

# Solitary Pulmonary Nodule

Martin Sheridan, M.D.

Section Chief, Pulmonary

Medical Director, Respiratory Care Services

Medstar Franklin Square Hospital

# 1. Solitary Pulmonary Nodule

## Objectives:

1. Define Solitary Pulmonary Nodule (SPN) and list types of SPN's
2. Describe predictors of malignancy for SPN's
3. Discuss the role of diagnostic techniques available
4. Summarize recommended guidelines for monitoring SPN's



# Solitary Pulmonary Nodule

- Definition: A round opacity that is at least moderately well marginated and no larger than 3 cm in it's maximum diameter



## Metastasis: Melanoma



MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

Knowledge and Compassion **Focused on You**

# Solitary Pulmonary Nodule

## Differential Diagnosis: Benign SPN

- Non-specific or healed granulomas (25%)
- Infectious granulomas (15%)
- Benign neoplasms (15%)
  - Hamartoma
  - Lipoma, fibroma, countless others (rare)
- Others: lung abscess, pseudotumor, round atelectasis, AVM, infarct, mucoid impaction, hematoma, rheumatoid nodule, Wegener's

# Differential Diagnosis: Malignancy

- Adenocarcinoma (~50%)
  - Bronchoalveolar cell carcinoma (~5%)
- Squamous cell carcinoma (~20%)
- Solitary metastasis (~10%)
- Undifferentiated NSCLC (~10%)
- Small cell carcinoma (<2%)

# Solid nodule

- Known history of malignancy
- Nodules of any size: Metastasis should be considered
- Follow-up/Work-up according to relevant protocol for that malignancy
- Frequent follow-up may be indicated



# SPN

- Pre-test Probability: Facilitates selection and interpretation of subsequent tests
- Validated model from Mayo Clinic
  - Six independent predictors of malignant SPN
  - Patient characteristics: **Age, smoking status, history of extrathoracic malignancy**
  - Nodule characteristics: **diameter, spiculation, upper lobe location**

**Swensen et al. Arch Intern Med 1997;157:849**





# CT: Size Matters

<u>Size</u>	<u>% malignant</u>
• 2-5 mm	1%
• 6-10 mm	24%
• 11-20 mm	33%
• 21-45 mm	80%

Henschke et al. Lancet 1999;354:9-105.



MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

Knowledge and Compassion **Focused on You**

# CT: Edge Characteristics

<u>Border type</u>	<u>LR</u>
1. Smooth	0.2
2. Lobulated	0.5
3. Spiculated	5.0
4. Corona radiata	14



