

LUNG-RADS 1.1- A case based review: What's new?

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Disclosure of Commercial Interest

Neither I, my co-authors nor my immediate family members have a financial relationship with a commercial organization that may have a direct or indirect interest in the contents of this presentation.

Goals and Objectives

1. Lung cancer screening rationale
2. Eligibility
3. LUNG-RADS scoring system
4. Illustrative cases
5. Highlight of the changes in 1.1

Target Audience

1. General & Thoracic Radiologists
2. Radiology Residents & Fellows

Introduction

- Lung cancer is the 2nd most common cancer in both sex
- Approximately quarter million new cases and 150,000 deaths (2018)
- Approximately 14% of all cancers but 25% of all cancer mortality
- Overall 5 year survival 18% (diagnosed between 2003-2009)
- Median age: 70 years
- 88% of all lung cancers occur at age >55 years
- Approximately 90% of lung cancers are attributable to smoking

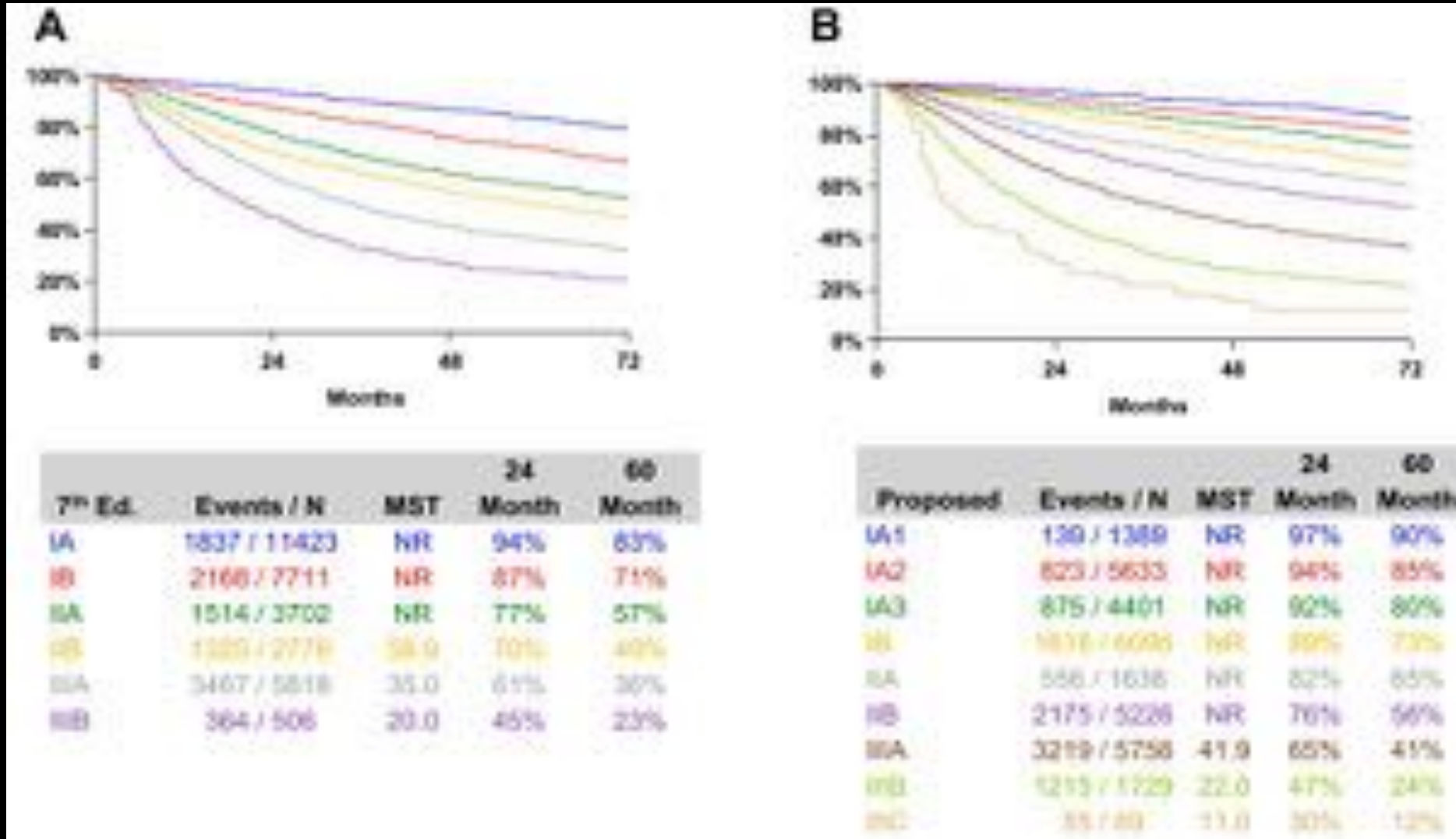
Survival SEER Data

5 year relative survival for NSCLC

5 year relative survival for SCLC

SEER stage	5-year relative survival rate	SEER stage	5-year relative survival rate
Localized	60%	Localized	29%
Regional	33%	Regional	15%
Distant	6%	Distant	3%
All SEER stages combined	23%	All SEER stages combined	6%

Survival AJCC 7 vs AJCC 8



Goldstraw P et al. The IASLC Lung Cancer Staging Project: Proposals for Revision of the TNM Stage Groupings in the Forthcoming (Eighth) Edition of the TNM Classification for Lung Cancer. J Thorac Oncol. 2016 Jan;11(1):39-51.

Screening improves survival

The **NEW ENGLAND**
JOURNAL *of* **MEDICINE**

ESTABLISHED IN 1812

AUGUST 4, 2011

VOL. 365 NO. 5

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

The National Lung Screening Trial Research Team*

Dutch-Belgian Randomized **Lung Cancer** Screening **Trial** (Dutch acronym: **NELSON**)

National Lung Screening Trial (NLST)

- CT screening- 26,309 versus X ray screening 26,732
- Follow up for 5 years
- Positive screening – Nodule > 4 mm in largest axis
- In the CT group:
 - Positive screening test – 27.3%
 - False positive 96.4%
 - Cancer diagnosis – 1.1%
 - Stage I cancer – 58.3%
 - Relative reduction in mortality 20%
 - Number needed to treat (NNT) = 320

<u>Nodule size</u>	<u>PPV</u>
4-6mm	0.5
7-10mm	1.7
10-20mm	11.9
20-30mm	29.7
>30mm	41.3

Chance of malignancy proportional to size

NNT for breast cancer screening 1339!

Eligibility

- Age 55 – 80 years (USPTF) **Up to 77 years per CMS**
- Asymptomatic (no signs or symptoms of lung cancer)
- Smoking > 30 pack-years
- Current smoker or quit smoking < 15 years

CMS: Radiology Imaging Facility Eligibility Criteria

- Performs LDCT with volumetric CT dose index (CTDI_{vol}) of ≤ 3.0 mGy for standard size patients (defined to be 5' 7" and approximately 155 pounds) with appropriate reductions in CTDI_{vol} for smaller patients and appropriate increases in CTDI_{vol} for larger patients
- Utilizes a standardized lung nodule identification, classification and reporting system
- Makes available smoking cessation interventions for current smokers
- Collects and submits data to a CMS-approved registry for each LDCT lung cancer screening performed

LUNG-RADS

- Lung CT Screening Reporting and Data System
- Developed by American College of Radiology (ACR)
- First version in April 2014, version 1.0
- For standardized reporting and management recommendations
- Categorized nodules based predominantly on size
- Solid vs ground glass vs mixed
- Categories 0-4 (Cat 0 is incomplete study)
- Higher category corresponds to higher chance of malignancy
- Recently updated in January 2019, version 1.1

1.0 vs 1.1: Changes in Category 2

solid nodule(s): < 6 mm new < 4 mm
part solid nodule(s): < 6 mm total diameter on baseline screening
non solid nodule(s) (GGN): < 20 mm OR ≥ 20 mm and unchanged or slowly growing
category 3 or 4 nodules unchanged for ≥ 3 months

Perifissural nodule(s) (See Footnote 11) < 10 mm (524 mm ³)
Solid nodule(s): < 6 mm (< 113 mm ³) new < 4 mm (< 34 mm ³)
Part solid nodule(s): < 6 mm total diameter (< 113 mm ³) on baseline screening
Non solid nodule(s) (GGN): < 30 mm (< 14137 mm ³) OR ≥ 30 mm (≥ 14137 mm ³) and unchanged or slowly growing
Category 3 or 4 nodules unchanged for ≥ 3 months

Category 2

1.0 vs 1.1: Change in Category 3

3	solid nodule(s): ≥ 6 to < 8 mm at baseline OR new 4 mm to < 6 mm	6 month LDCT
	part solid nodule(s) ≥ 6 mm total diameter with solid component < 6 mm OR new < 6 mm total diameter	
	non solid nodule(s) (GGN) ≥ 20 mm on baseline CT or new	

