SLMFs ST KURS I LUNGCANCER, 7. oktober 2024

Radiologi vid Lungcancer

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Bild och Funktion

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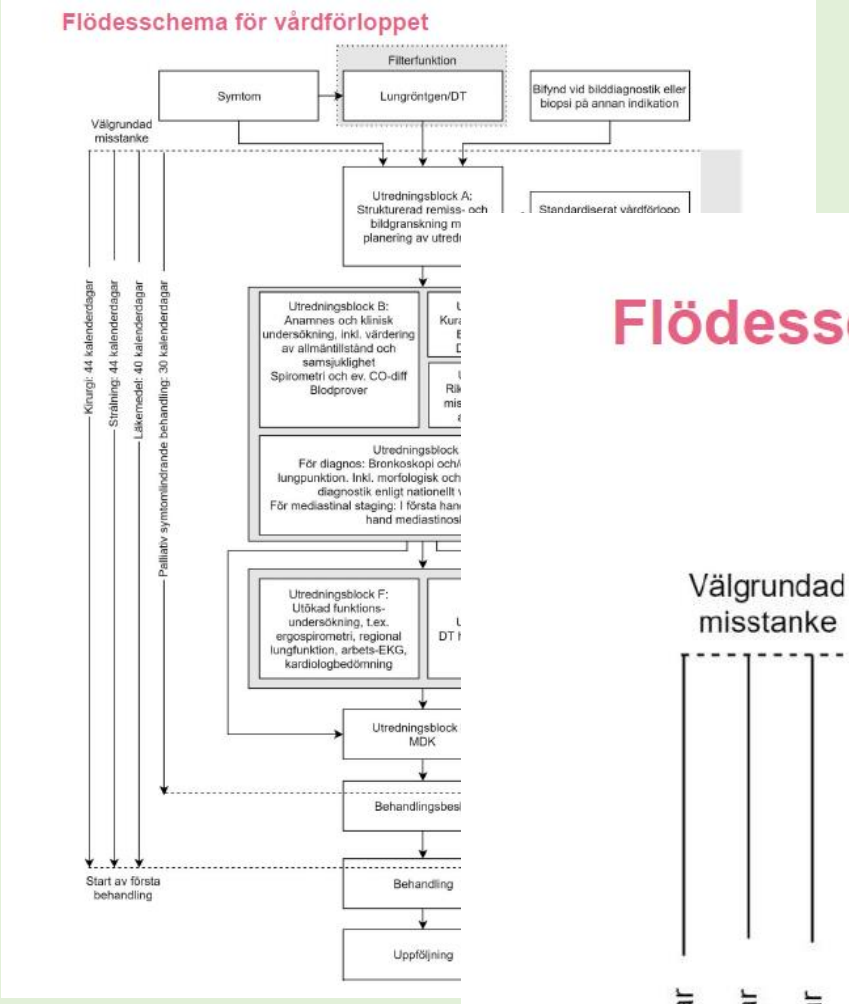
Lungcancer ur radiologens perspektiv

- Utgå från Standardiserat Vårdförlopp för Lungcancer
- Presentera de bilddiagnostiska metoder som används
- Berätta hur radiologen tänker