Siegelman et al. Radiology 1986;160:307

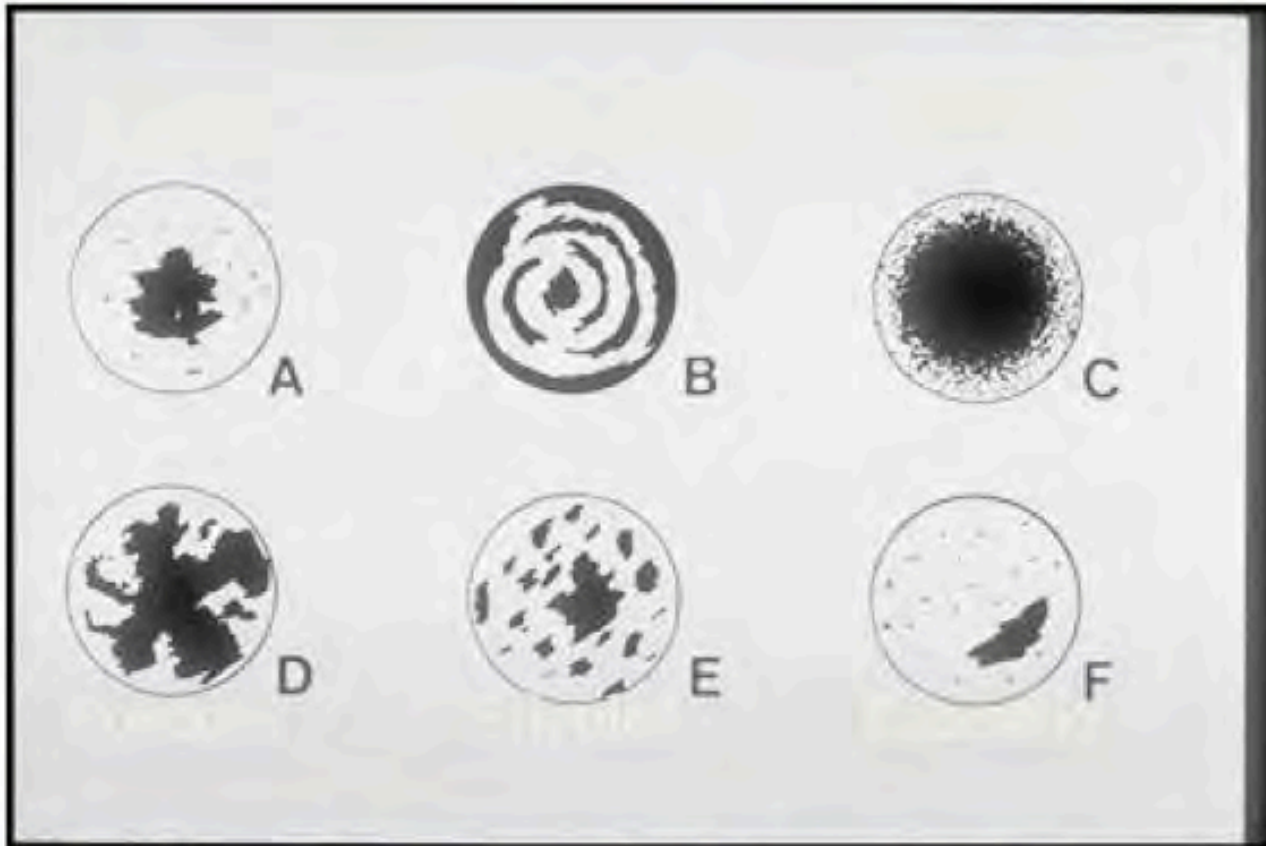
© 2014 American College of Chest Physicians



MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

Knowledge and Compassion **Focused on You**

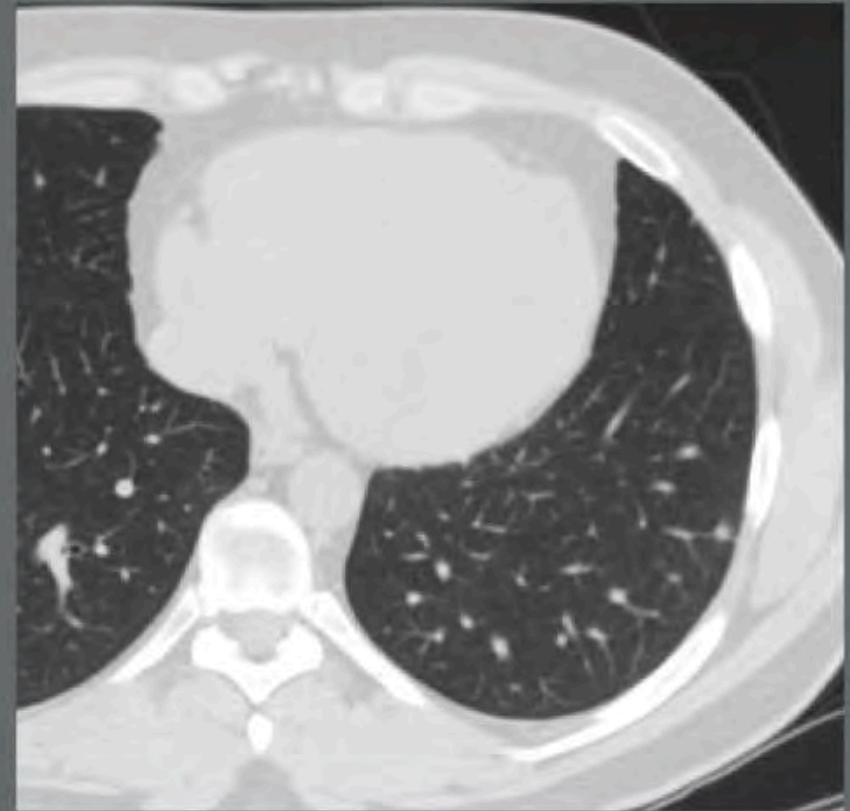
# CXR: Patterns of Calcification

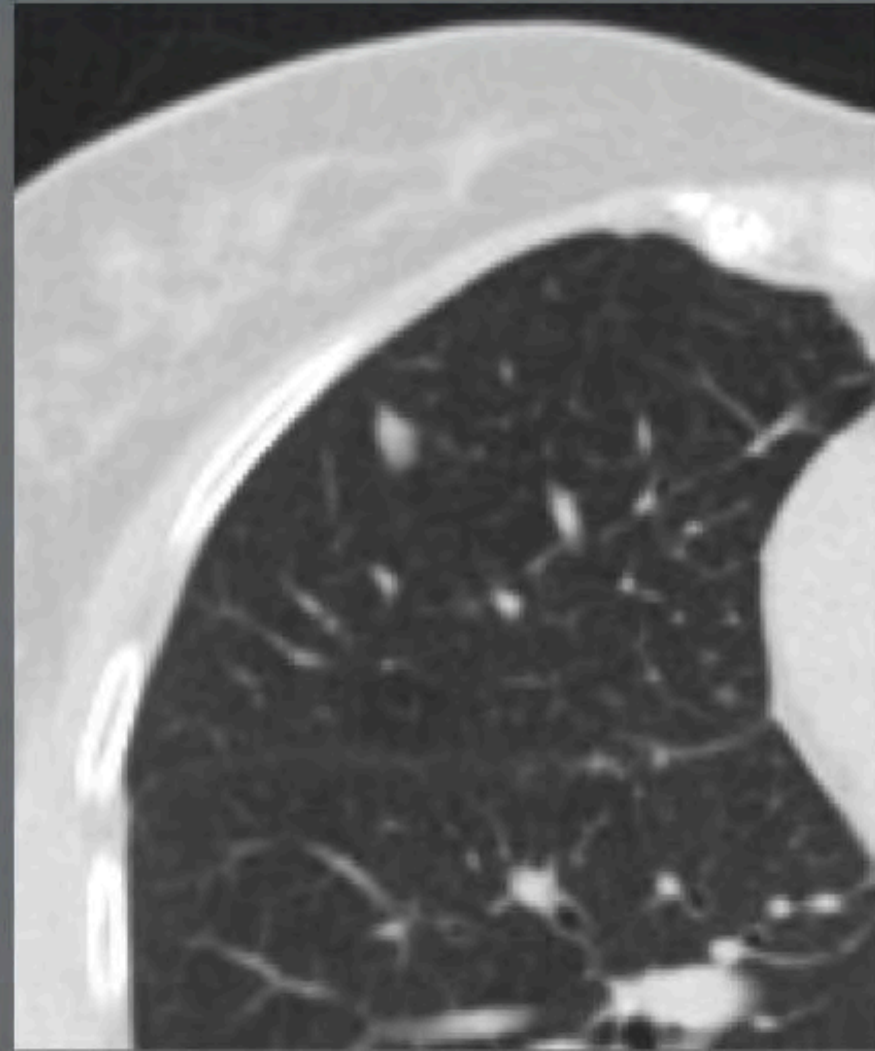
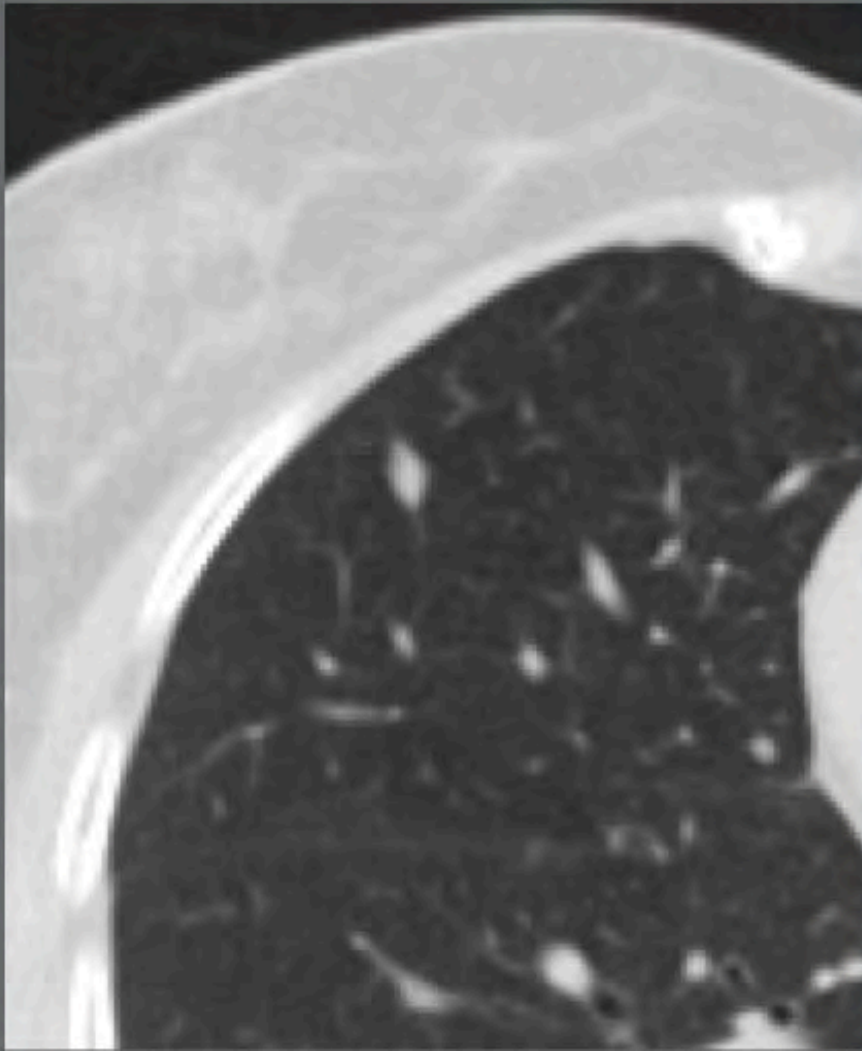