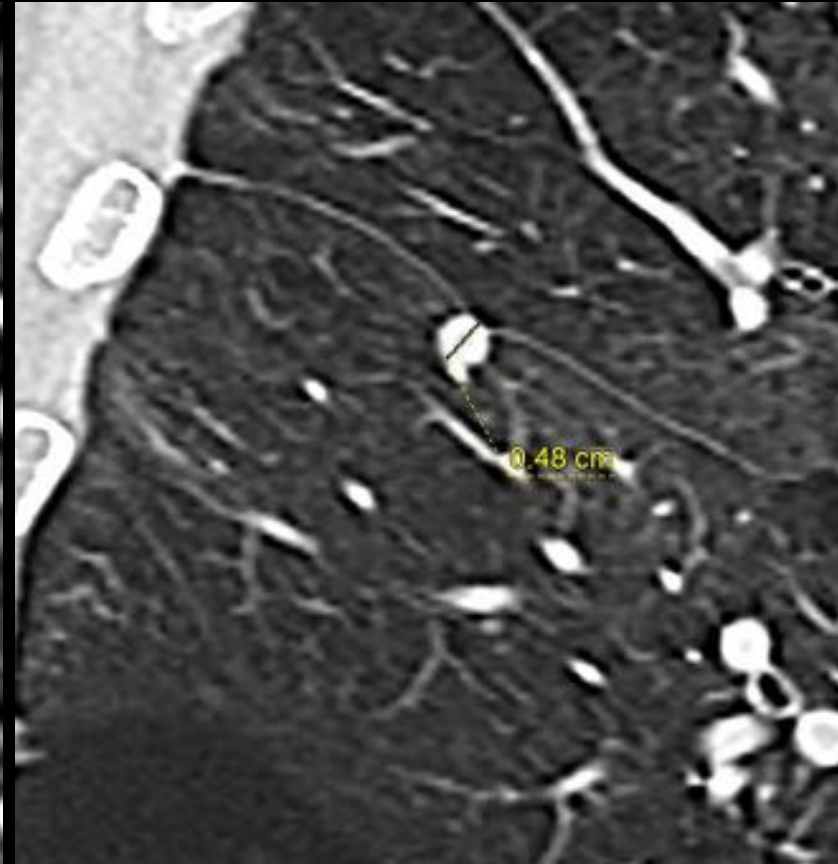
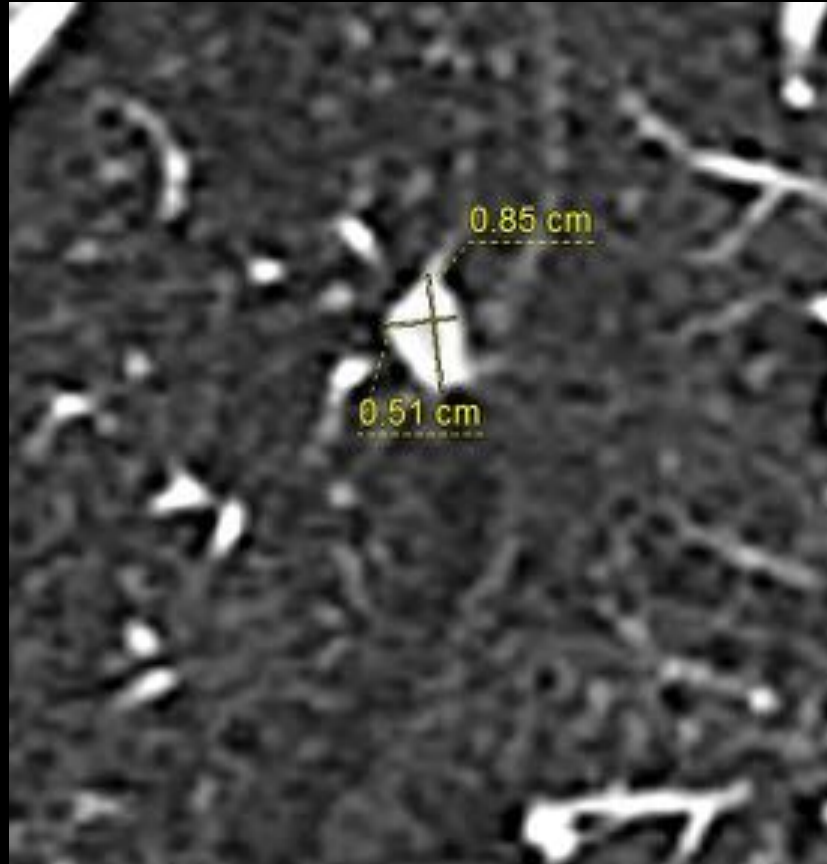
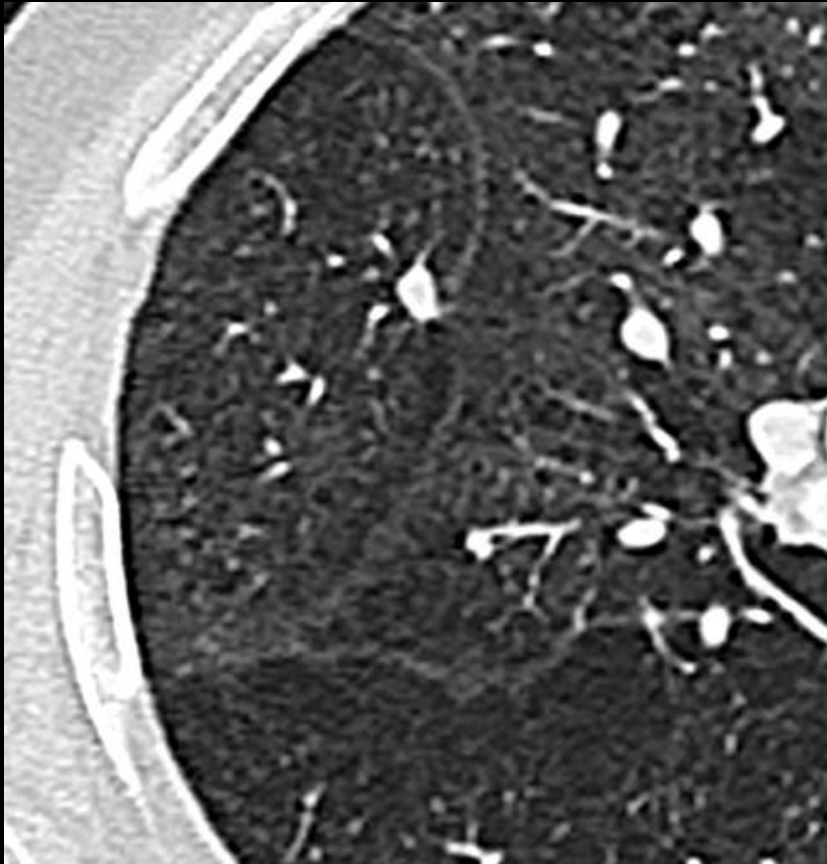
Probably Benign Probably benign finding(s) - short term follow up suggested; includes nodules with a low likelihood of becoming a clinically active cancer	3	Solid nodule(s): ≥ 6 to < 8 mm (≥ 113 to < 268 mm ³) at baseline OR new 4 mm to < 6 mm (34 to < 113 mm ³)	6 month LDCT
		Part solid nodule(s) ≥ 6 mm total diameter (≥ 113 mm ³) with solid component < 6 mm (< 113 mm ³) OR new < 6 mm total diameter (< 113 mm ³)	
		Non solid nodule(s) (GGN) ≥ 30 mm (≥ 14137 mm ³) on baseline CT or new	

1.0 vs 1.1: Change in Category 4B

4B	solid nodule(s) ≥ 15 mm OR new or growing, and ≥ 8 mm	chest CT with or without contrast, PET/CT and/or tissue sampling depending on the *probability of malignancy and comorbidities. PET/CT may be used when there is a ≥ 8 mm solid component.
	part solid nodule(s) with: a solid component ≥ 8 mm OR a new or growing ≥ 4 mm solid component	
4X	Category 3 or 4 nodules with additional features or imaging findings that increases the suspicion of malignancy	

Very Suspicious Findings for which additional diagnostic testing and/or tissue sampling is recommended	4B	Solid nodule(s) ≥ 15 mm (≥ 1767 mm ³) OR new or growing, and ≥ 8 mm (≥ 268 mm ³)	Chest CT with or without contrast, PET/CT and/or tissue sampling depending on the *probability of malignancy and comorbidities. PET/CT may be used when there is a ≥ 8 mm (≥ 268 mm ³) solid component. <i>For new large nodules that develop on an annual repeat screening CT, a 1 month LDCT may be recommended to address potentially infectious or inflammatory conditions</i>
	4X	Part solid nodule(s) with: a solid component ≥ 8 mm (≥ 268 mm ³) OR a new or growing ≥ 4 mm (≥ 34 mm ³) solid component	
	4X	Category 3 or 4 nodules with additional features or imaging findings that increases the suspicion of malignancy	

Case 1



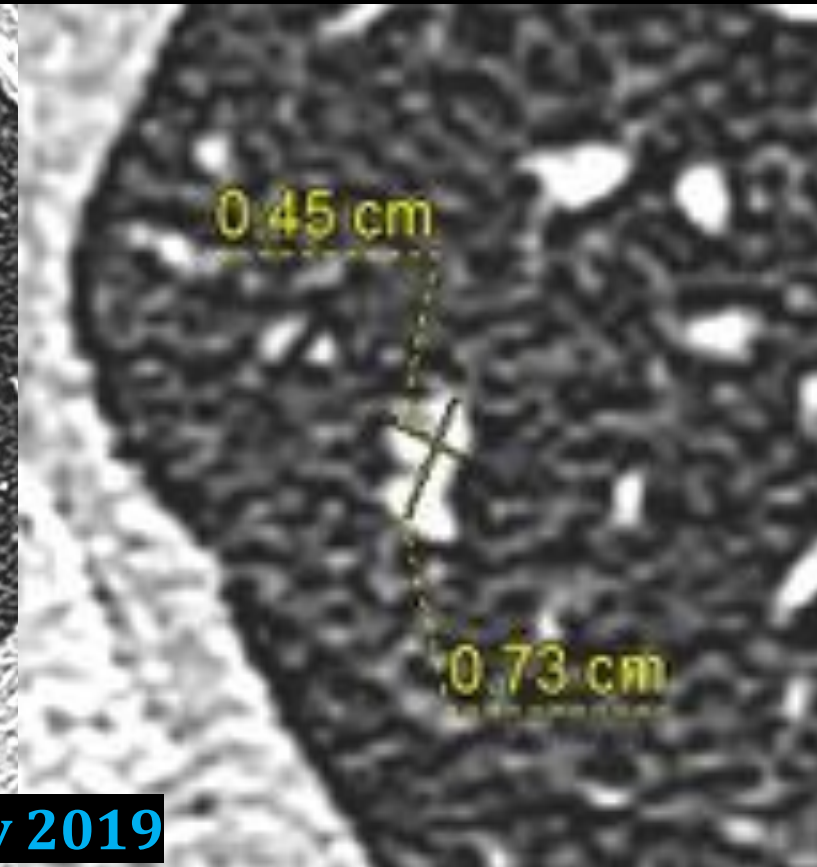
Version 1.0

- Right middle lobe solid 7 mm nodule
- LUNG RADS 3
- CT in 6 months

Version 1.1

- Perifissural nodule measuring 6.8 mm
- Volume 164 cc
- LUNG RADS 2
- Continue annual CT screening

Case 2



Version 1

- **New 6 mm solid nodule**
- LUNG RADS 4a
- Recommendation CT in 3 months

Version 1.1

- **New 5.9 mm solid nodule**, vol 107 cc
- LUNG RADS 3
- Recommendation CT in 6 months

What's different?

1. Addition of perifissural nodule in the nomenclature

Location : Along the fissure

Margin: Smooth

Shape: Oval or Lentiform or Triangular

All perifissural nodule < 10 mm should be considered LUNG-RADS 2

Rationale:

Data from NELSON trial, PANCAN and BCCA study

Risk of perifissural nodule < 10 mm developing cancer is 0%

2. Change in the measurement recommendation

Average of measurements of long and short axis

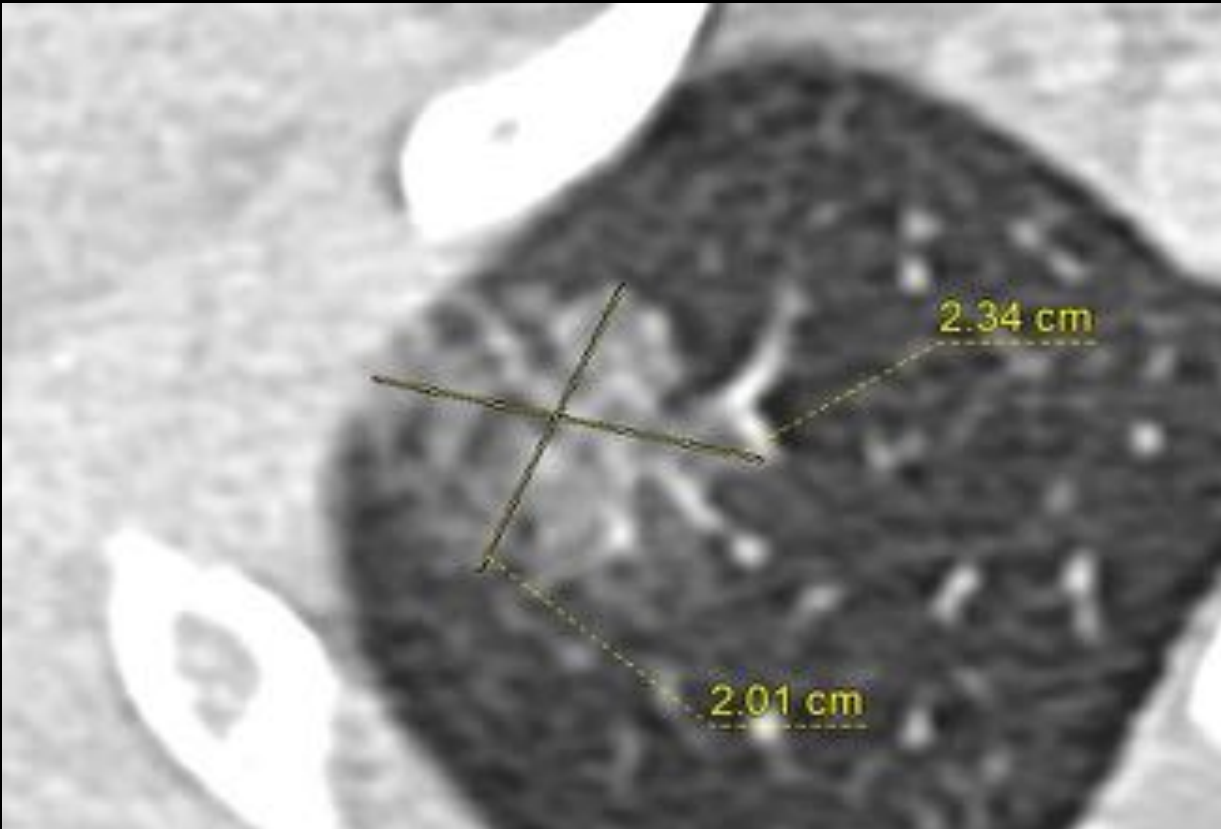
Measurement up to one decimal

3. Mention volumetric measurements in addition to two dimensional measurement

Rationale:

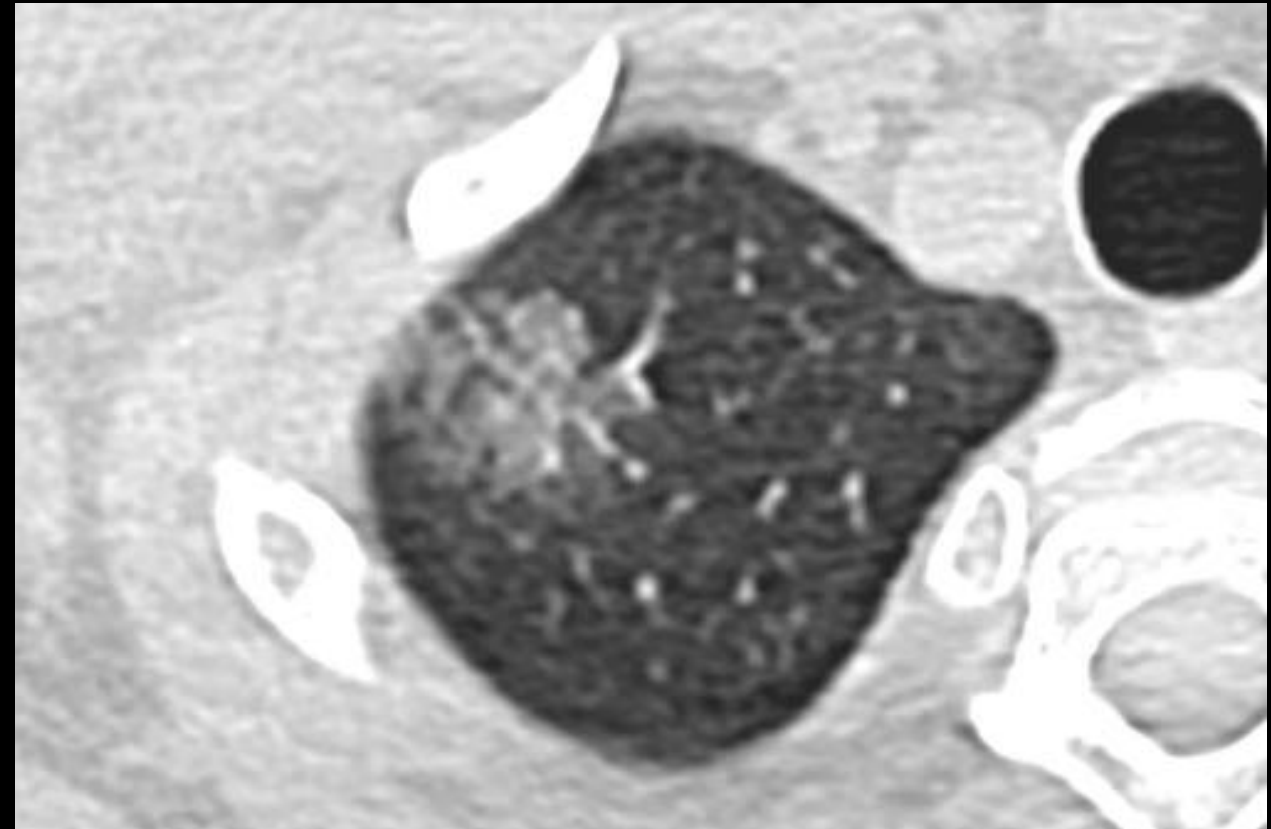
Gives better estimate of growth

Case 3



Version 1

- Ground glass nodule 22 mm
- LUNG RADS 3
- Follow up CT in 6 months



Version 1.1

- Ground glass nodule 21.8 mm, vol 5424 cc
- LUNG RADS 2
- Continue annual CT screening

What's different?

4. For ground glass nodule LUNG-RADS 2 cut off changed from < 20 mm to < 30 mm

Rationale:

90% of lesions don't grow

Doubling time usually > 2years

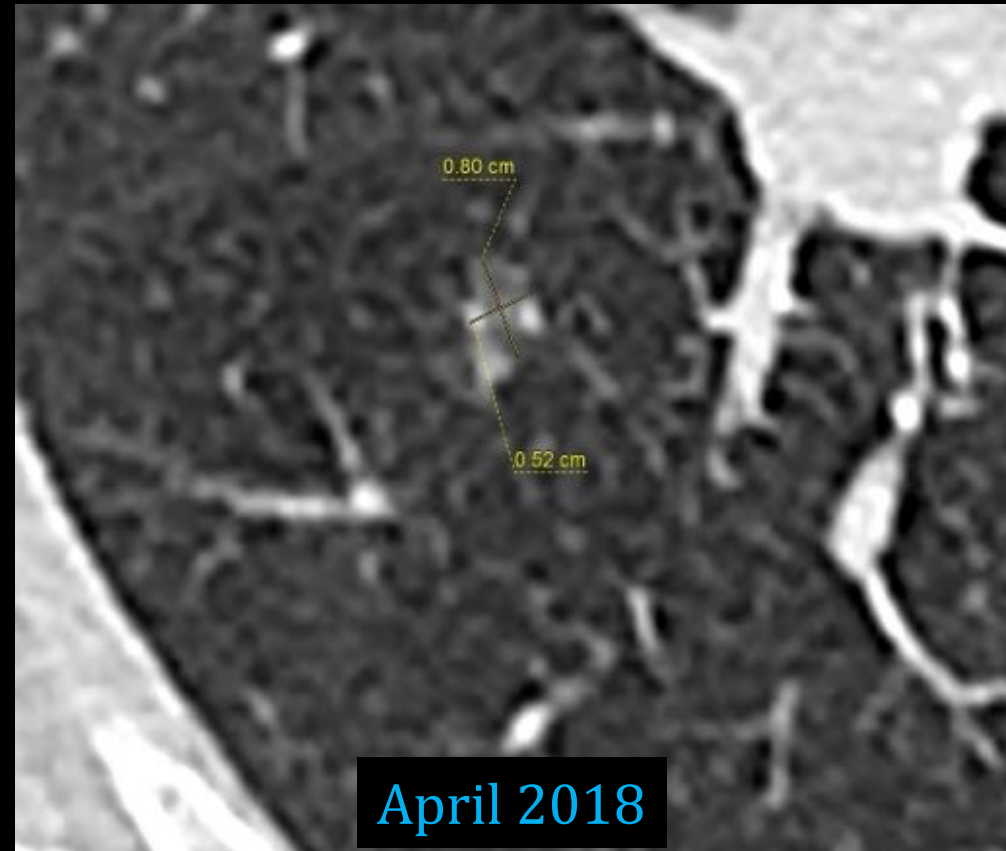
New solid component is a marker of invasive malignancy

5. C- modifier category has been removed

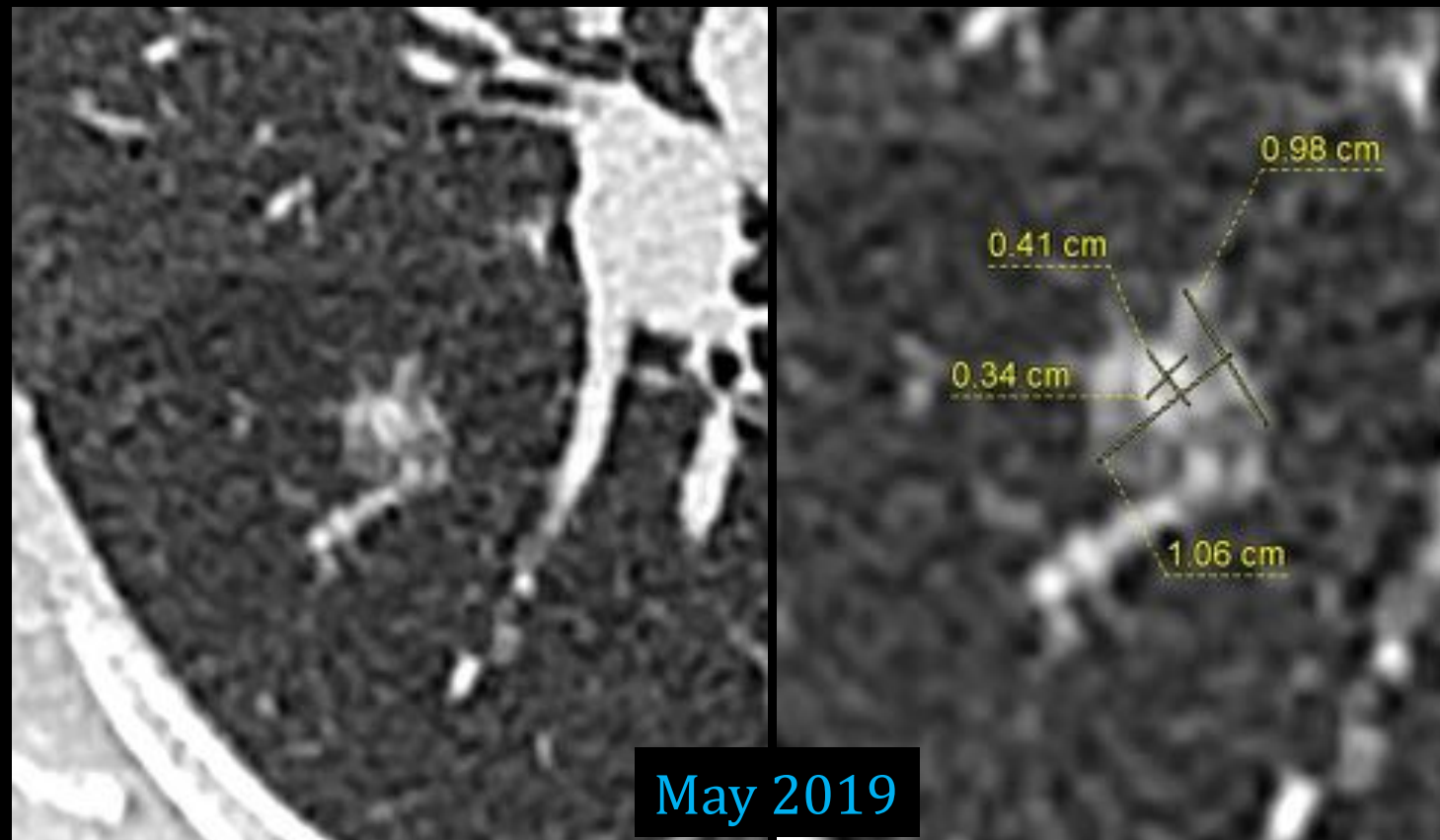
Rationale:

Imaging post treatment of lung cancer is surveillance, not screening

Case 4

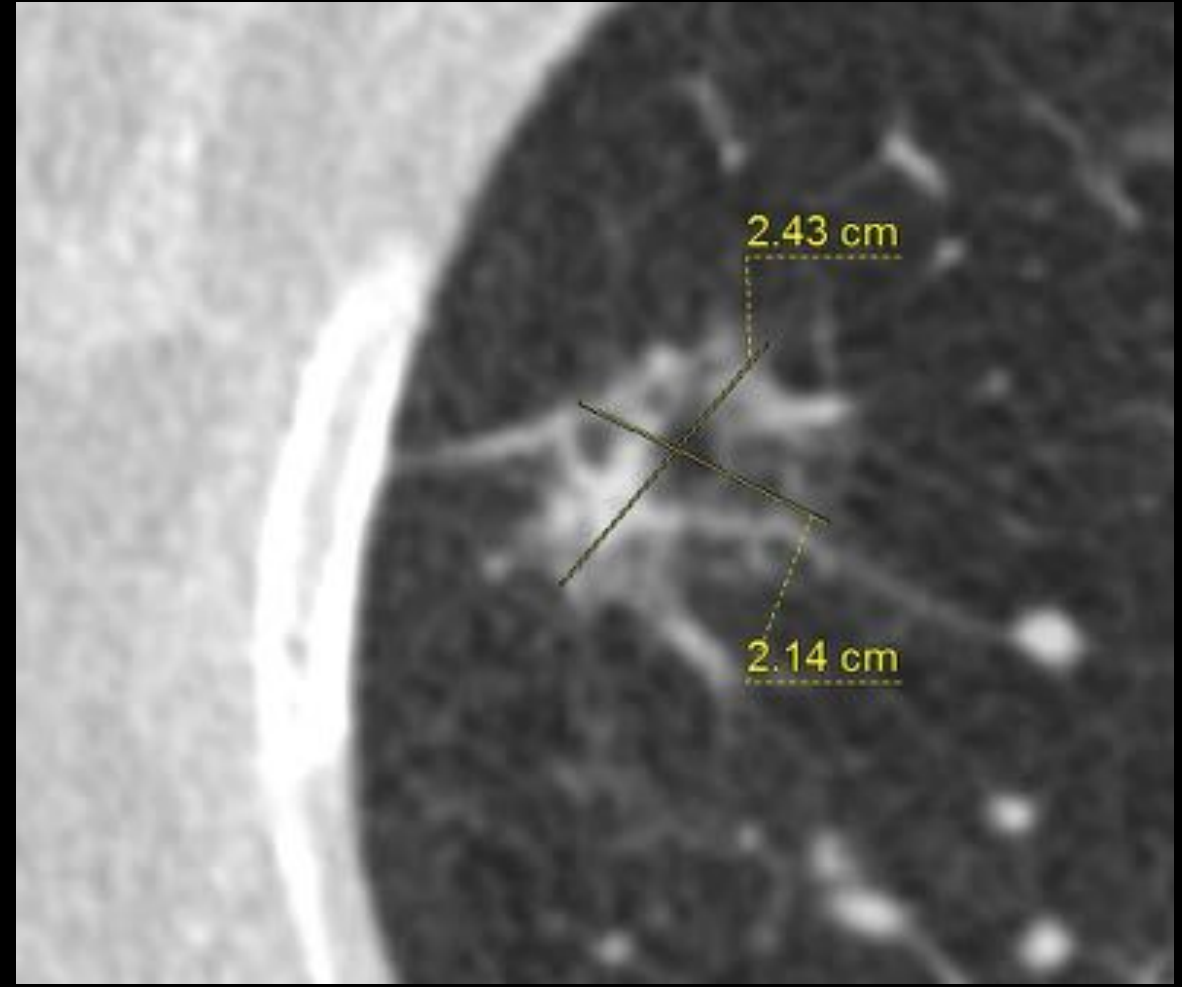
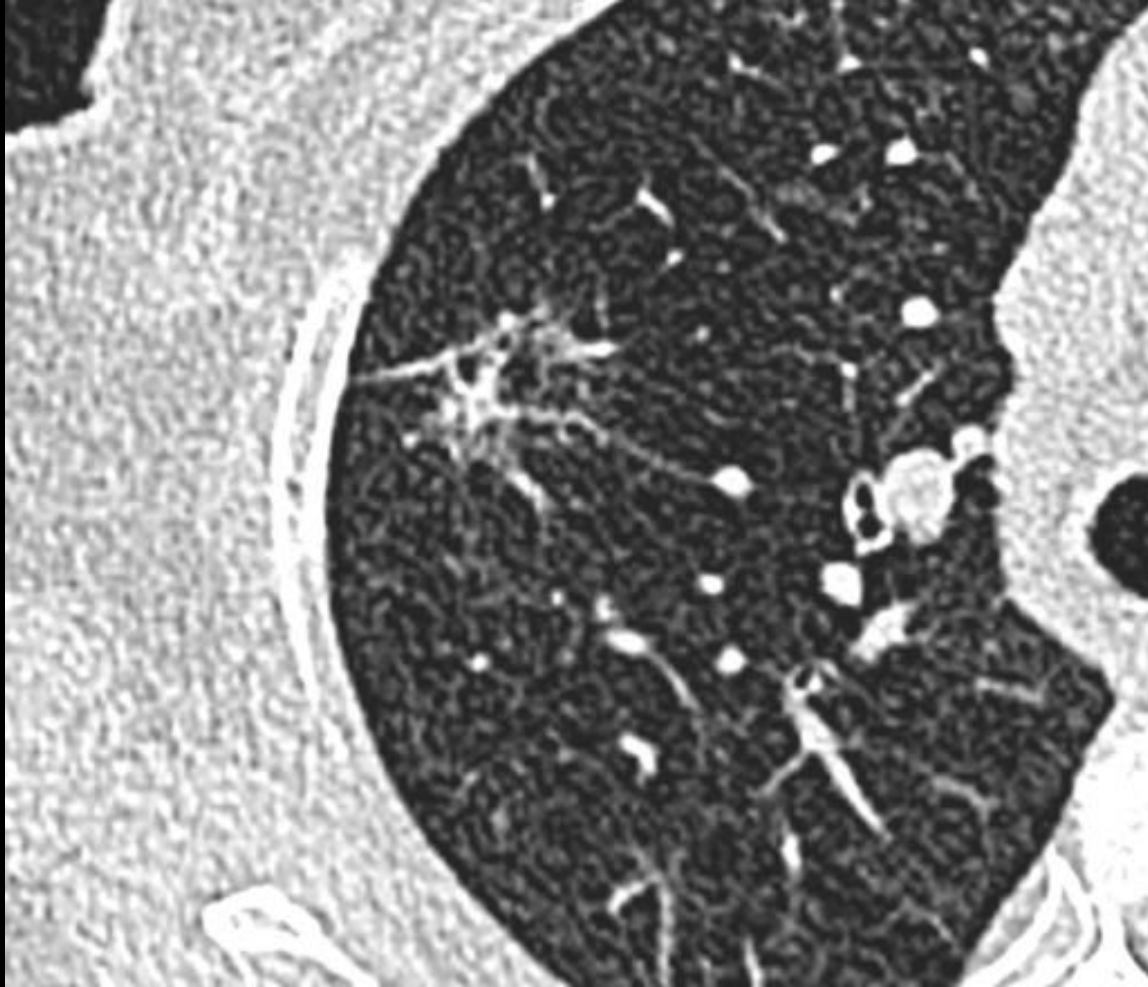


- 6.6 mm Ground glass nodule (GGN)
- Estimated volume 150 cc
- LUNG-RADS 2
- Recommend annual screening



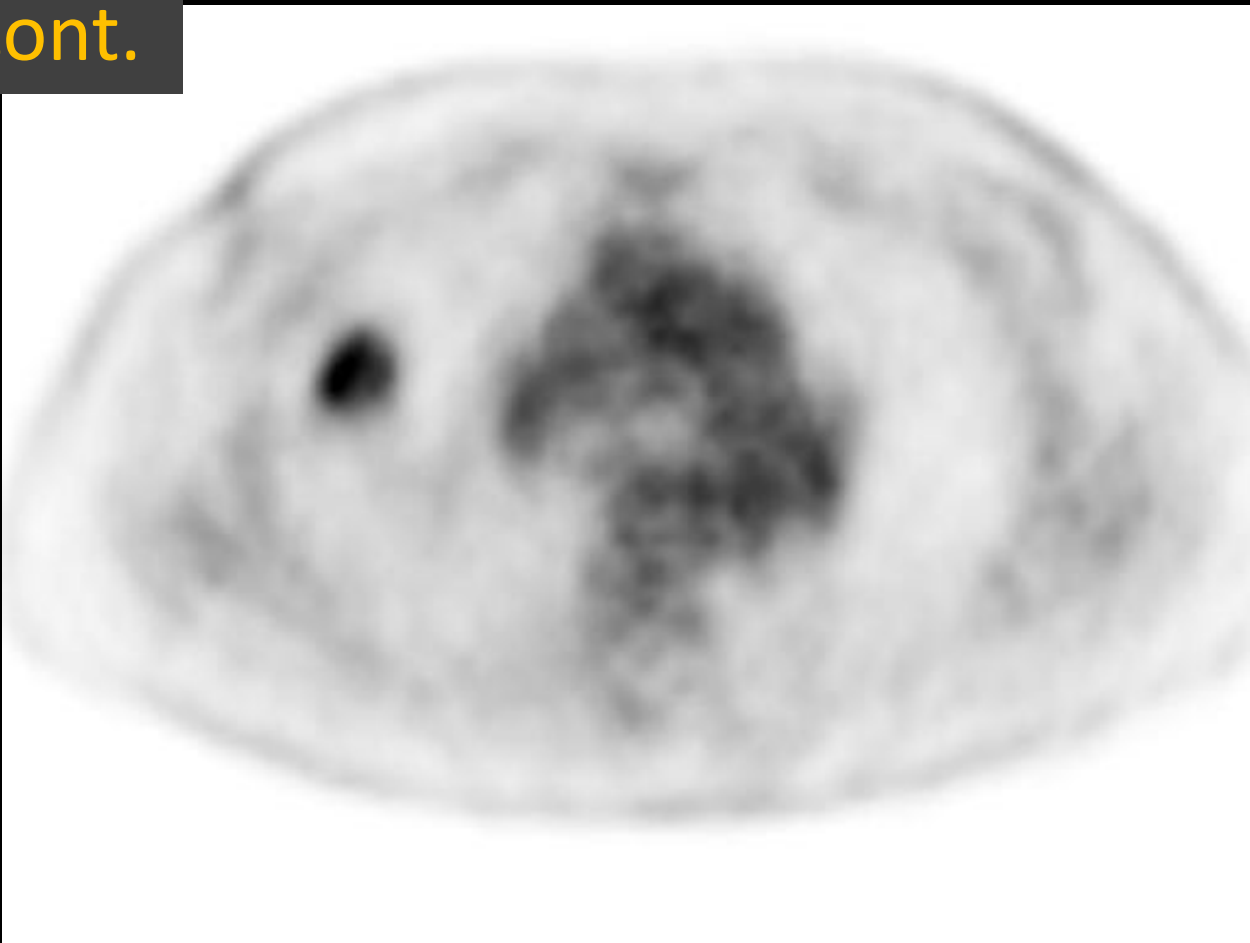
- Enlarging GGN measuring 10.2 mm, vol 555 cc
- New 3.8 mm solid component, vol 28 cc
- LUNG-RADS 4a
- Recommend CT in 3 months

Case 5



- Part solid nodule: Overall 22.9 mm with 10 mm solid component
- LUNG-RADS 4b
- Recommend PET-CT and biopsy

Cont.



PET-CT- Increased FDG uptake in the nodule
SUVmax of 4.5
Biopsy - Adenocarcinoma

Teaching point:

- In ground glass nodule- Large solid component or growing solid component is suspicious for invasive cancer
- PET-CT is recommended if solid component > 8mm