Flödesschema för vårdförloppet

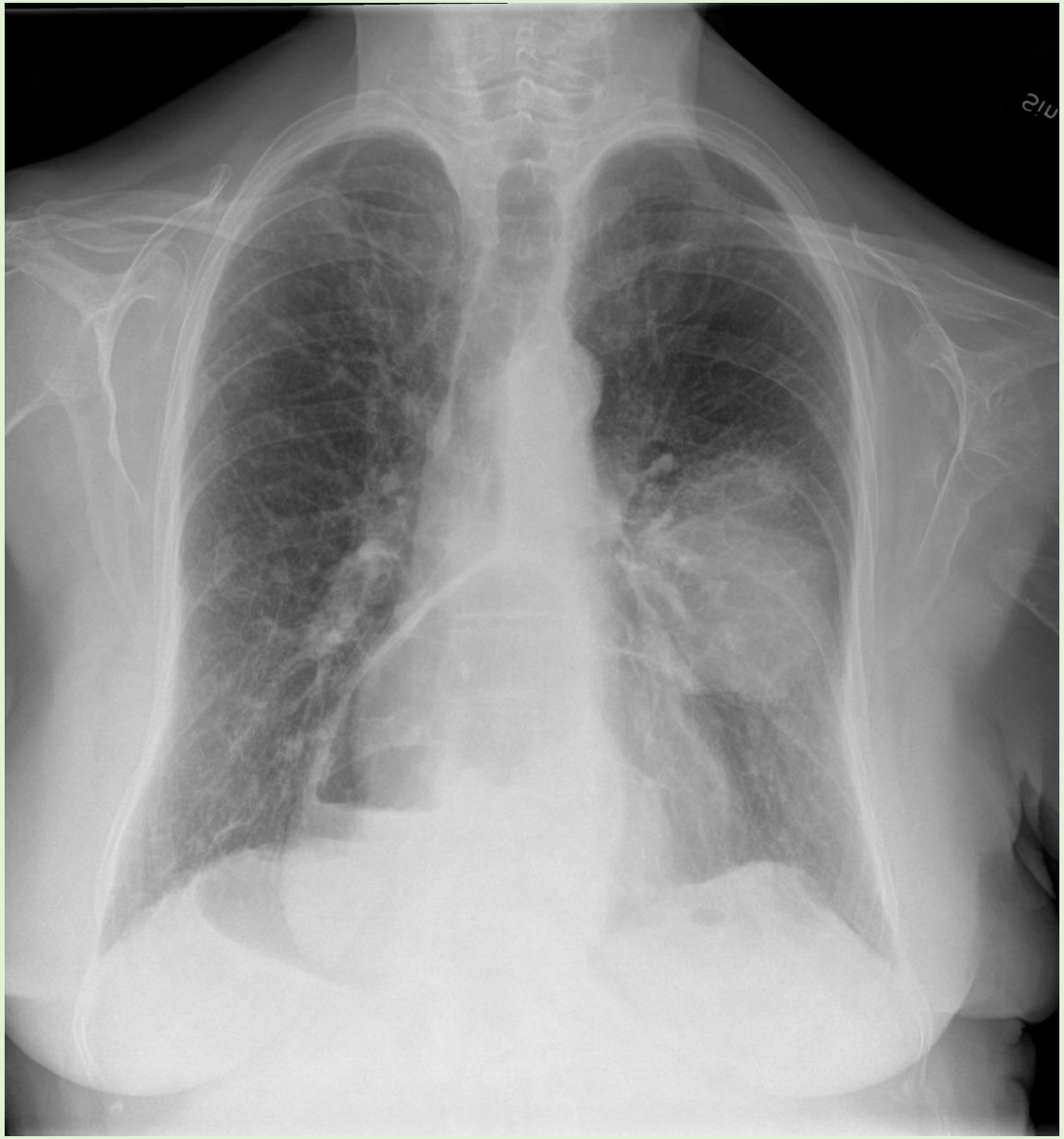
Filterfunktion
Symtom
Lungröntgen/DT
Bifynd vid bilddiagnostik eller biopsi på annan indikation
Välgrundad misstanke
Utredningsblock A: Strukturerad remiss- och bildgranskning med planering av utredning
Standardiserat vårdförlopp avslutas
Utredningsblock B: Anamnes och klinisk undersökning, inkl. värdering av allmäntillstånd och
Utredningsblock C: Kurativ intention: PET-DT Ej kurativ intention: DT thorax-övre buk

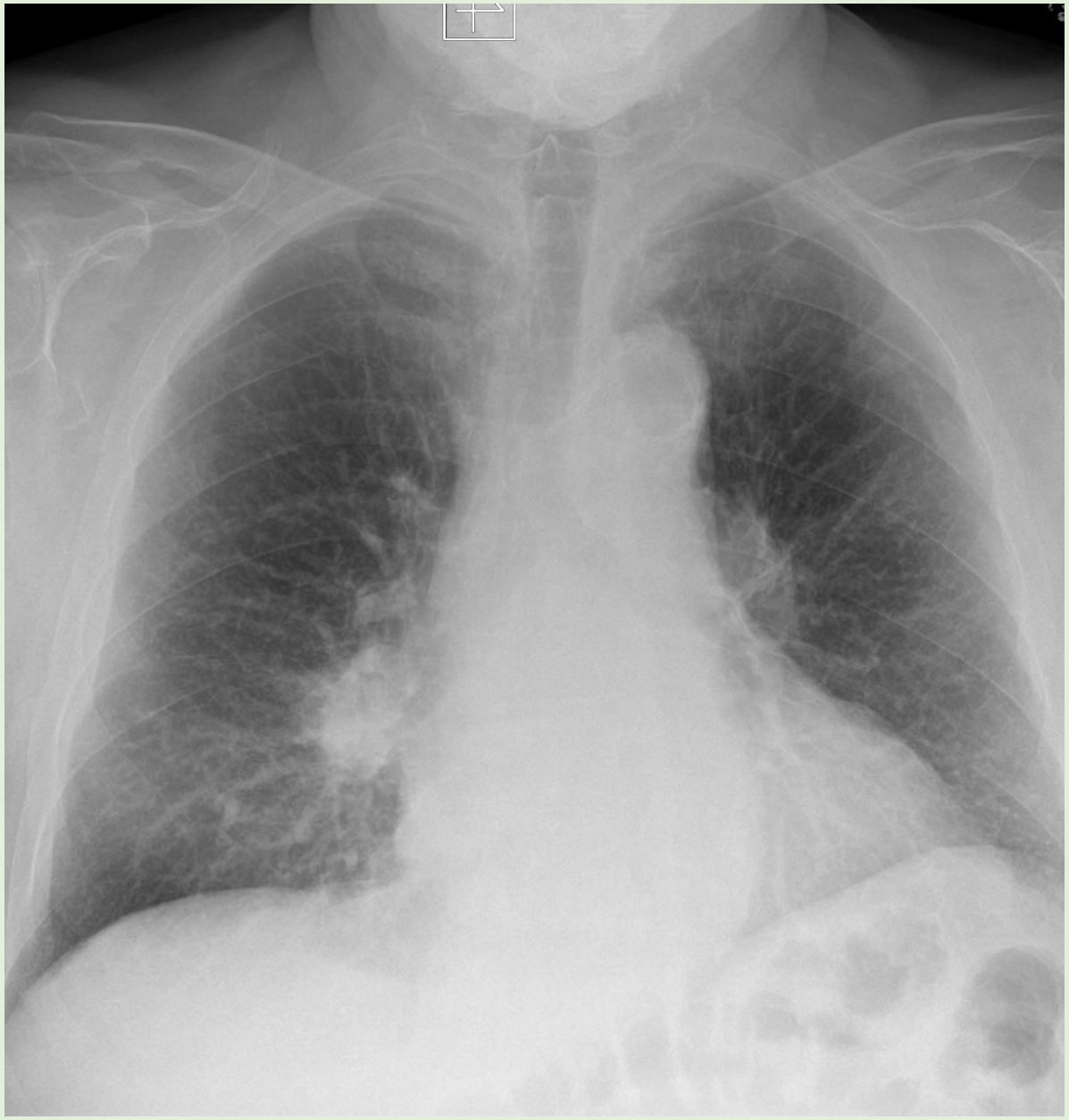
https://kunskapsbanken.cancercentrum.se/globalassets/cancerdiagnoser/lunga-och-lungsack/vardforlopp/svf-lungcancer.pdf

