Solitary Pulmonary Nodule

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10/16/2019

RAD3030 Diagnostic Radiology

Case from Dr. Erika Odisio and Dr. Matthew Lambert

UTHealth® The University of Texas Health Science Center at Houston | McGovern Medical School

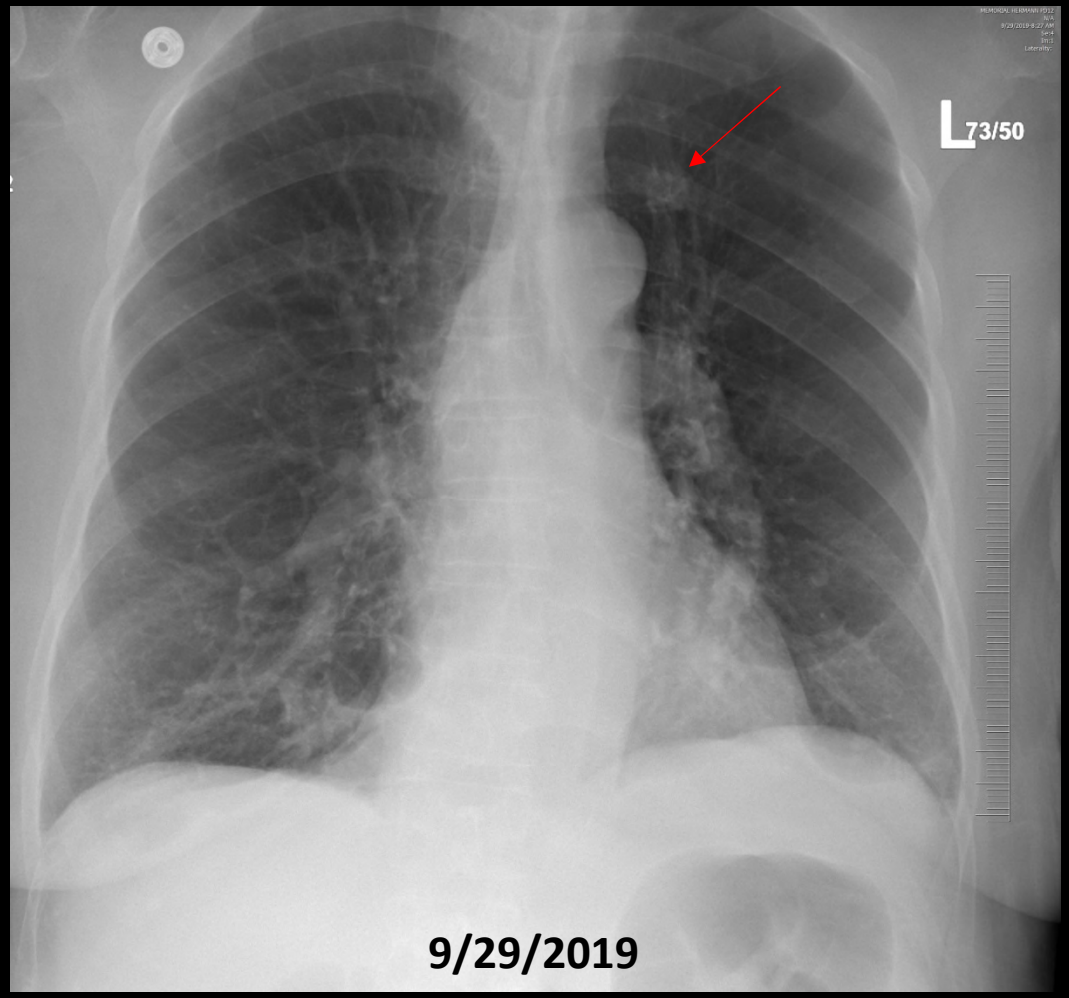
Clinical History

- 85 year old female at Hermann Hospital-Inpatient
  - CC: Patient was in the ED s/p fall and for herpes ophthalmicus on 9/23/2019
  - PMHx:
    - COPD on 4L of O2 at home- 30 pack year smoking Hx
  - Follow up CXRs were performed when patient presented with weakness on 9/25 and shortness of breath on 9/27
  - Incidental pulmonary nodule found on CXR on 9/25