Patterns A-D are benign; patterns E and F are non-specific



# Intrapulmonary lymph node ( IPLN )





MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

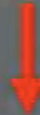
Knowledge and Compassion **Focused on You**

# What is an Intrapulmonary Lymph Node?

Nodule of lymphatic tissue in the lungs

Benign

Develop in response to antigenic stimuli



Inhaled dust

Inflammatory response

Accumulation of Lymphocytes and Macrophages

Hyperplasia of lymph nodes



# Characteristics of IPLN

Subcarinal	Vast majority are in the RML, Lingula and lower lobes
Subpleural	Vast majority are within 2 cm of the pleura
Size	Vast majority are less than 1 cm
Shape	Triangular, Angular, Elliptical, Semicircular
Linear Opacity	Associated with Interlobular septa



# Location and Shape of IPLN

- **Location:**
  - Subcarinal
  - Peripheral, often subpleural
- **Shape:**
  - Triangular or Angular
  - Elliptical
  - Semicircular





# SPN

- Pre-test probability of cancer
  - Low is  $< 5\%$ 
    - Serial CT's
  - Intermediate is 5 – 60%
    - Consider PET, TTNA, Bronch
  - High is  $> 60\%$ 
    - Excisional biopsy with frozen section



# Bronchoscopy

- **Central lesions**
  - 30 studies, total of 3,754 patients
  - Overall sensitivity 88%

## Procedure

## Sensitivity %

**Direct endobronchial Bx**

**74%**

**Endobronchial brush**

**59%**

**Bronchial wash**

**48%**



# ***Role of Bronchoscopy***

- **Peripheral lesions**
  - **30 studies, 4,136 patients**
  - **Overall sensitivity 30-60%**
- **Factors affecting yield:**
  - **Size of the lesion**
    - **>2cm sensitivity 62%**
    - **<2cm only 33%**
  - **Bronchus extending to the lesion (60%)**
  - **Use of fluoroscopy, number of biopsies (>5)**



# CT-Guided FNA

11 studies with data about accuracy in SPN:

- Median sensitivity 90% (range 65% to 94%)
- Median specificity 100% (range 96% to 100%)
- Specificity assumed to be 100% in some studies
- Non-diagnostic results 5x more common in benign than malignant nodules, but non-diagnostic biopsy does not rule out malignancy
- Median probability of PTX 15% (range 15% to 43%)
- ~6% required chest tube (range 4% to 18%)