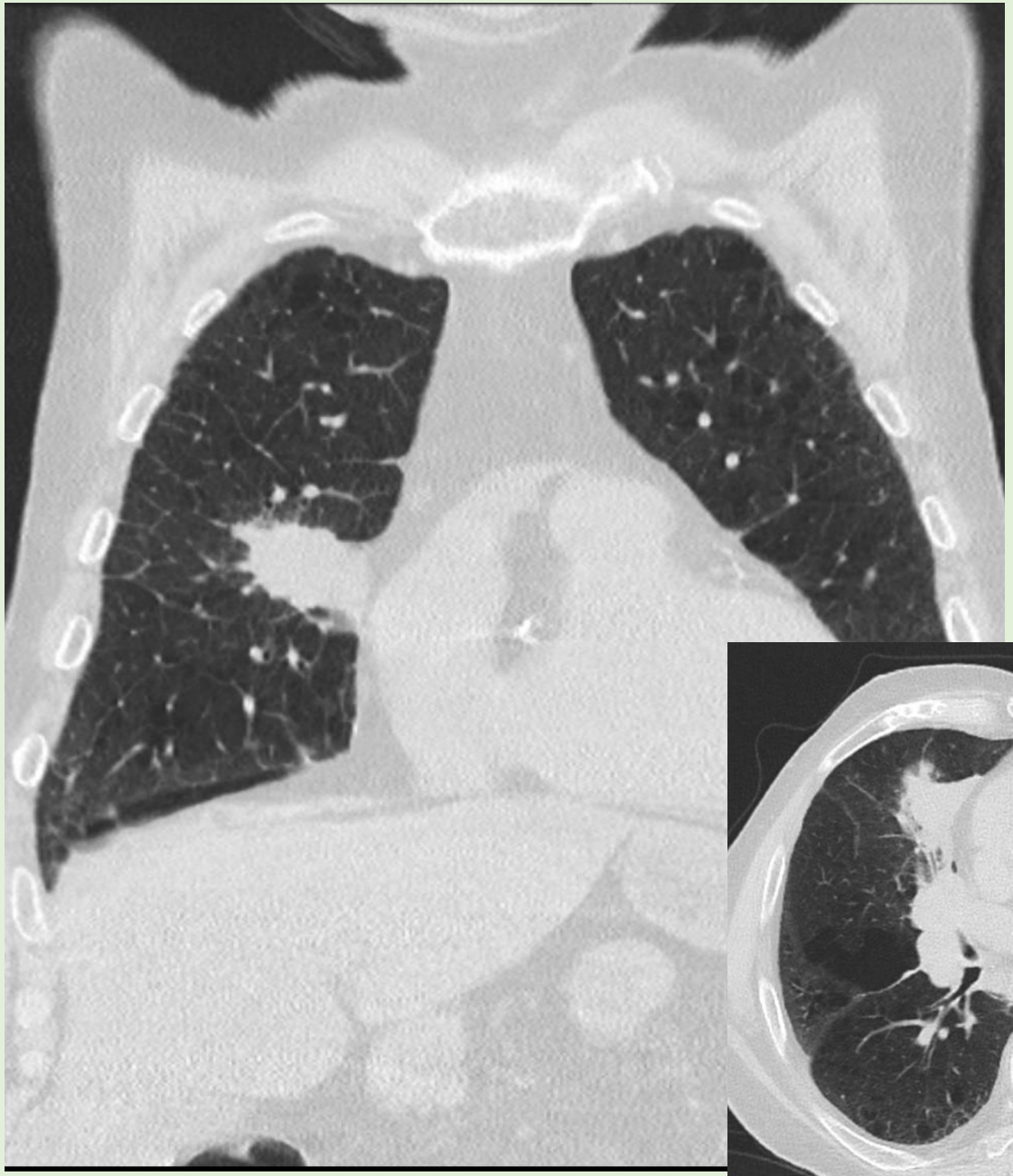
Standardiserat vårdförlopp för Lungcancer