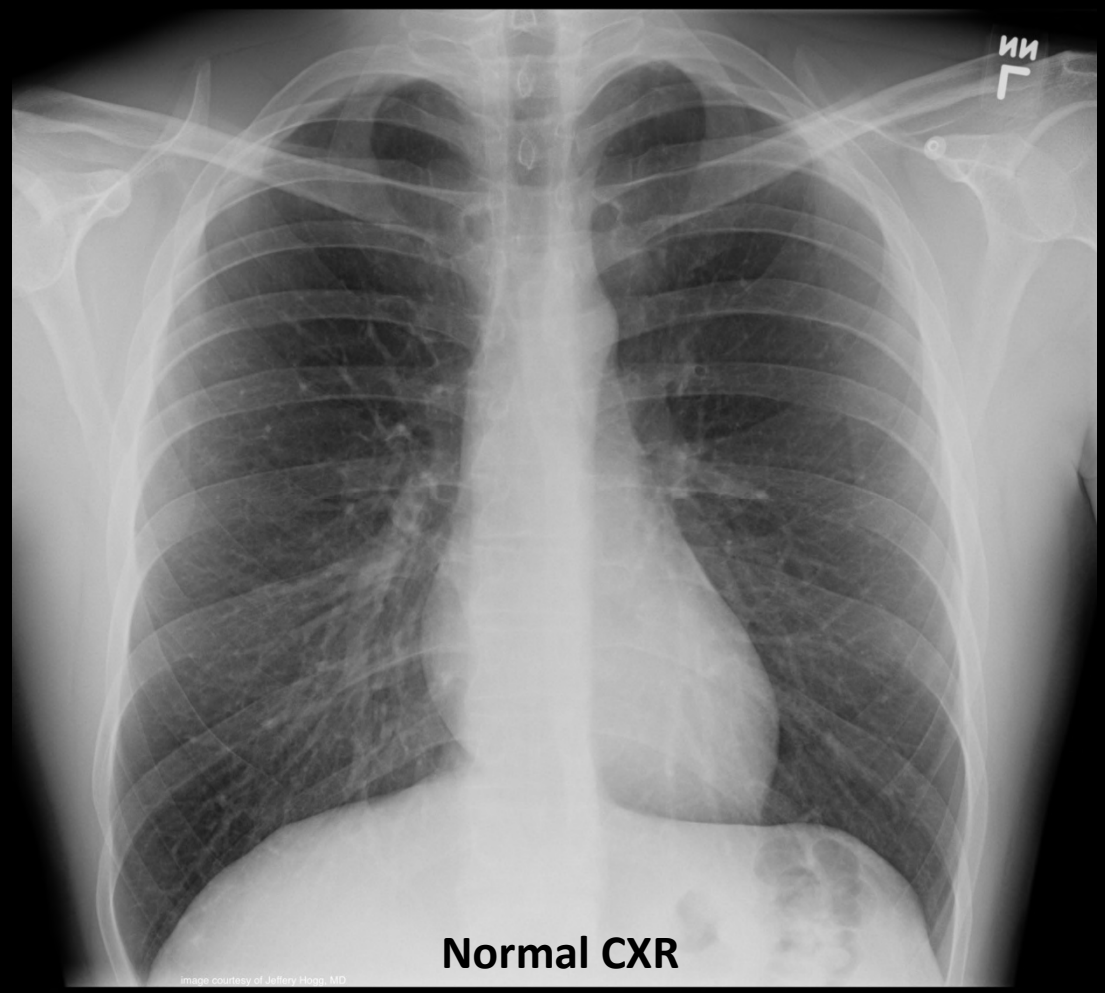
Imaging Performed

- CXR (9/25, 9/29)
- CT without contrast (9/29)