LUNG-RADS: 4a

Solid component ≥ 6 mm to < 8 mm

OR

New or growing solid component < 4 mm

LUNG-RADS: 4b

Solid component ≥ 8 mm

OR

New/growing solid component ≥ 4 mm

Case 6

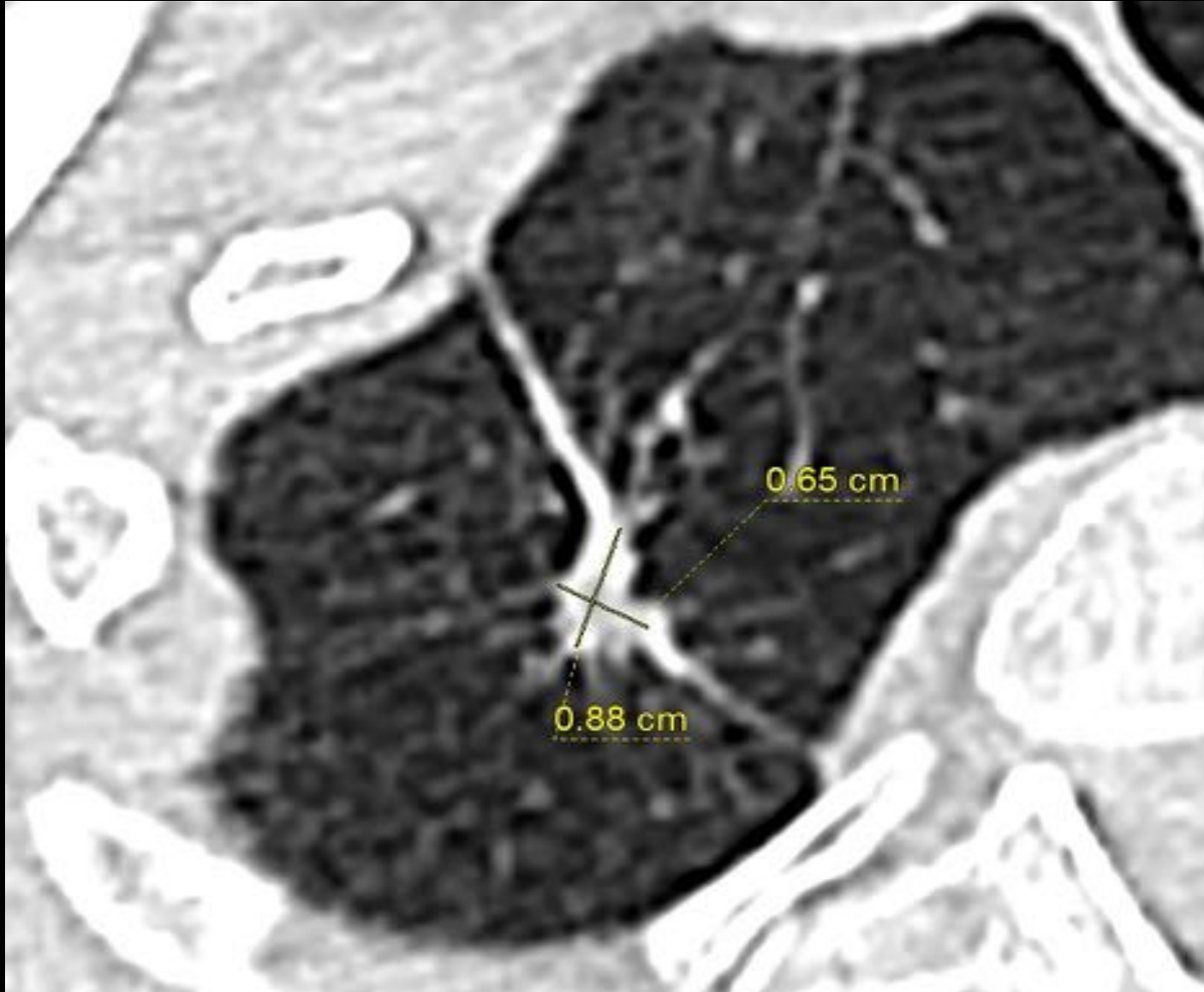


- Solid 3 mm nodule
- Estimated volume 14 cc
- LUNG-RADS 2
- Recommend annual CT screening



- Interval growth of Solid nodule now 6 mm
- Estimated volume 113 cc
- LUNG-RADS 4a
- Recommend CT in 3 months

Cont.



- Enlarging nodule 7.7 mm from previous 6 mm
- Estimated volume 239 cc from previous 113 cc
- LUNG-RADS 4b
- Recommend PET-CT

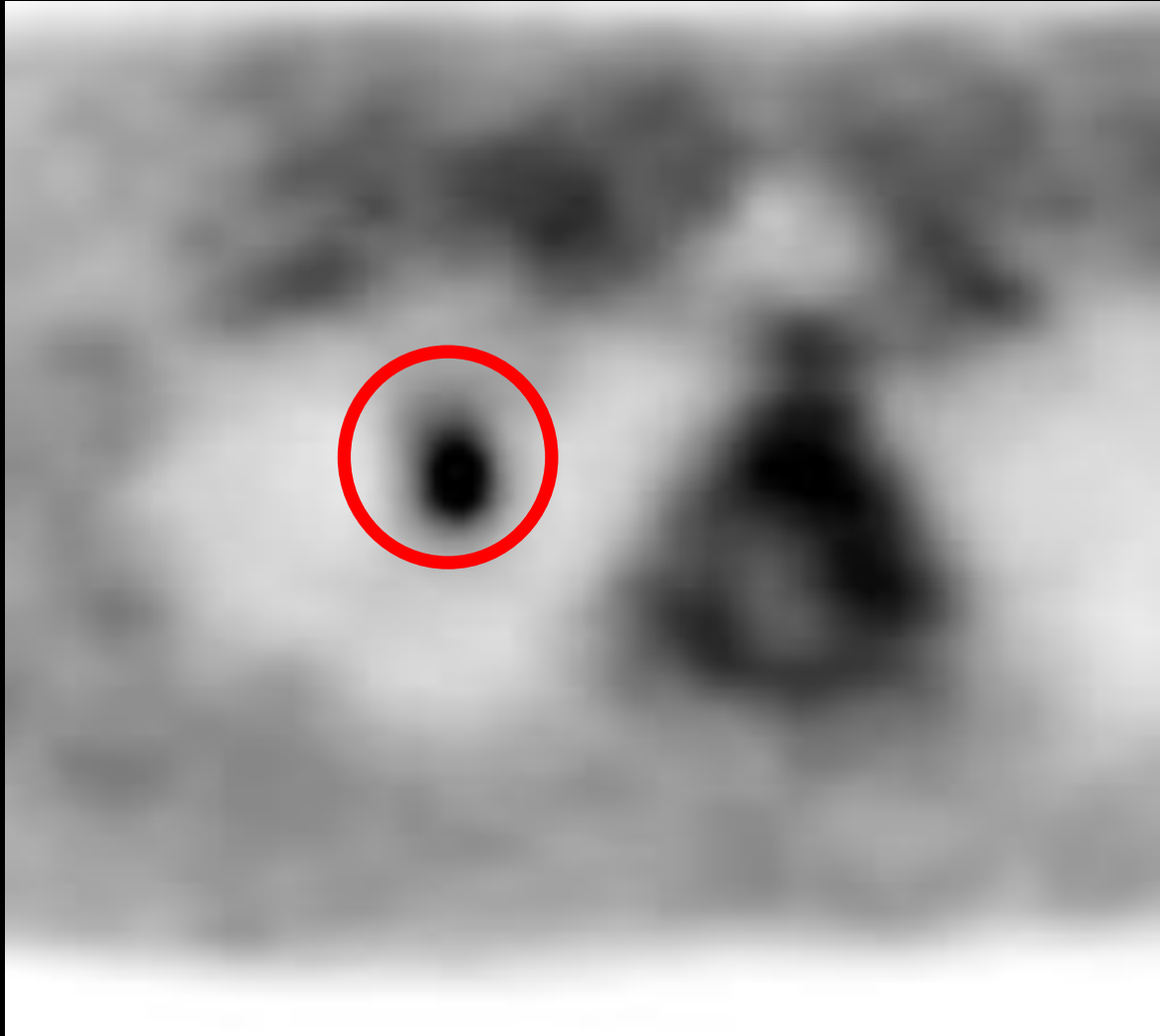
Size: 6mm -> 7.7 mm

Vs

Volume: 113cc -> 239 cc

June 2018

Cont.

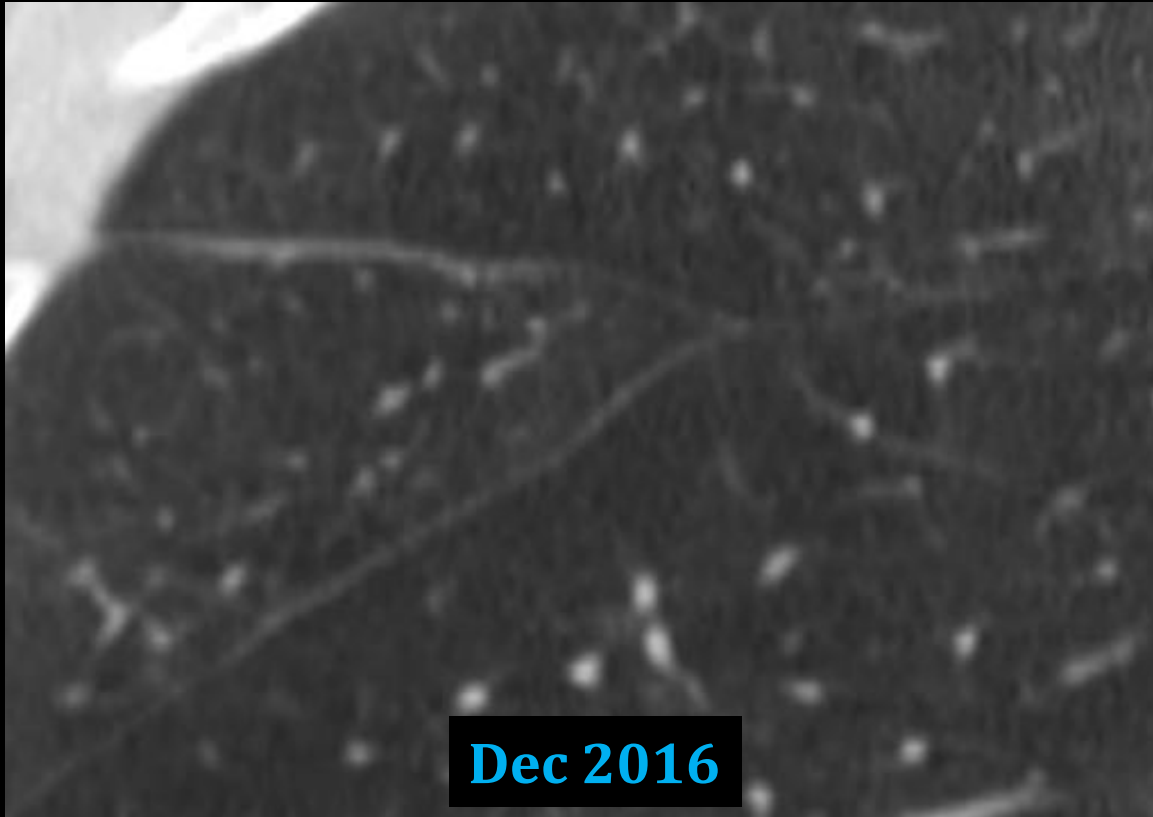


Teaching point:

- **At least 1.5 mm growth is required to account for measurement errors**
- **Volumetric measurements give a better estimate of doubling**
- **Mean doubling time of Adenocarcinoma is approximately 160 days**

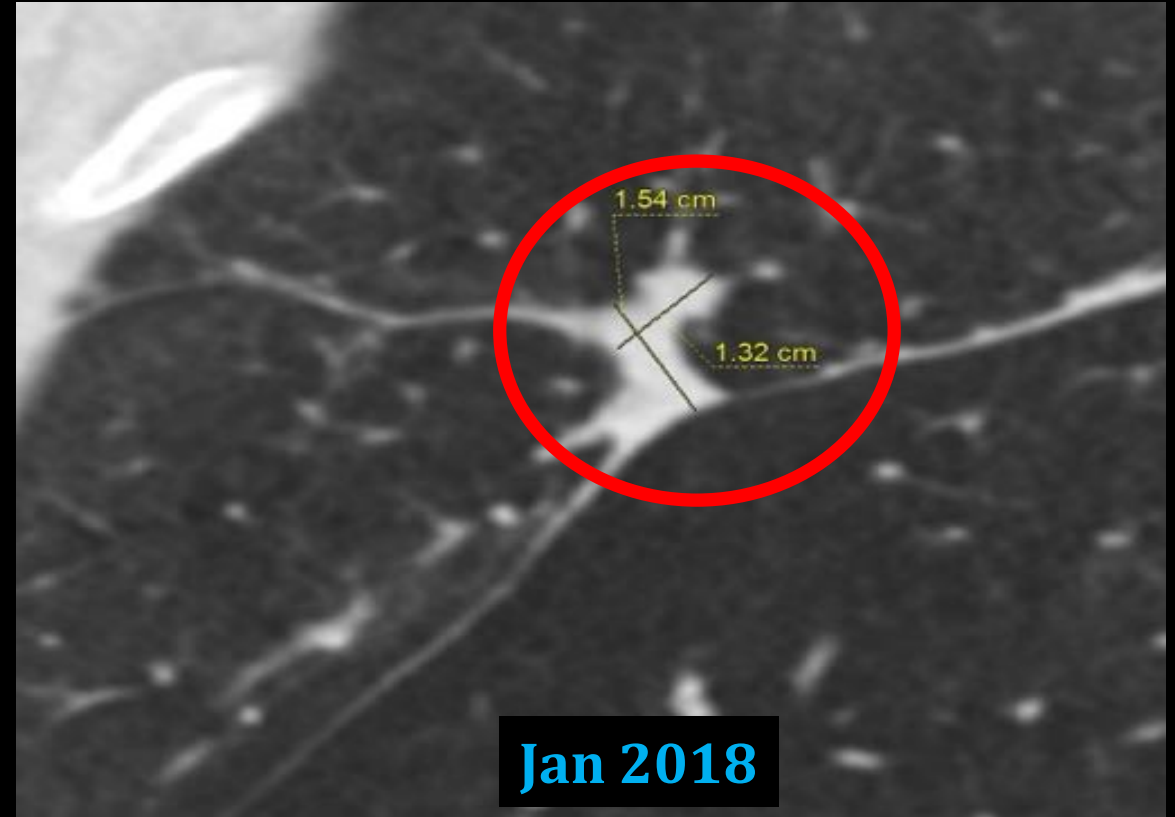
PET showing **increased FDG uptake SUVmax 5.5**
Biopsy showed Adenocarcinoma

Case 7



Version 1.0

- **New solid nodule measuring 14 cc**
- LUNG-RADS 4b
- Recommendation PET-CT or biopsy



Version 1.1

- New solid perifissural nodule measuring 14.3 mm, Vol 1531 cc
- LUNG-RADS 4b
- Recommendation CT in 1 month

Cont.

