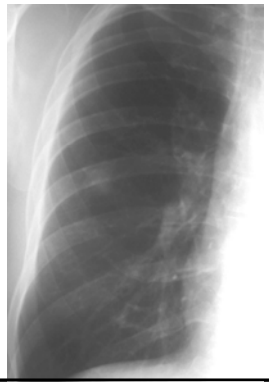
Growth Rate





6 WEEK Follow UP CXR

Pneumonia or infection

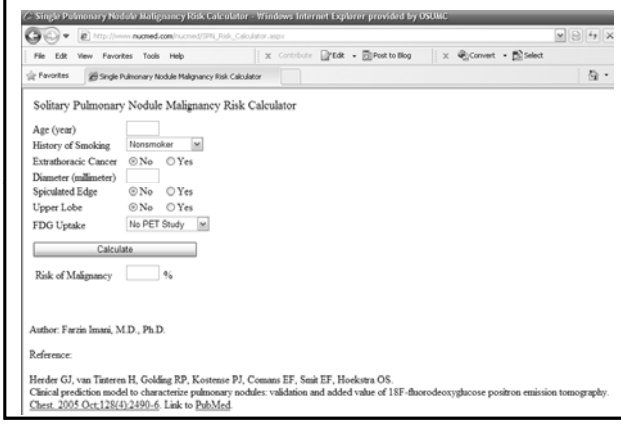


Calculate Pre Test Probability of Malignancy

- **Review Clinical History**
- **Use a validated prediction model**
  - **http://www.nucmed.com/nucmed/SPN_Risk_Calculator.aspx**
- **To facilitate the selection and interpretation of subsequent diagnostic tests**

Gould M, CHEST 2007;132:108s

Calculate Pre Test Probability of Malignancy



High Risk Nodules

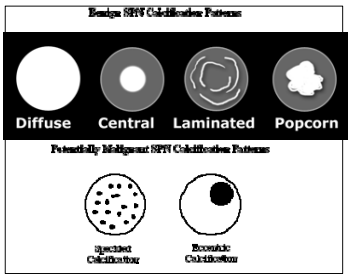
- Size
- Calcification
- Attenuation
- Border
- Morphology

Size & Risk of Malignancy

<3 mm	0.2%
4-7 mm	0.9%
8-20 mm	18%
>20 mm	50%

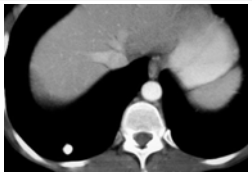
MacMahon H. Radiology. 2005;237:295
Midthun DE. Lung Cancer 2003;41:S40

Calcification Patterns

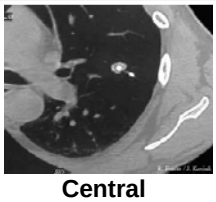


- SPNs calcified in a clearly benign pattern do not warrant additional diagnostic evaluation

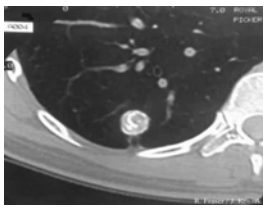
Benign Calcifications



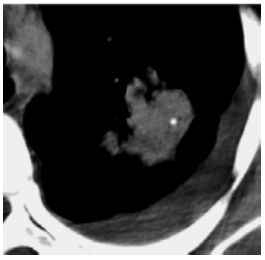
Diffuse



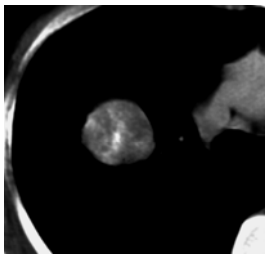
Central



Malignant Calcifications



Eccentric



Speckled

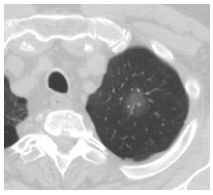
Attenuation

- Pure ground glass or sub solid lesion
- Could be infection or adenocarcinoma-in-situ
- Formerly BAC
- Volume doubling 3-5 years

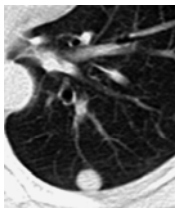
- Part Solid more likely malignant
- Solitary GGO<5mm- Atypical alveolar hyperplasia
- No follow up

Solitary GGO >5mm

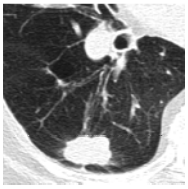
- Obtain 1mm thin section
- Initial follow up in 3 months
- If unresolved, yearly CT for minimum of 3 years
- PET not useful



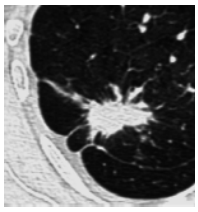
Border



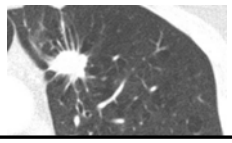
Smooth



Lobulated



Spiculated



Corona Radiata

Border & Risk of Malignancy

• 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

Variable		Risk of cancer	
	Low	Intermediate	High
Diameter of nodule (cm)	<1.5	1.5-2.2	≥2.3
Age (years)	<45	45-60	>60
Smoking status	Never smoked	Current smoker (≤20 cigarettes/day)	Current smoker (>20 cigarettes/day)
Smoking-cessation status	Quit ≥7 years ago or never smoked	Quit <7 years ago	Never quit
Characteristics of nodule margins	Smooth	Scalloped	Corona radiata or spiculated

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

Midthun DE, Swensen SJ, Jett JR, Hartman TE. Evaluation of nodules detected by screening for lung cancer with low dose spiral computed tomography. Lung Cancer 2003;41(suppl 2):S40.