Chest X-ray Comparison

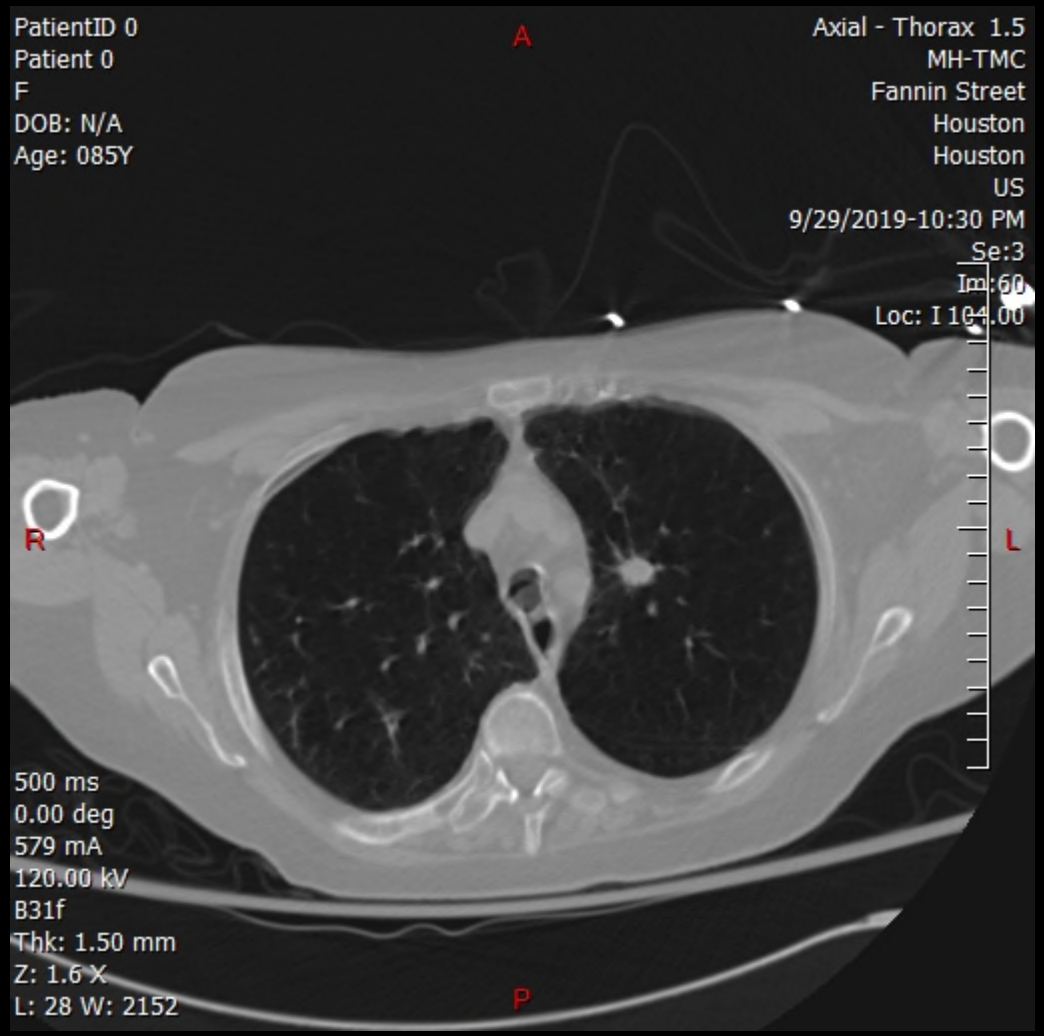


9/29/2019



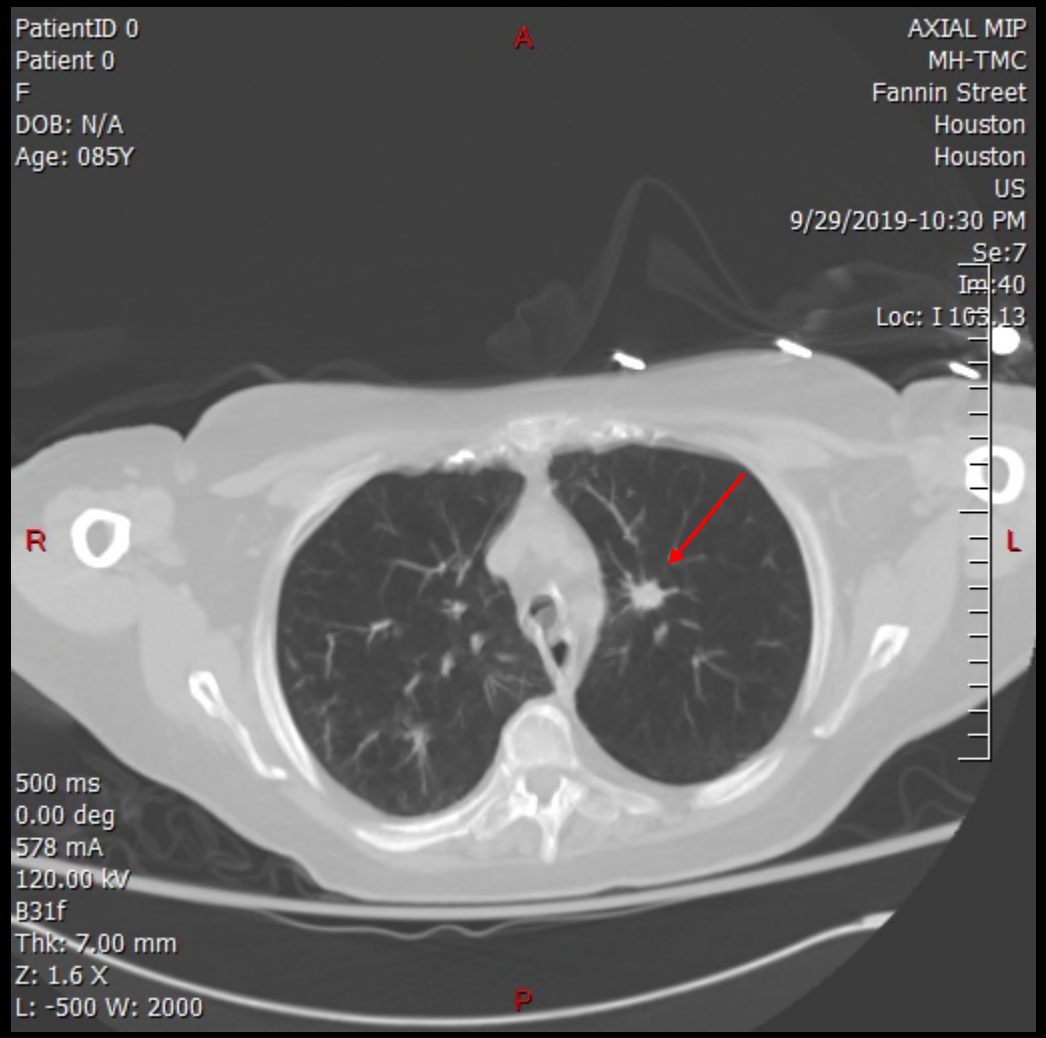
Normal CXR

Axial CT Chest

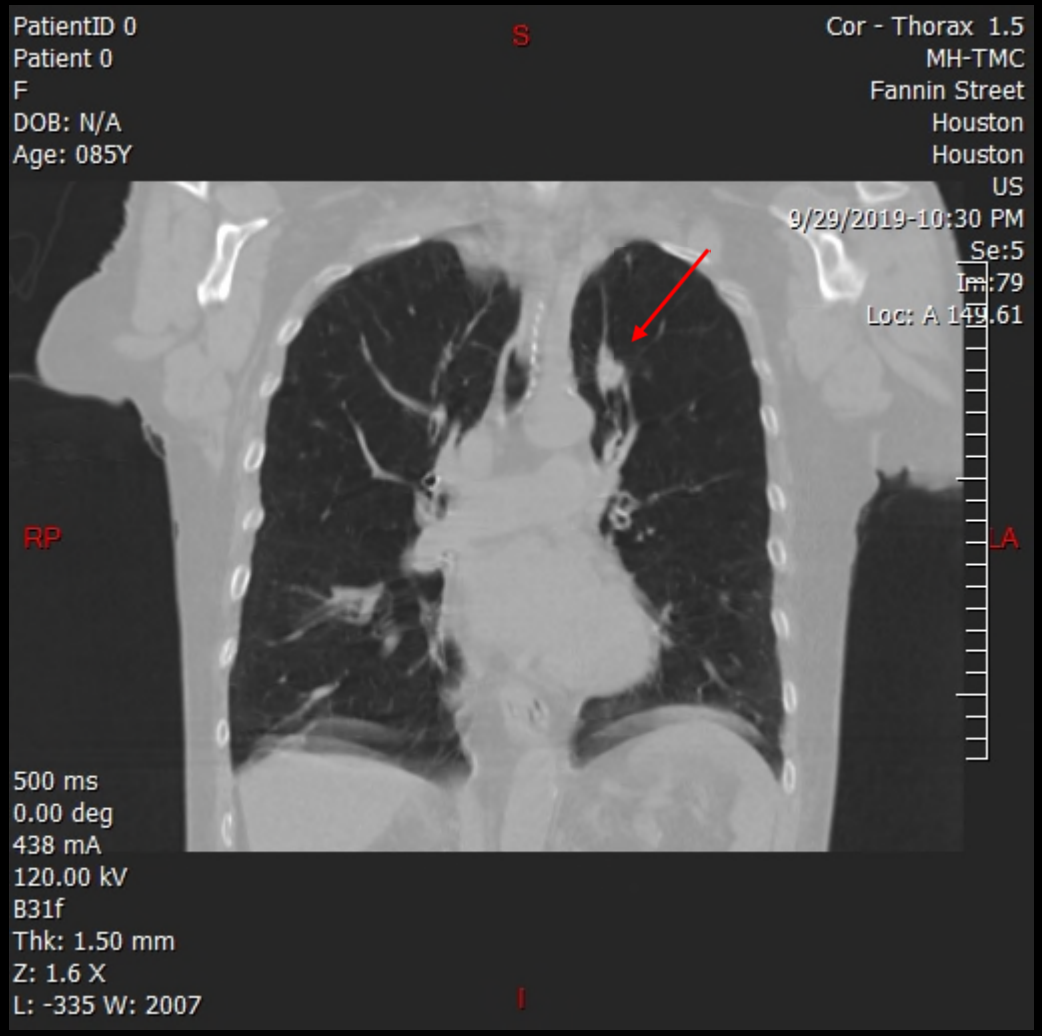