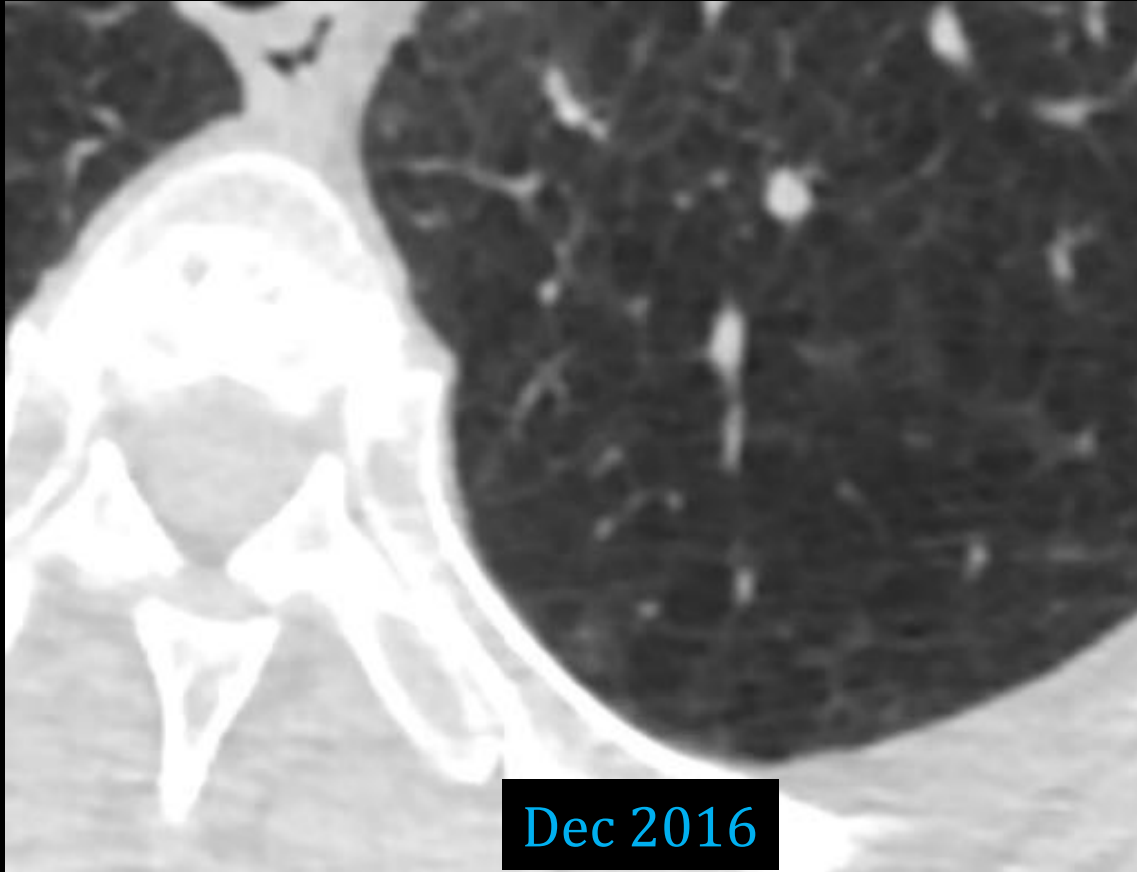


Follow up CT after 2 months show **resolution of the nodule**

Teaching Point:

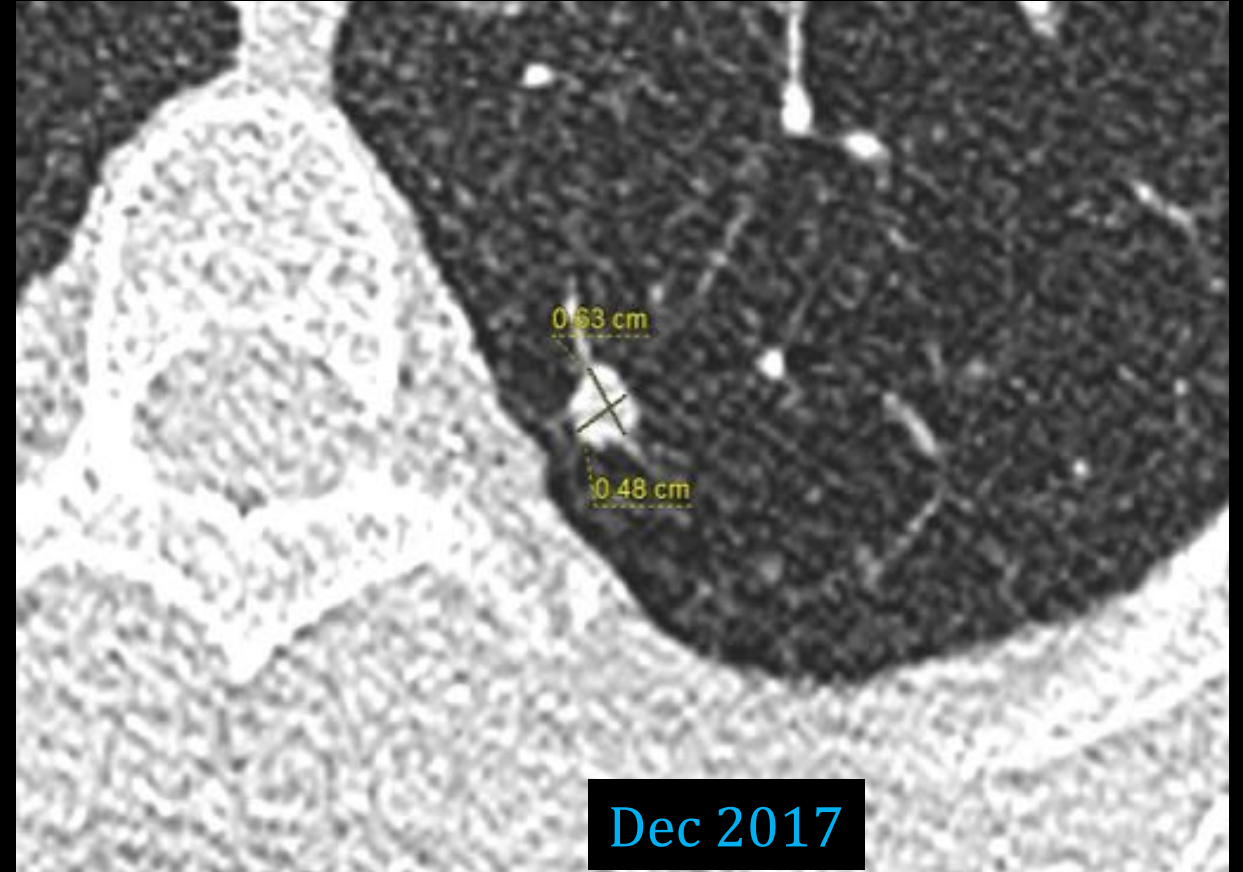
For new Cat 4b nodule that develop on an annual repeat screening CT, a 1 month LDCT may be recommended to address potentially infectious or inflammatory conditions

Case 8



Version 1.0

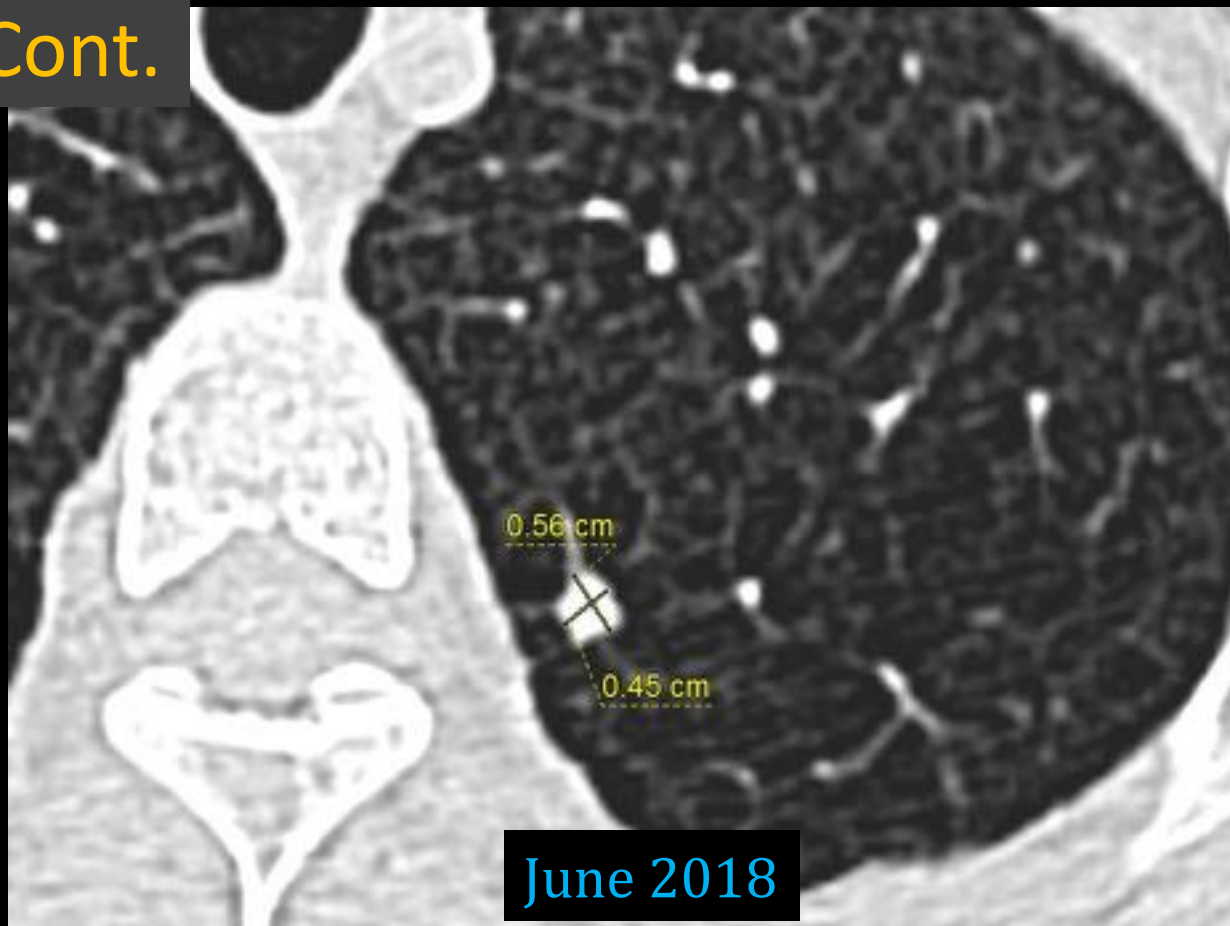
- New nodule measuring 6 mm
- LUNG-RADS 4a
- Recommend CT in 3 months