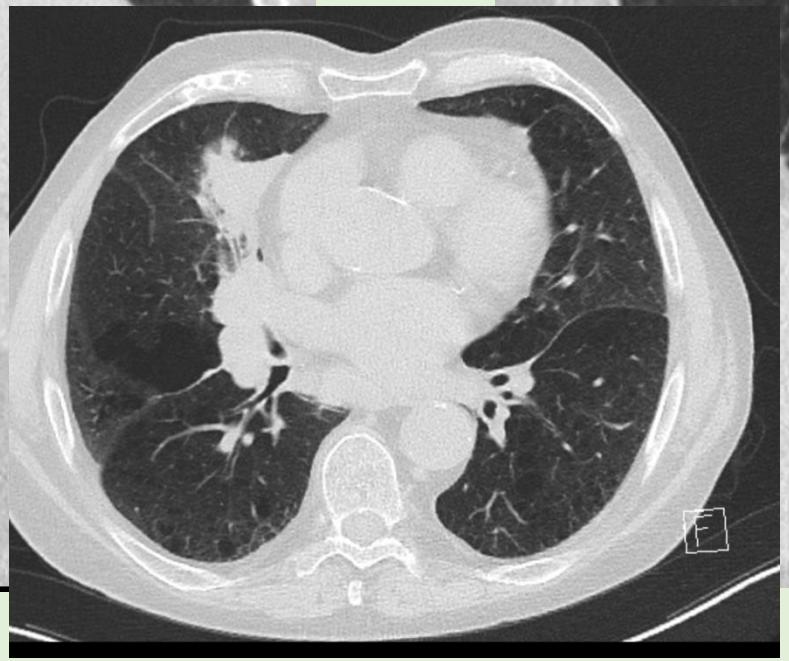
- Filterfunktionen utgörs av lungröntgen eller DT med svar till inremitterande.