- Image 60: 1.3 x 1.1 cm left apical nodule

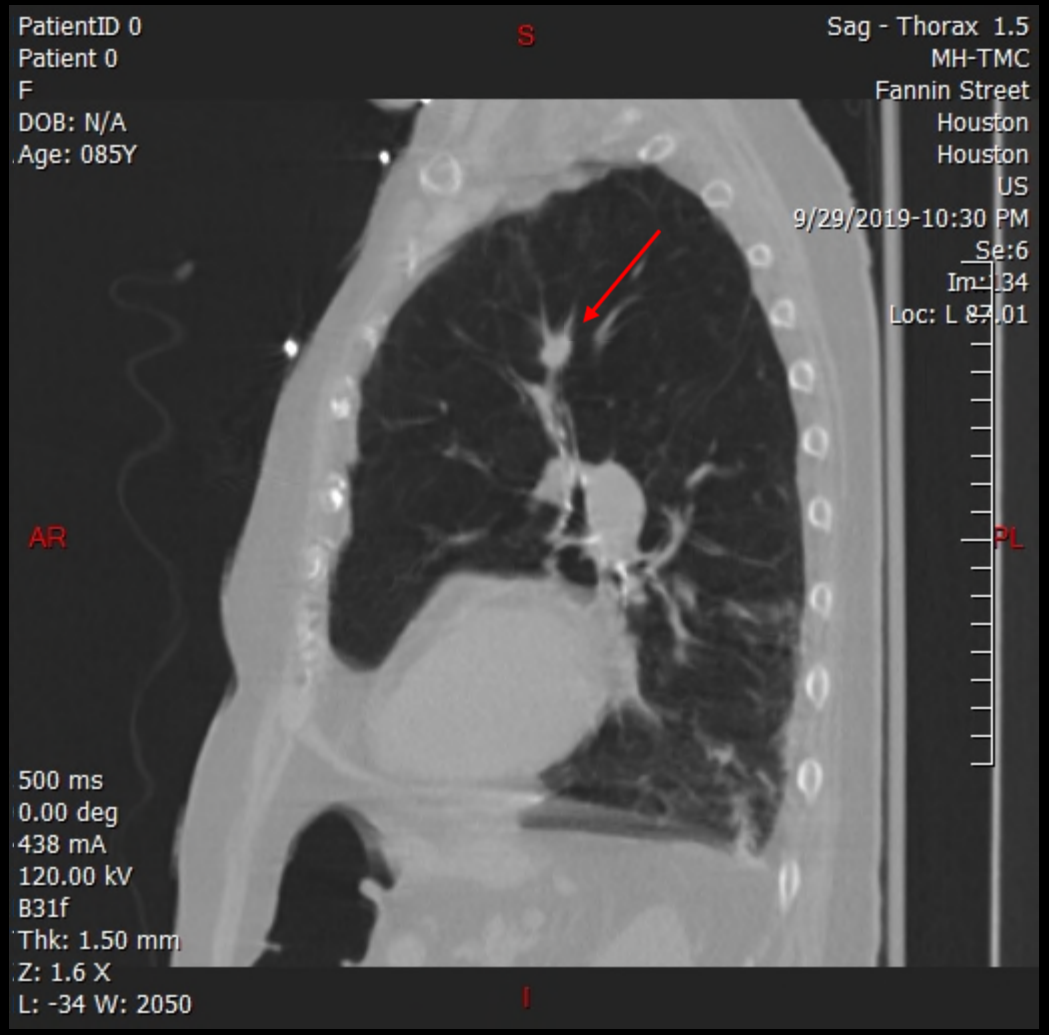
Maximum Intensity Projection (MIP)-Axial



Coronal CT


PatientID 0
Patient 0
F
DOB: N/A
Age: 085Y
S
Cor - Thorax 1.5
MH-TMC
Fannin Street
Houston
Houston
US
9/29/2019-10:30 PM
Se:5
Im:79
Loc: A 149.61
RP
LA
500 ms
0.00 deg
438 mA
120.00 kV
B31f
Thk: 1.50 mm
Z: 1.6 X
L: -335 W: 2007
I