**Gould et al. Chest 2013.**



# Biopsy: TTNA

**ACCP recs:** In patients with an indeterminate SPN (10 mm) it is appropriate to perform a TTNA or bronchoscopy in the following circumstances:

- when clinical pre-test probability and findings on imaging tests are discordant, for example, when the pre-test probability of cancer is high and the lesion is not hypermetabolic by PET
- when a benign diagnosis requiring specific medical treatment is suspected
- when a fully informed patient desires proof of a malignant diagnosis prior to surgery, especially when the risk of surgical complications is high.
- Patient non operative and need tissue to rx

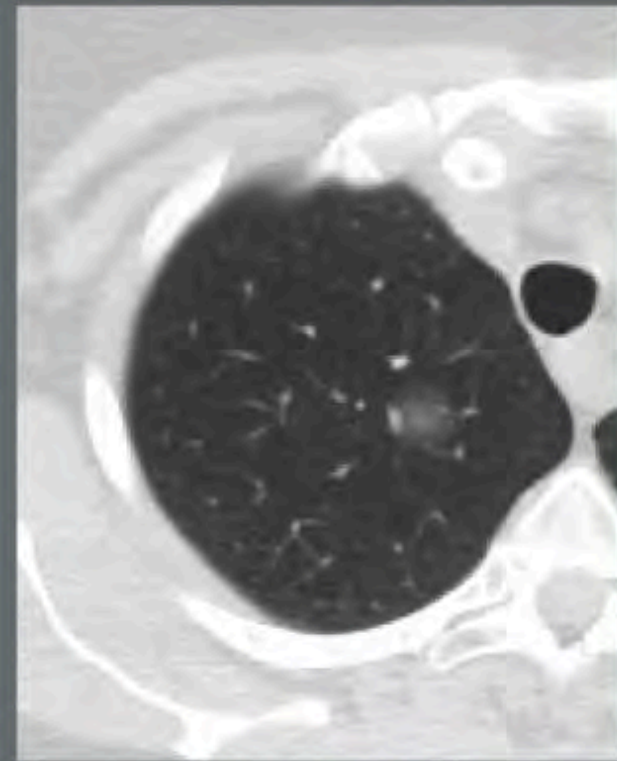


# SPN

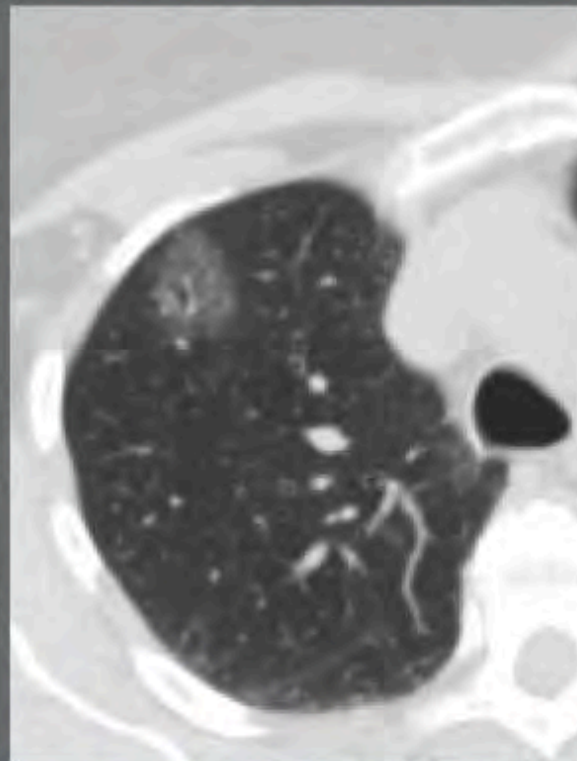
## Radiographic Follow-up

Nodule Size (mm)*	Low-Risk Patient <sup>†</sup>	High-Risk Patient <sup>‡</sup>
≤4	No follow-up needed <sup>§</sup>	Follow-up CT at 12 mo; if unchanged, no further follow-up <sup>  </sup>
>4–6	Follow-up CT at 12 mo; if unchanged, no further follow-up <sup>  </sup>	Initial follow-up CT at 6–12 mo then at 18–24 mo if no change <sup>  </sup>
>6–8	Initial follow-up CT at 6–12 mo then at 18–24 mo if no change	Initial follow-up CT at 3–6 mo then at 9–12 and 24 mo if no change
>8	Follow-up CT at around 3, 9, and 24 mo, dynamic contrast-enhanced CT, PET, and/or biopsy	Same as for low-risk patient