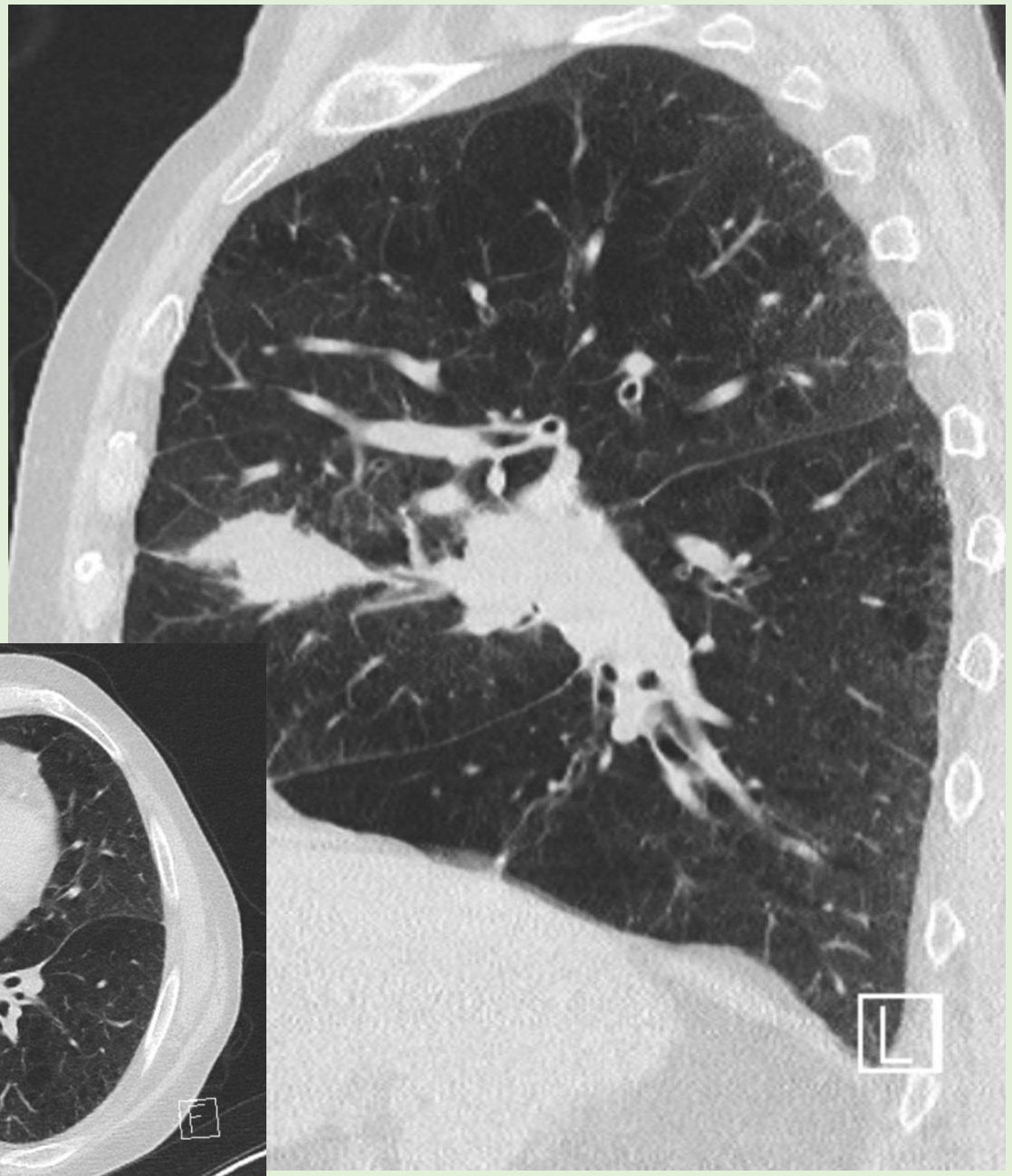
- Om lungröntgen eller DT visar cancermisstanke ska inremitterande fatta beslut om välgrundad misstanke och remittera till utredning enligt standardiserat vårdförlopp.