Sagittal CT


PatientID 0
Patient 0
F
DOB: N/A
Age: 085Y
S
Sag - Thorax 1.5
MH-TMC
Fannin Street
Houston
Houston
US
9/29/2019-10:30 PM
Se:6
Im: 34
Loc: L 87.01
AR
PL
500 ms
0.00 deg
438 mA
120.00 kV
B31f
Thk: 1.50 mm
Z: 1.6 X
L: -34 W: 2050
I

Key Findings

1. Left apical nodule concerning for primary pulmonary malignancy in a high risk patient (previous smoker)
    1. Spiculated appearance
2. Confluent centrilobular emphysema

Differential Diagnosis

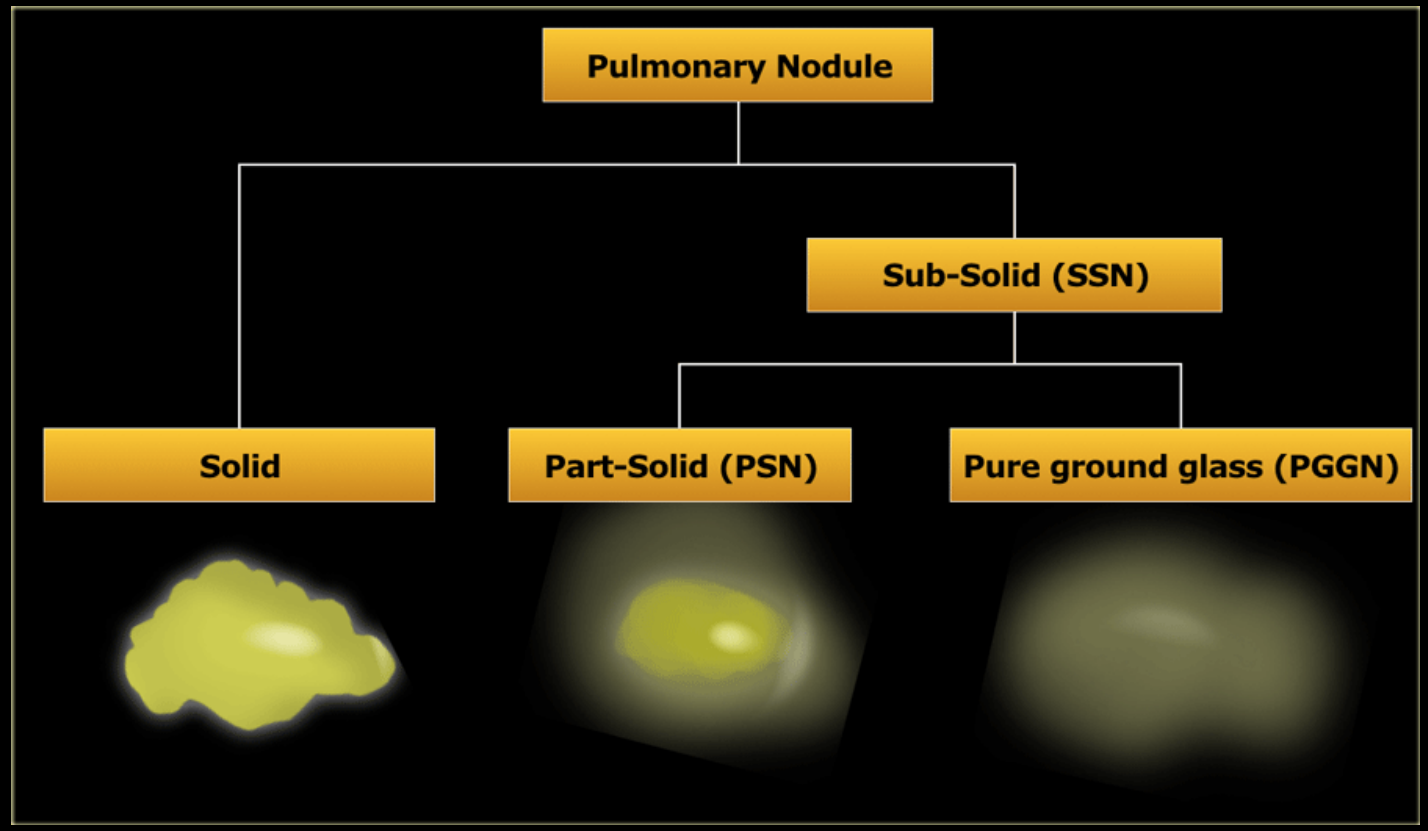
- Benign
  - Granuloma
  - Abscess
  - Cyst
  - Mimics
- Malignant
  - Primary lung cancer
  - Carcinoid tumor
  - Lung metastases