# Subsolid nodules



Pure ground glass



Part solid



# Subsolid nodule

- Pure ground glass nodule (GGN) or Part solid nodule
- Solitary or Multiple
- May be benign
  - Infection
- Assumed to be adenocarcinoma in situ (AIS), formerly referred to as bronchioloalveolar carcinoma ( BAC )
- Part solid: More likely to be malignant

© 2014 American College of Chest Physicians





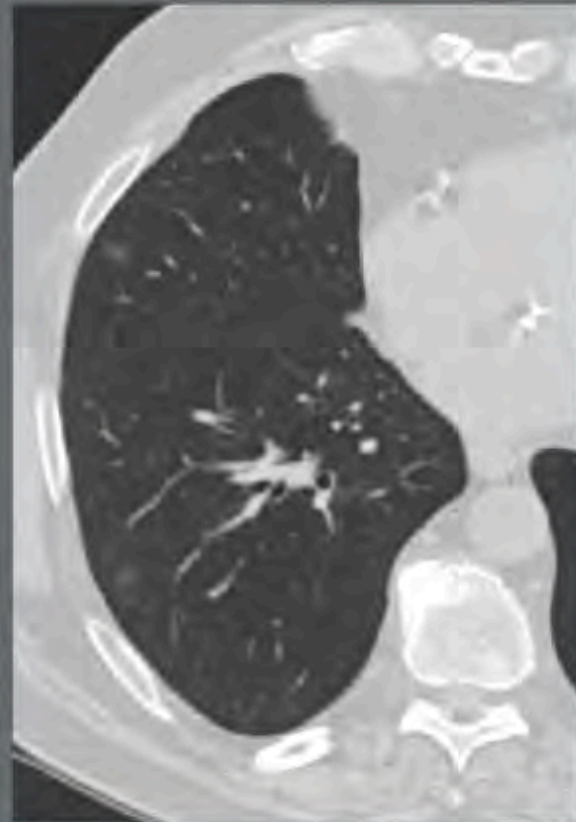
# Solid nodule: Larger than 9 mm

- Short interval follow-up
- If resolved:
  - Likely infection and no further work-up necessary
- If decreased in size:
  - Likely infection but follow-up to resolution
- If unchanged: Requires work-up
  - Follow-up
  - Bronchoscopy, TTNB, Surgery
  - PET Imaging
  - Nodule enhancement CT scan



# Solitary GGN: Less than 5 mm

- Do not require follow-up examination
- Doubling time is 3 to 5 years
- Many likely represent incidental foci of adenomatous hyperplasia
- To establish true nature of GGN:
  - Obtain 1 mm thin sections



Naidich DP, Bankier AA, MacMahon H, Schaefer-Prokop CM, Pistolesi M, Goo JM, Macchiarini P, Crapo JD, Herold CJ, Austin JH, Travis WD.  
Recommendations for the management of subsolid pulmonary nodules detected at CT: A statement from the Fleischner Society. *Radiology* Vol 266(1):304-317