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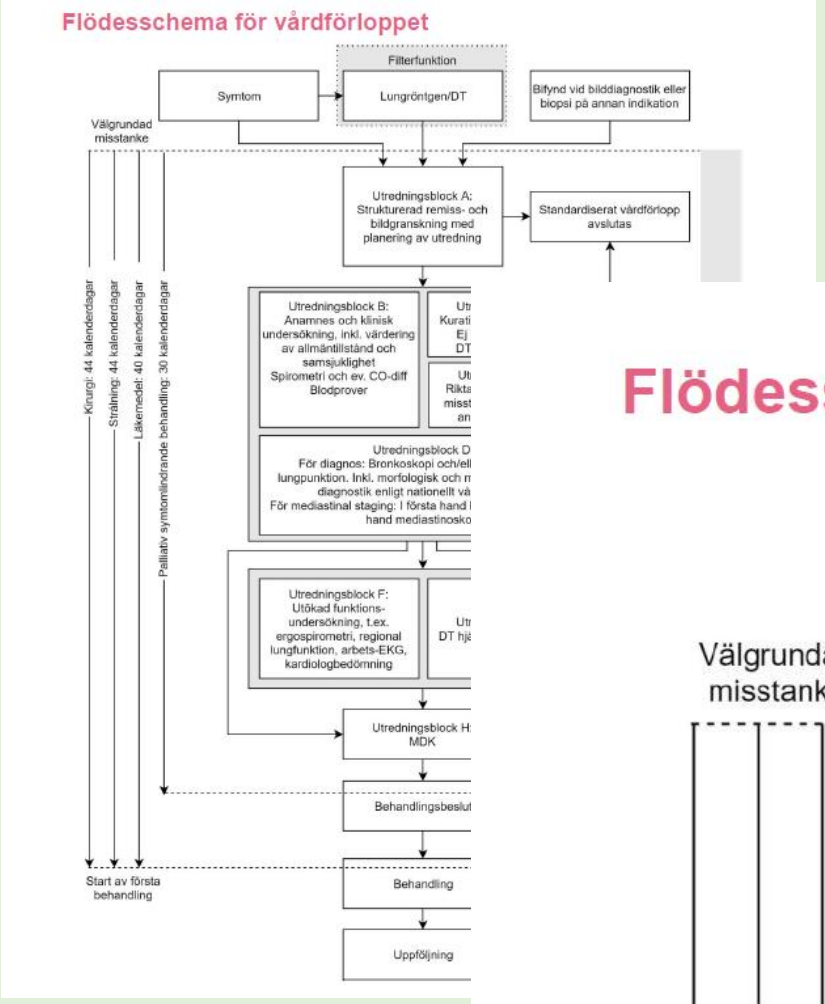
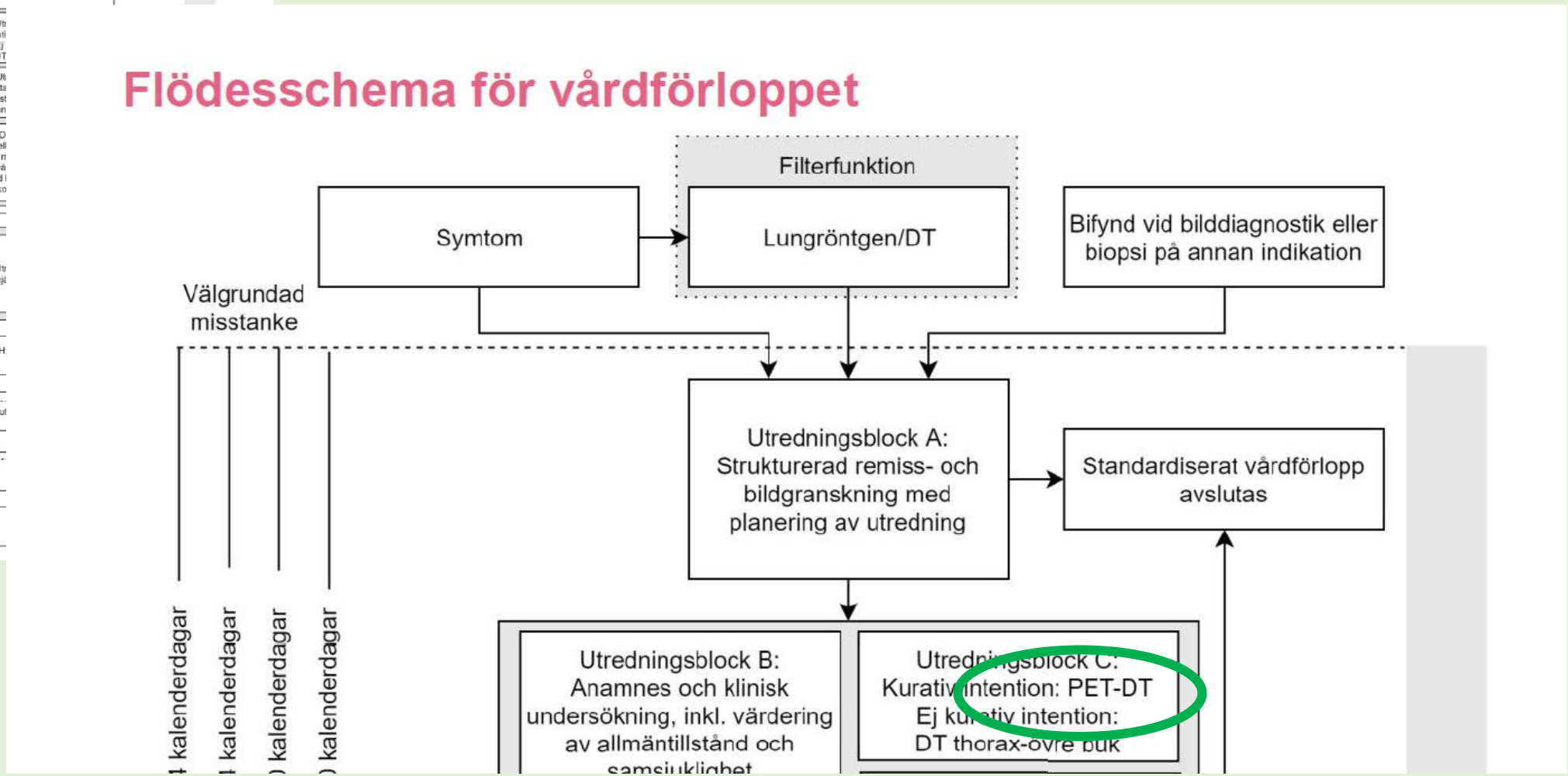
Steg 1