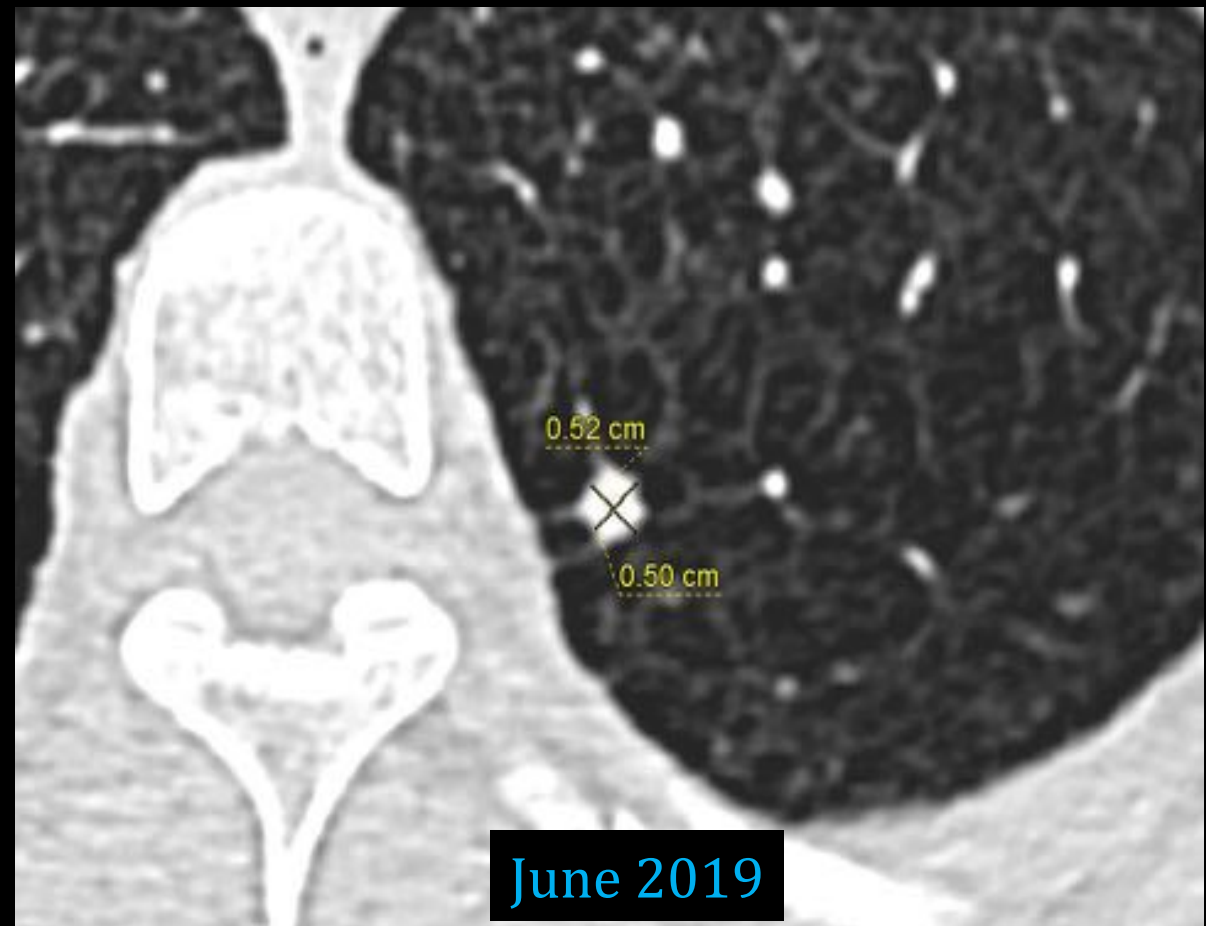
Version 1.1

- New nodule measuring 55 mm, vol 87 cc
- LUNG-RADS 3
- Recommend CT in 6 months

Cont.



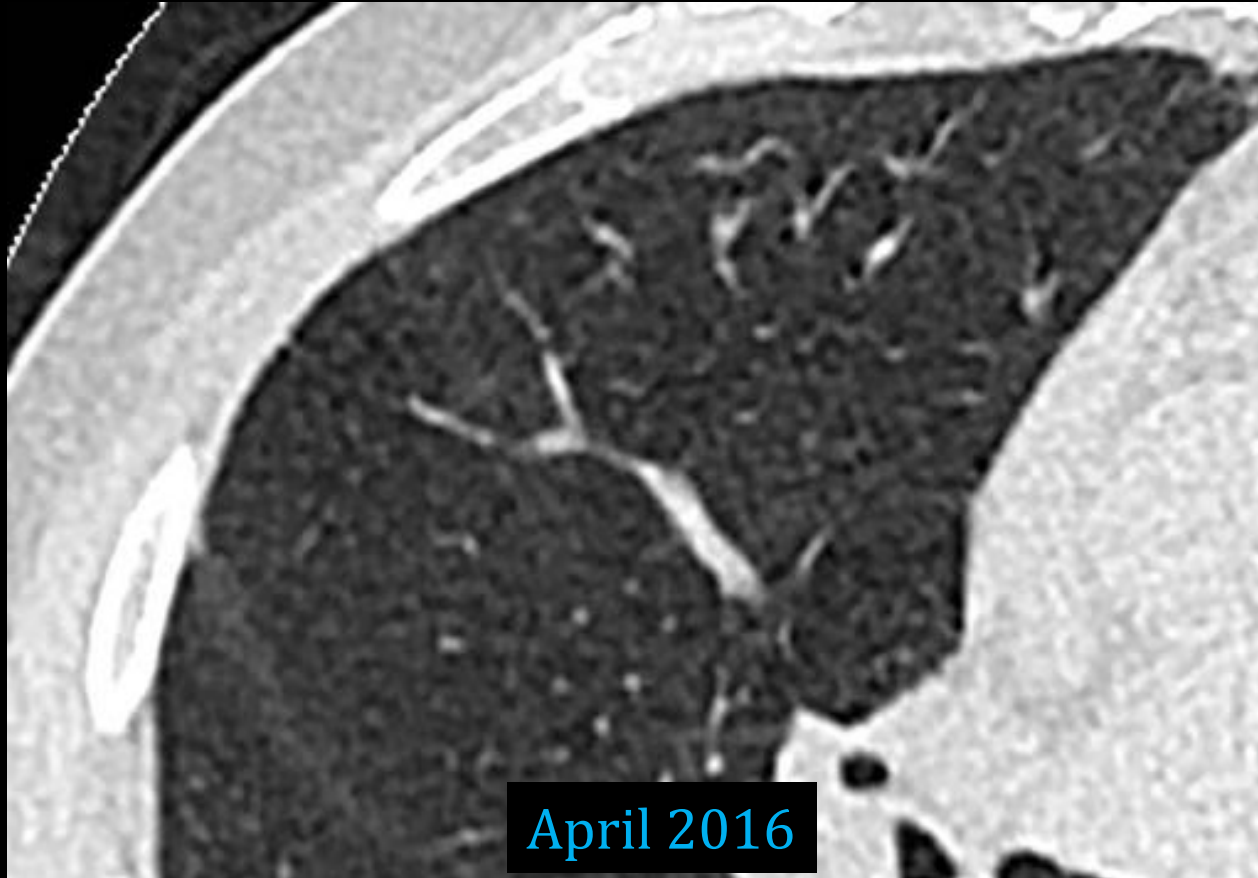
- 5 mm nodule- stable over 6 months
- LUNG-RADS: 2
- Continue annual screening



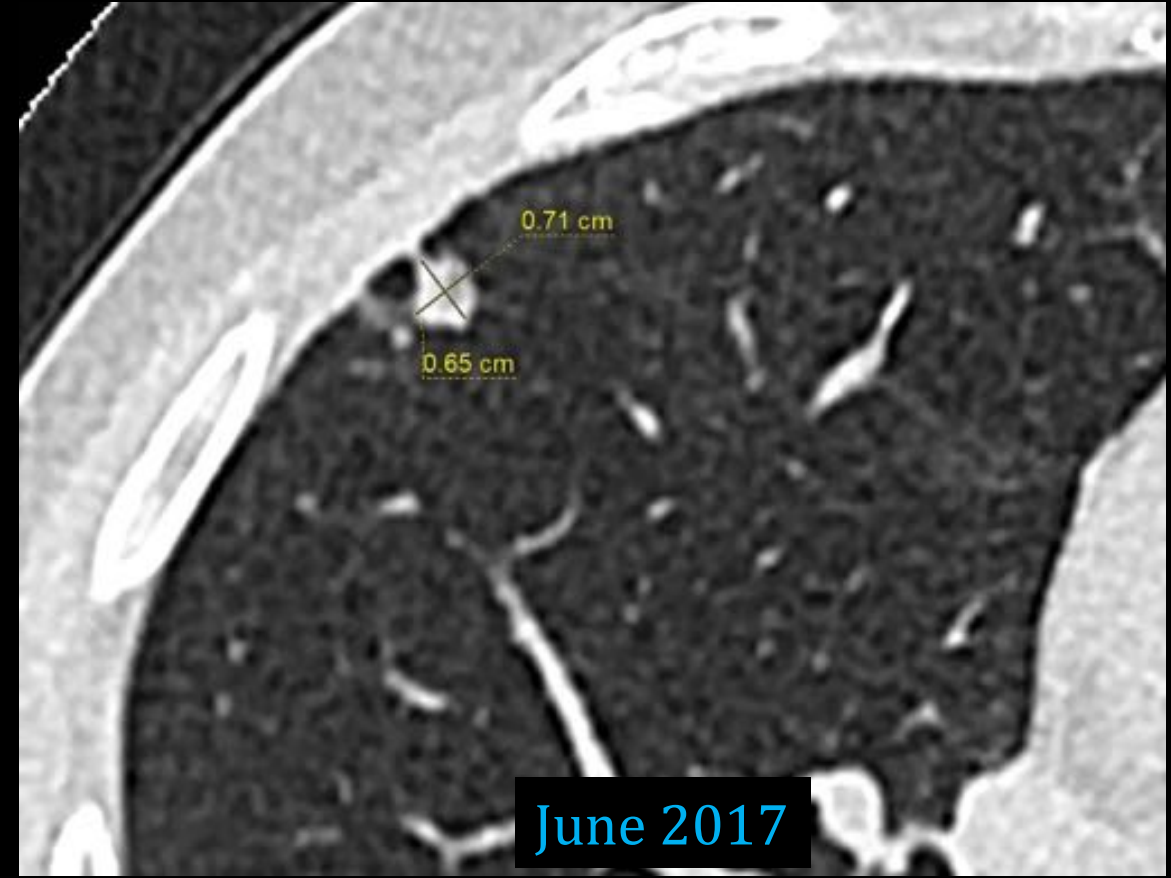
- 5.1 mm nodule- stable over 18 months
- LUNG-RADS: 2
- Continue annual screening

Teaching point: LUNG-RADS is a dynamic scoring system. Cat 3 and 4 nodules stable >3 months, should be downgraded to category 2

Case 9



- No nodule
- LUNG-RADS 1
- Recommend annual screening



- New 6.8 mm solid nodule
- Estimated volume 164 cc
- LUNG-RADS 4a
- Recommend CT in 3 months



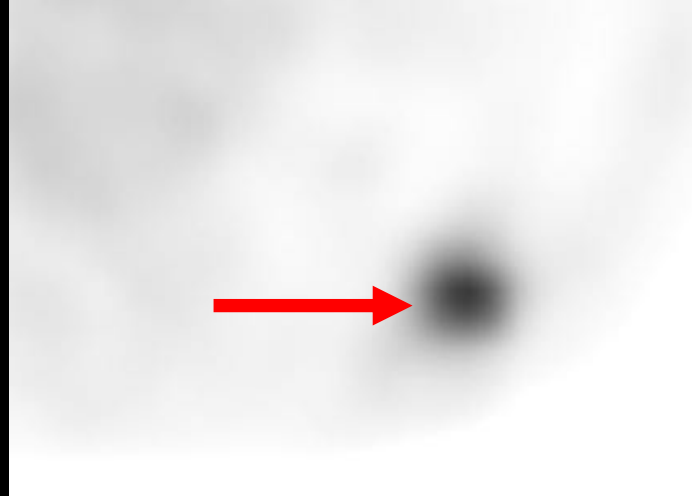
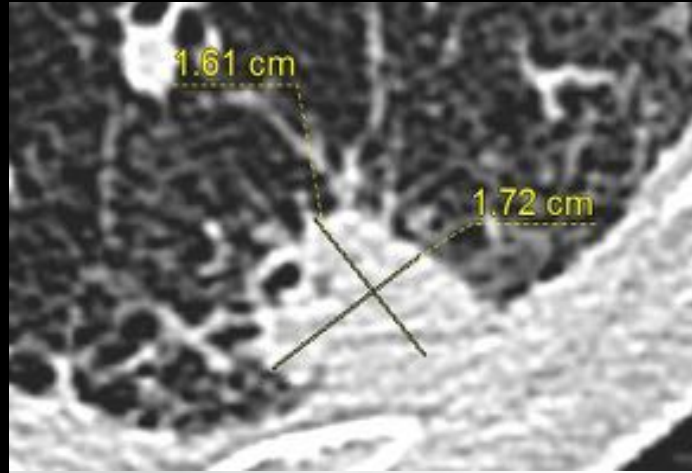
- Enlarging nodule now measuring 14 mm
- Estimated volume 1437 cc
- LUNG-RADS 4b
- Recommend PET-CT and biopsy

Volume growth approximately 8 (2^3) times
Interval 24 months
Doubling time 8 months
Biopsy showed adenocarcinoma

Teaching Point:
Adenocarcinoma can be very slow growing!