Solid nodule: 5 to 8 mm in size

Fleischner Society Guidelines

Nodule Size	Low-Risk Patient	High-Risk Patient
>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

Heber MacMahon, John H. M. Austin, Gordon Gamsu, Christian J. Herold, James R. Jett, David P. Naidich, Edward F. Patz, Jr, and Stephen J. Swensen. Guidelines for Management of Small Pulmonary Nodules Detected on CT Scans: A Statement from the Fleischner Society *Radiology* November 2005 237:395-400

>8mm Solid Nodule

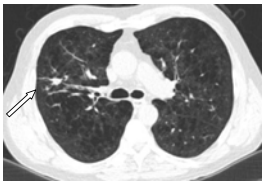
- **Short follow up in 4-6 weeks**
- **If unresolved**
  - **Follow up**
  - **PET imaging**
  - **Diagnostic procedure e.g bronchoscopy, TTNA, VATS**

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**

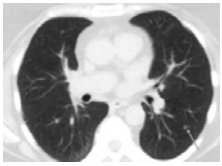
CASE ANALYSIS

- **RISK FACTORS**
  - **Likelihood of malignancy is high**
    - **Age**
    - **Smoker**
    - **Size 1.6mm**
    - **Spiculated**
  - **Navigation bronchoscopy with EBUS**



Second Case

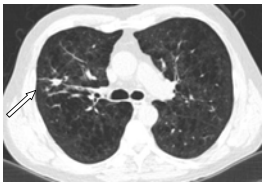
- 57 year old female with post intubation tracheal stenosis found to have 5mm nodule in the LLL.
- Never smoked



- 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

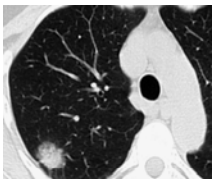
Indeterminate Nodules

- 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 (eg. fungal infection)
    - A fully-informed patient desires proof of malignancy diagnosis prior to surgery
    - Surgery is high risk

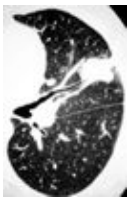
Gould M, CHEST 2007;132:108S-130S

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)

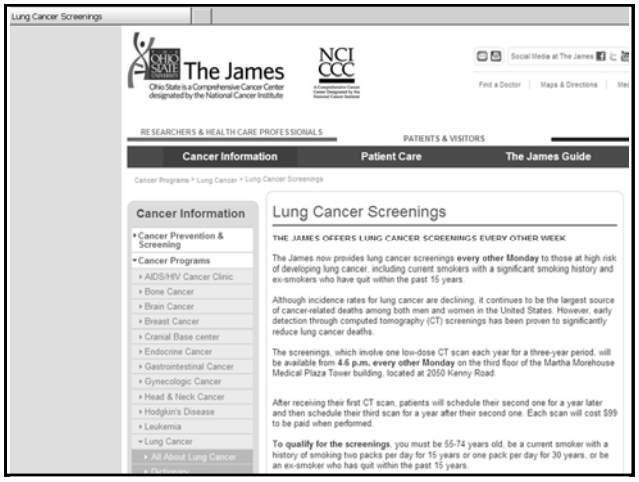
- **For patients with NO risk factors for lung cancers:**
- **Nodules < 4mm**
  - **No further follow-up**
- **Nodules 4 – 6 mm**
  - **Re-evaluate with a chest CT at 12 months**
  - **No further follow-up if unchanged at 12 months**
- **Nodules 6 – 8 mm**
  - **Re-evaluate with a chest CT between 6-12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

The NEW ENGLAND JOURNAL of MEDICINE

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

The National Lung Screening Trial Research Team

Large Randomized Clinical Trial
N= 53,454
High Risk patients
20% Relative Risk Reduction of mortality from Lung Cancer



Last Case

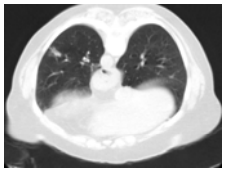
- **65 year old female**
- **30PY smoking**
- **Quit 9 years ago**
- **Maternal aunt breast Ca**
- **1.6cm spiculated mass on screening CT**

What is the best approach?

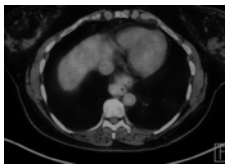
1. TTNA
2. Bronchoscopy
3. VATS
4. Radiographic surveillance

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