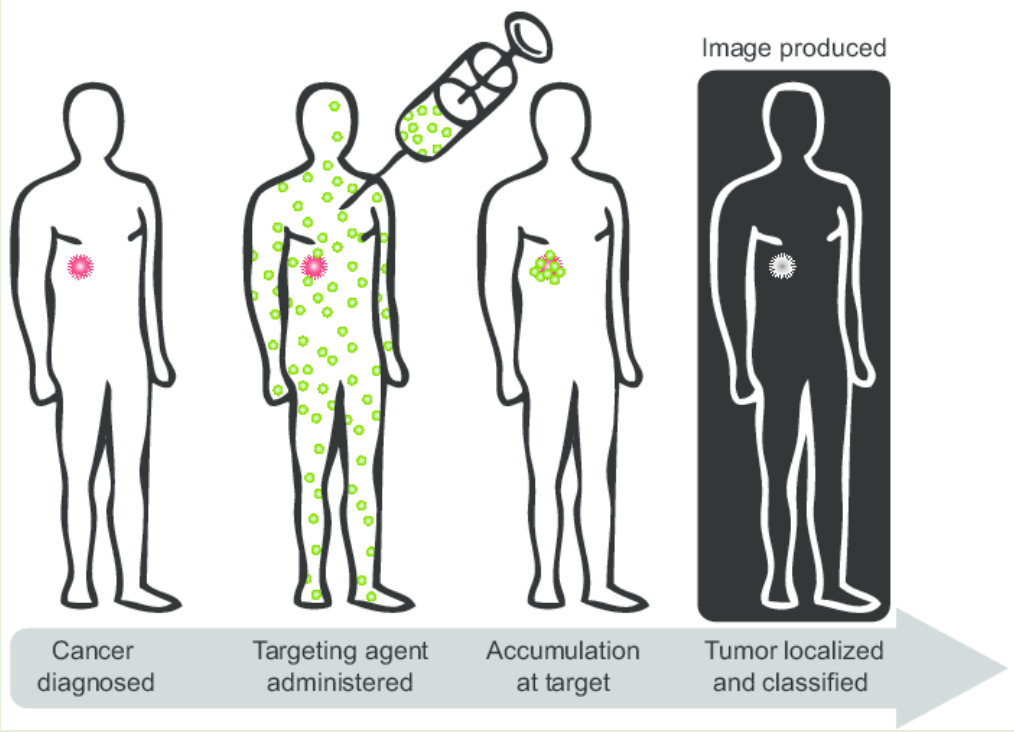
Misstanke om lungcancer.

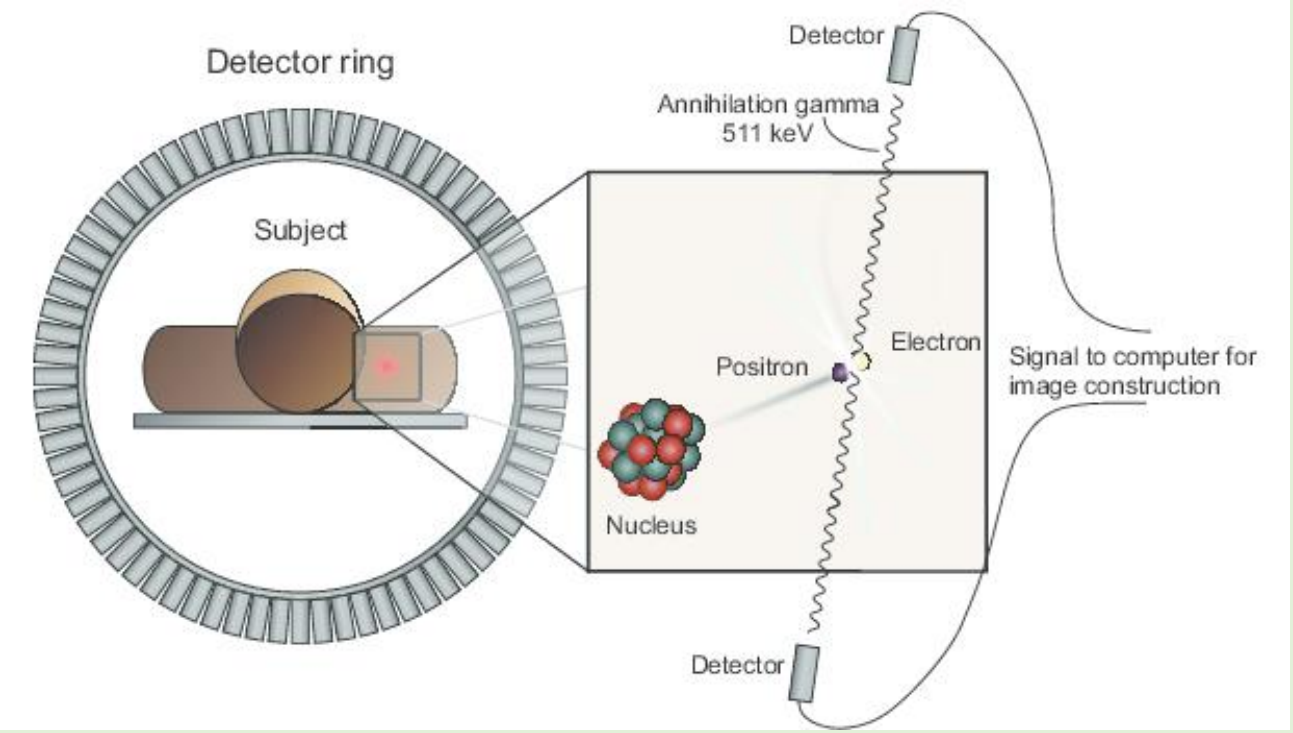




https://kunskapsbanken.cancercentrum.se/globalassets/cancerdiagnoser/lunga-och-lungsack/vardforlopp/svf-lungcancer.pdf