Nodule Size		
Size	Total	Malignancy
< 4 mm	2038	0%
4 - 7 mm	1034	1%
8 - 20 mm	268	15%
> 20 mm	16	75%

Relationship between SPN-size and chance of malignancy in patients with high risk for lung cancer

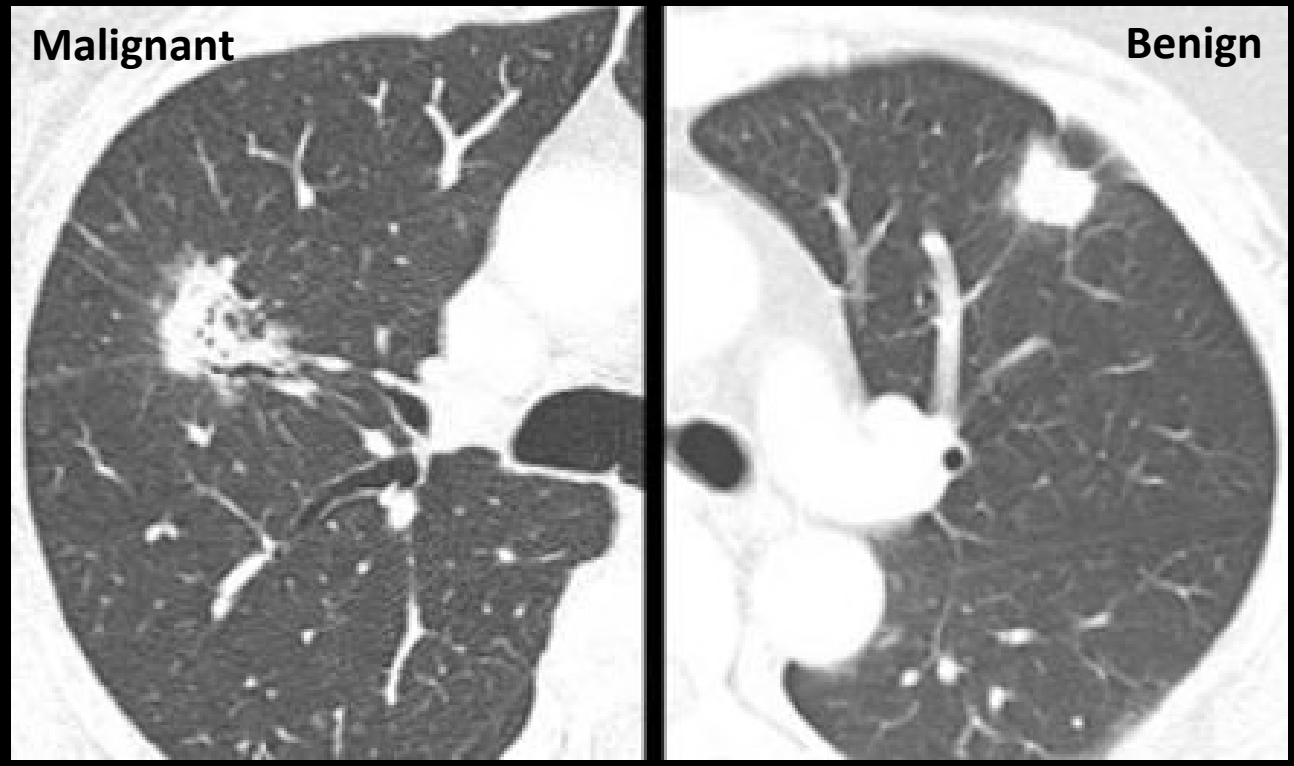
Benign vs. Malignant

- Size
  - Nodule ≤ 3 cm
  - Mass ≥ 3cm
- Morphology
  - Solid
  - Subsolid
    - Part-solid
    - Pure ground-glass
- Rate of Growth



Benign vs. Malignant continued

- Calcification
  - Diffuse
  - Central
  - Laminated
  - Popcorn
- Margin
  - Corona radiata sign
  - Lobulated
  - Smooth
- Contrast Enhancement



Fleischner Guidelines- Solid Nodules

A: Solid Nodules*

Nodule Type	Size <6 mm (<100 mm³)	Size 6–8 mm (100–250 mm³)	Size >8 mm (>250 mm³)	Comments
Single				
Low risk†	No routine follow-up	CT at 6–12 months, then consider CT at 18–24 months	Consider CT at 3 months, PET/CT, or tissue sampling	Nodules <6 mm do not require routine follow-up in low-risk patients (recommendation 1A).
High risk†	Optional CT at 12 months	CT at 6–12 months, then CT at 18–24 months	Consider CT at 3 months, PET/CT, or tissue sampling	Certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-month follow-up (recommendation 1A).
Multiple				
Low risk†	No routine follow-up	CT at 3–6 months, then consider CT at 18–24 months	CT at 3–6 months, then consider CT at 18–24 months	Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk (recommendation 2A).
High risk†	Optional CT at 12 months	CT at 3–6 months, then at 18–24 months	CT at 3–6 months, then at 18–24 months	Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk (recommendation 2A).