Patient returned in March 2019

Case 10



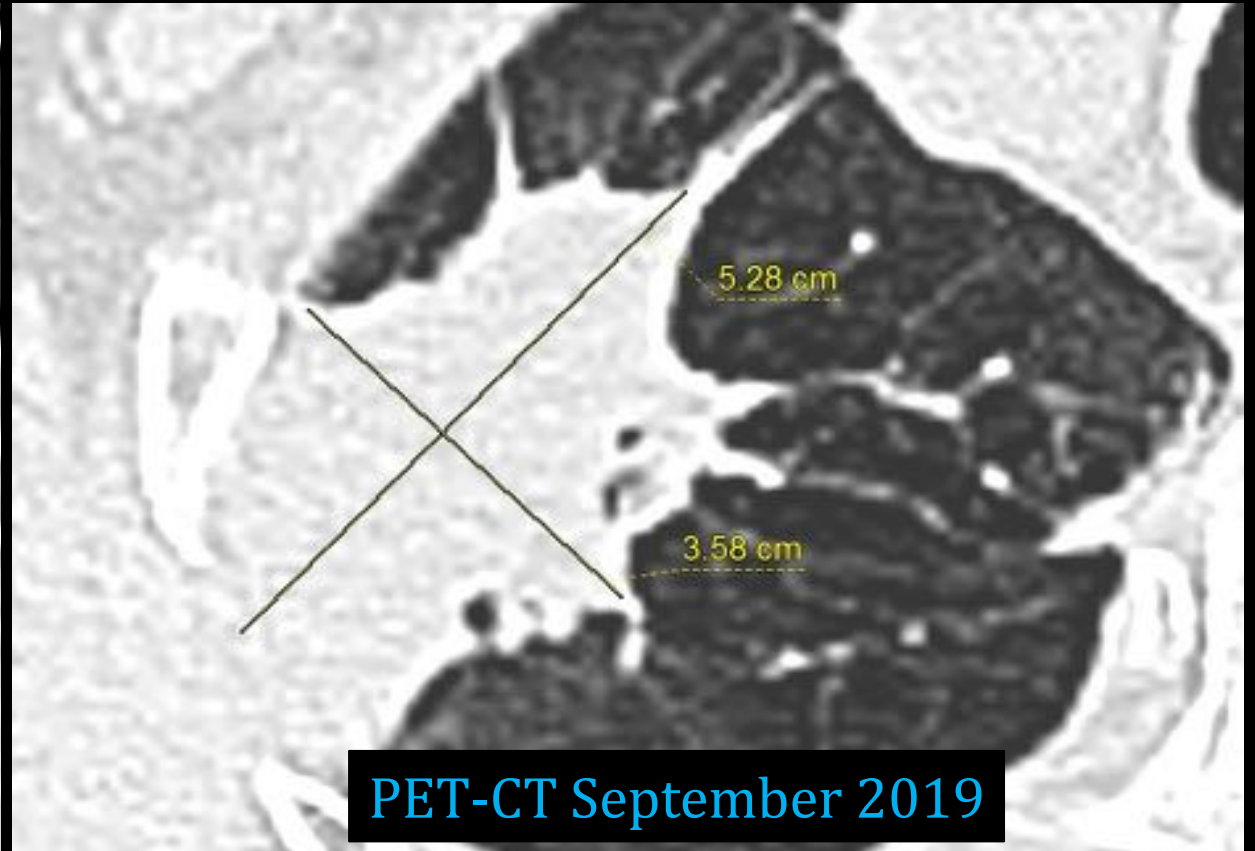
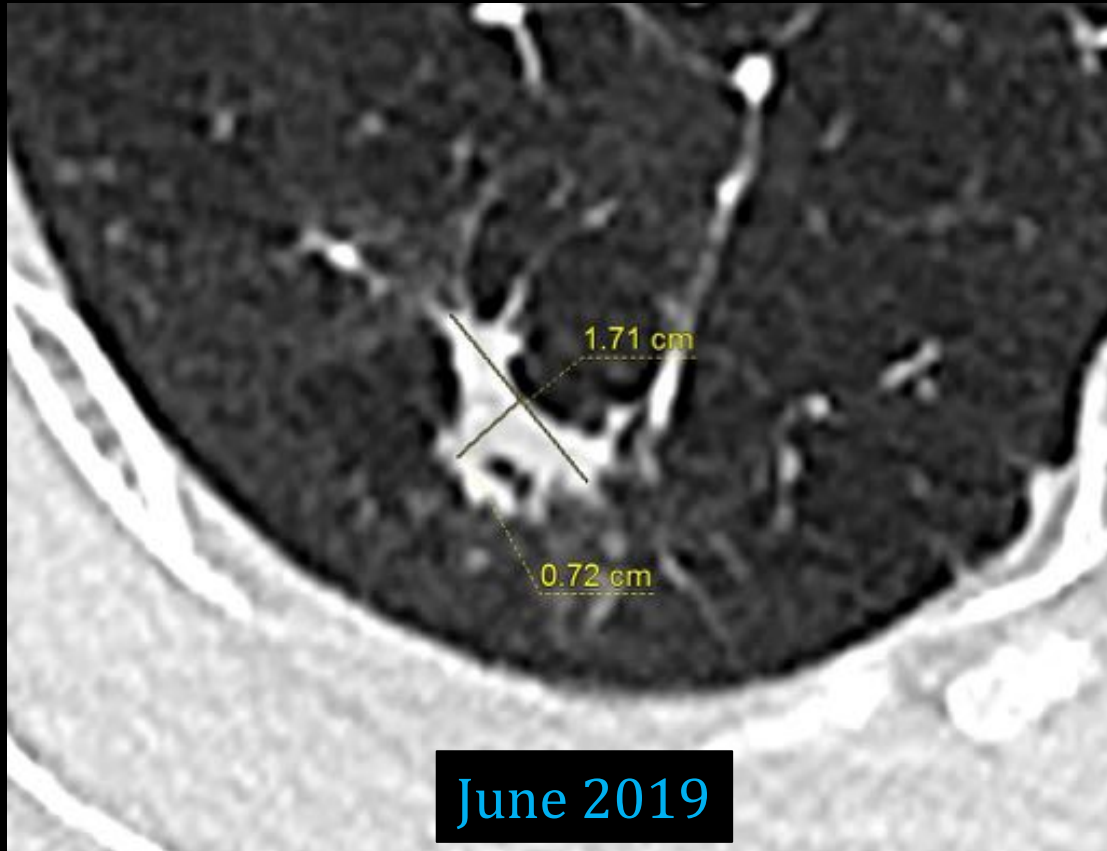
Teaching point:
Larger the nodule greater chance of malignancy

LUNG-RADS: 4b
A solid nodule ≥ 15 mm
OR
A new or growing nodule ≥ 8 mm

- Solid nodule measuring 16.7 mm
- LUNG-RADS 4b
- Recommend PET-CT and biopsy

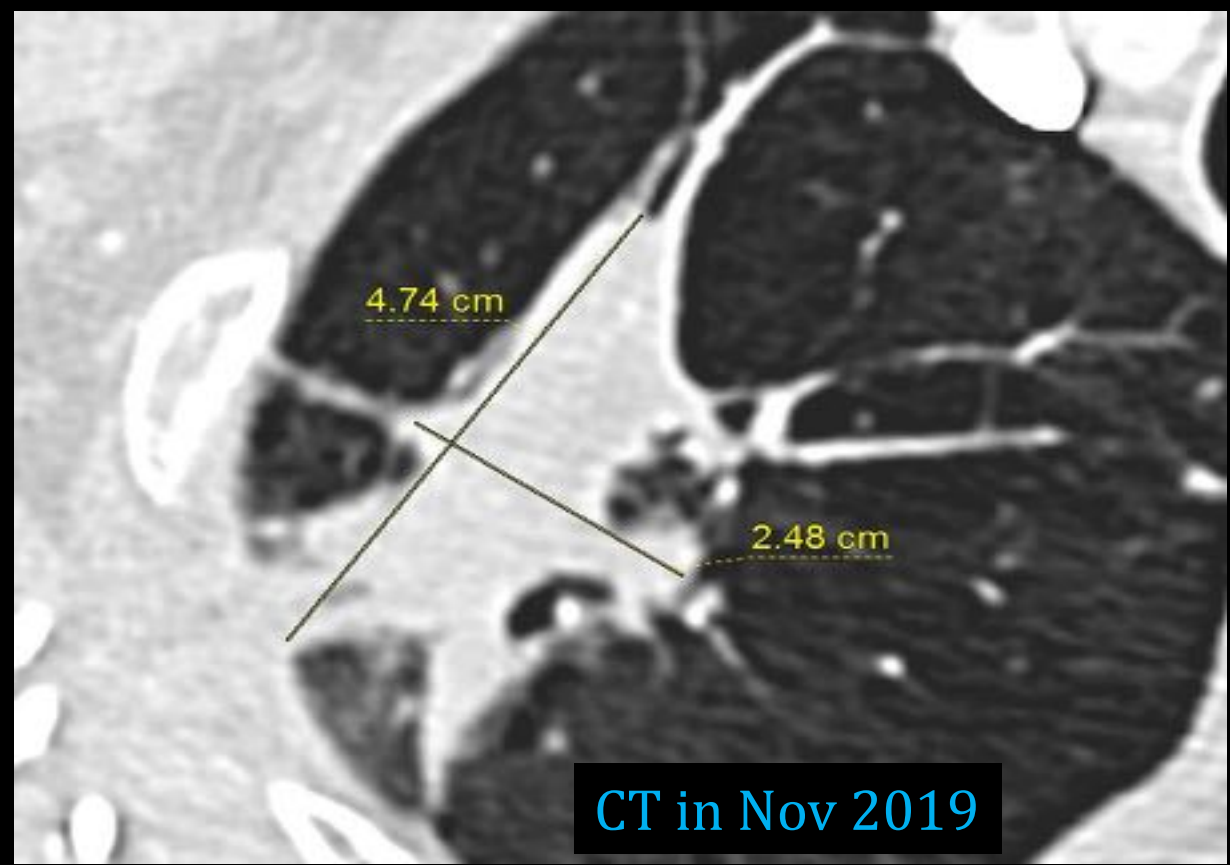
PET +ve SUVmax 6

Case 11



- Solid spiculated nodule 12.1 mm
- Vol 928 cc
- LUNG-RADS 4b
- Recommend PET-CT and biopsy

- Mass measuring 44.3 cm
- Vol 45520 cc



➤ Increased FDG uptake, SUVmax of 6.8

➤ Decreased size of the mass measuring 36.1 mm

Underwent Biopsy which was **negative for malignancy**

Underwent mediastinoscopy and LN biopsy, also **negative for malignancy**

Teaching points:

- **Not all PET +ve lesions are cancer**
- **Very rapidly growing lesions are not cancer**

Summary

- CT Lung cancer screening improves mortality
- Multi disciplinary team approach is essential
- LUNG-RADS to be followed for reporting and recommendation
- Radiologists should be aware of the changes in version 1.1

 **Mercy Fitzgerald Hospital**
A Member of Trinity Health

 **Mercy Philadelphia Hospital**
A Member of Trinity Health

Thank you

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