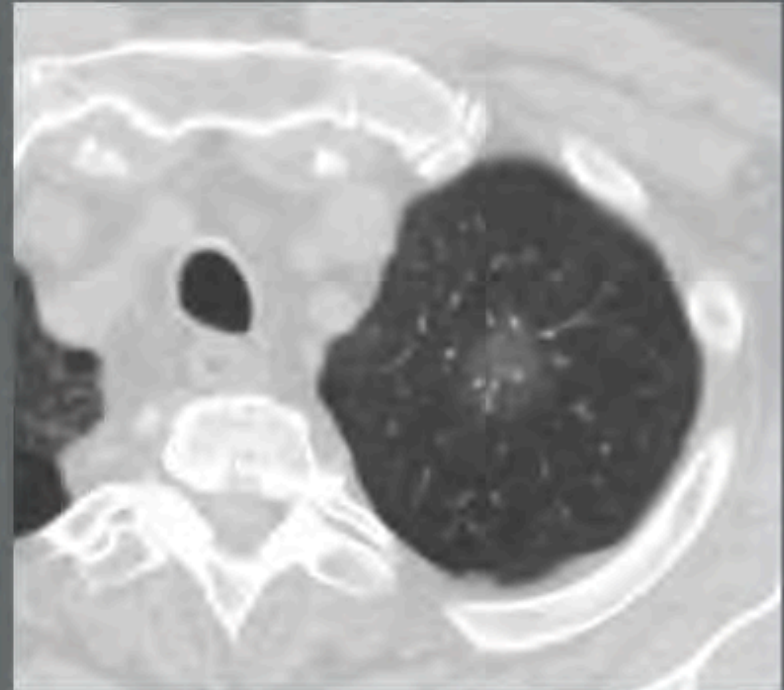


MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

Knowledge and Compassion **Focused on You**

# Solitary GGN: Larger than 5 mm

- Initial follow-up in 3 months
- If unresolved:
  - Yearly follow-up for minimum of 3 years
- No way to know exact nature short of resection
- Biopsy and PET CT scan are not recommended



Naidich DP, Bankier AA, MacMahon H, Schaefer-Prokop CM, Pistolesi M, Goo JM, Macchiarini P, Crapo JD, Herold CJ, Austin JH, Travis WD. Recommendations for the management of subsolid pulmonary nodules detected at CT: A statement from the Fleischner Society. *Radiology* Vol 266(1):304-317

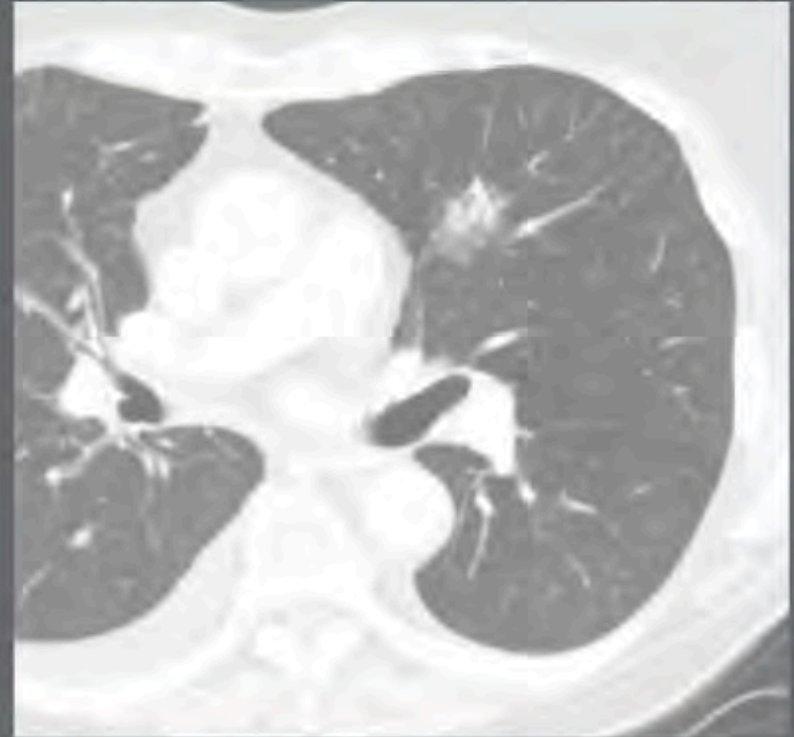


MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

Knowledge and Compassion **Focused on You**

# Solitary Subsolid nodule

- Initial follow-up in 3 months
- If solid component <5 mm:
  - Yearly follow-up for minimum 3 years
- If solid component >5 mm:
  - Recommend biopsy or surgical resection
  - Most likely to represent invasive adenocarcinoma
- Consider PET scan for nodules greater than 1 cm



Naidich DP, Bankier AA, MacMahon H, Schaefer-Prokop CM, Pistolesi M, Goo JM, Macchiarini P, Crapo JD, Herold CJ, Austin JH, Travis WD. Recommendations for the management of subsolid pulmonary nodules detected at CT: A statement from the Fleischner Society. *Radiology* Vol 266(1):304-317



MedStar Franklin Square  
Medical Center  
*Angelos Center for Lung Diseases*

Knowledge and Compassion **Focused on You**