Fleischner Guidelines- Subsolid Nodules

B: Subsolid Nodules*

Nodule Type	Size		Comments
	<6 mm (<100 mm³)	≥6 mm (>100 mm³)	
Single			
Ground glass	No routine follow-up	CT at 6–12 months to confirm persistence, then CT every 2 years until 5 years	In certain suspicious nodules < 6 mm, consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection. (Recommendations 3A and 4A).
Part solid	No routine follow-up	CT at 3–6 months to confirm persistence. If unchanged and solid component remains <6 mm, annual CT should be performed for 5 years.	In practice, part-solid nodules cannot be defined as such until ≥6 mm, and nodules <6 mm do not usually require follow-up. Persistent part-solid nodules with solid components ≥6 mm should be considered highly suspicious (recommendations 4A-4C)
Multiple	CT at 3–6 months. If stable, consider CT at 2 and 4 years.	CT at 3–6 months. Subsequent management based on the most suspicious nodule(s).	Multiple <6 mm pure ground-glass nodules are usually benign, but consider follow-up in selected patients at high risk at 2 and 4 years (recommendation 5A).

Final Diagnosis

- Assessment: High risk patient with a nodule measuring 1.6 x 1.1 cm
  - Huge concern for primary bronchogenic carcinoma given her smoking history and the lesion's spiculated appearance
- Diagnosis: undetermined– depends on how the nodule behaves over time and biopsy results
- Plan: Follow up with comparison CT in 3 months before considering lung biopsy

Next Steps

- Important to note: Fleischner Guidelines are meant for those greater than or equal to 35 years of age
- Important considerations in this patient
  - Elderly
  - COPD
- Risks of transthoracic needle lung biopsy
  - Pneumothorax
  - Hemorrhage
  - Tumor seeding
  - Air embolism

ACR appropriateness Criteria

Variant 2: **Solid nodule ≥1 cm, moderate to high clinical suspicion for cancer.**

Radiologic Procedure	Rating	Comments	RRL*
CT chest without IV contrast	8	To detect occult calcifications, fat, bronchus sign, etc.	☢☢☢
FDG-PET/CT whole body	8	If nodule is indeterminate on HRCT.	☢☢☢☢
Transthoracic needle biopsy	8	If nodule shows contrast enhancement or PET scan is positive.	Varies
CT chest with IV contrast	6	Probably not indicated if PET is performed.	☢☢☢
CT chest without and with IV contrast	6	Can look at washout.	☢☢☢
Watchful waiting with CT follow-up	2		Varies
MRI chest without IV contrast	2	Limited data.	O
MRI chest without and with IV contrast	2	Limited data.	O

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Cost of Imaging

Description	Typical Charges	Average Insured Patient Responsibility
Chest Xray Exam 1 View	$683	$250
Chest Xray Exam 2 Views	$762	$261
Ct Angio Chest W/O-W Con	$4,506	$294
Ct Chest W/Con	$3,936	$432
Ct Chest W/O Con	$3,788	$442
Ct Chest W/O-W Con	$5,326	-
Us Chest	$903	$137

https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/

Follow Up

- Patient was discharged on 10/15 to Houston Hospice due to deteriorating condition
- Highlights the importance of considering the patient and their condition when deciding treatment options

Discussion

- As use of CT continues to rise for a variety of indications including lung cancer screening, more and more patients will have a pulmonary nodule detected
- Patients and their providers must decide whether or not to pursue transthoracic needle biopsy
- Radiologists must outweigh the risks and benefits of additional imaging and procedures including potential complications and cost

Take Home Points

- Pulmonary nodules are frequently encountered incidentally on chest CT
- The Fleischner Criteria is a useful tool when dealing with pulmonary nodule and planning out the best course of action
- When evaluating pulmonary nodules, consider: size, number, morphology, rate of growth, margins, calcification, and contrast enhancement
- The role of the radiologist is to separate between benign and malignant lesions and advise on follow-up imaging or additional invasive imaging techniques

References

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- https://pubs.rsna.org/doi/10.1148/radiol.2017161659#tbl1
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Questions?

Thank you!