Positron Emission Tomografi - PET



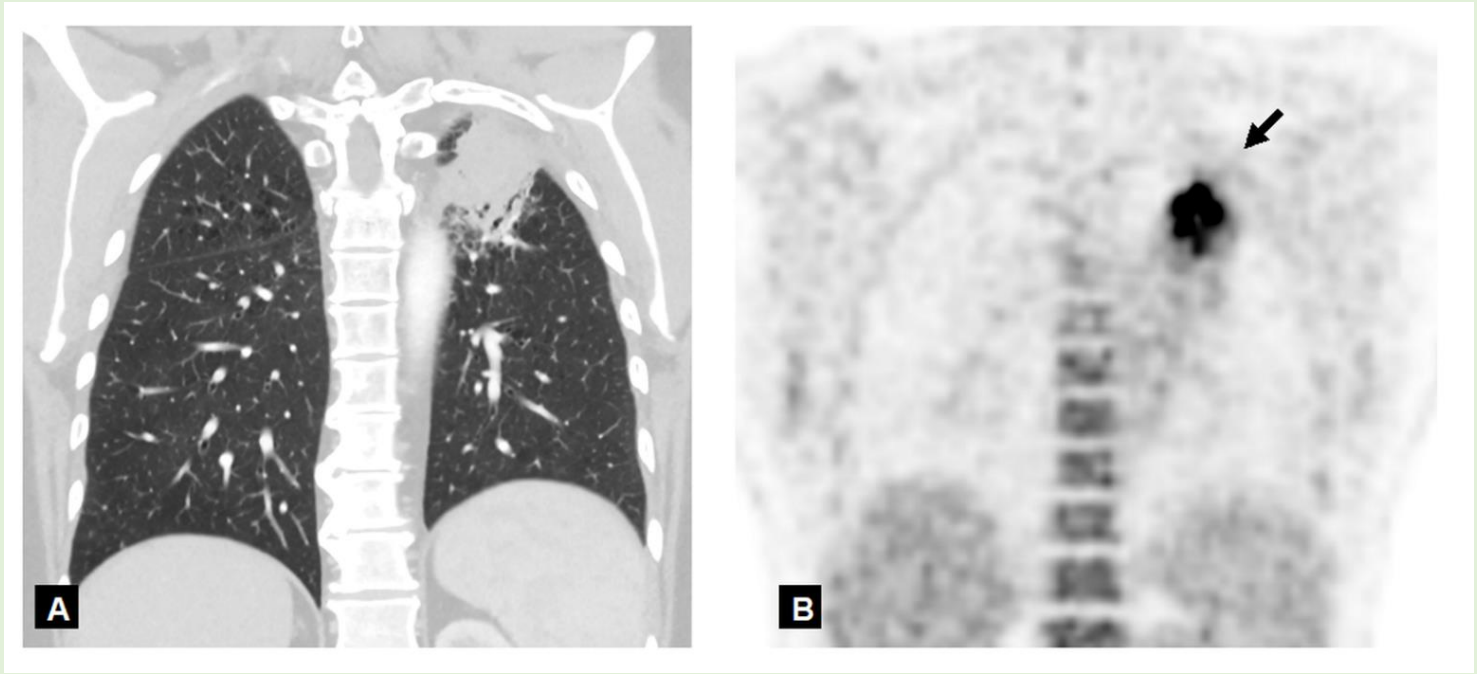


T. ex. FDG (Fludeoxyglukos (18F)), 68Ga Dotatate (Neuroendokrina Tu)

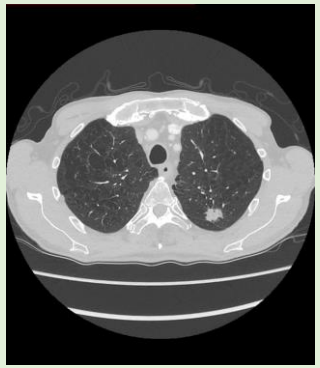
PET

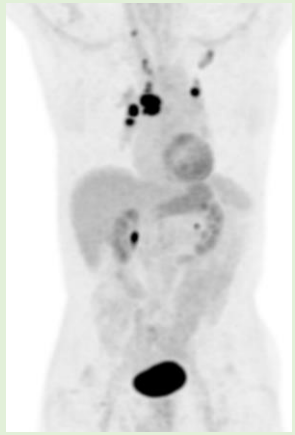
- Upptaget är beroende av dosen som administreras, patientens längd och vikt.
- Vanligen använder man ett standardiserat mått av upptaget (SUV-standardized uptake value) som beräknas individuellt för varje patient. 2.5 SUV är överenskommen cut-off för ökad metabol aktivitet.
- Om man kombinerar PET med CT eller MR kan man få bra spatial upplösning och bedöma exakt anatomisk lokalisation av det ökade upptaget.

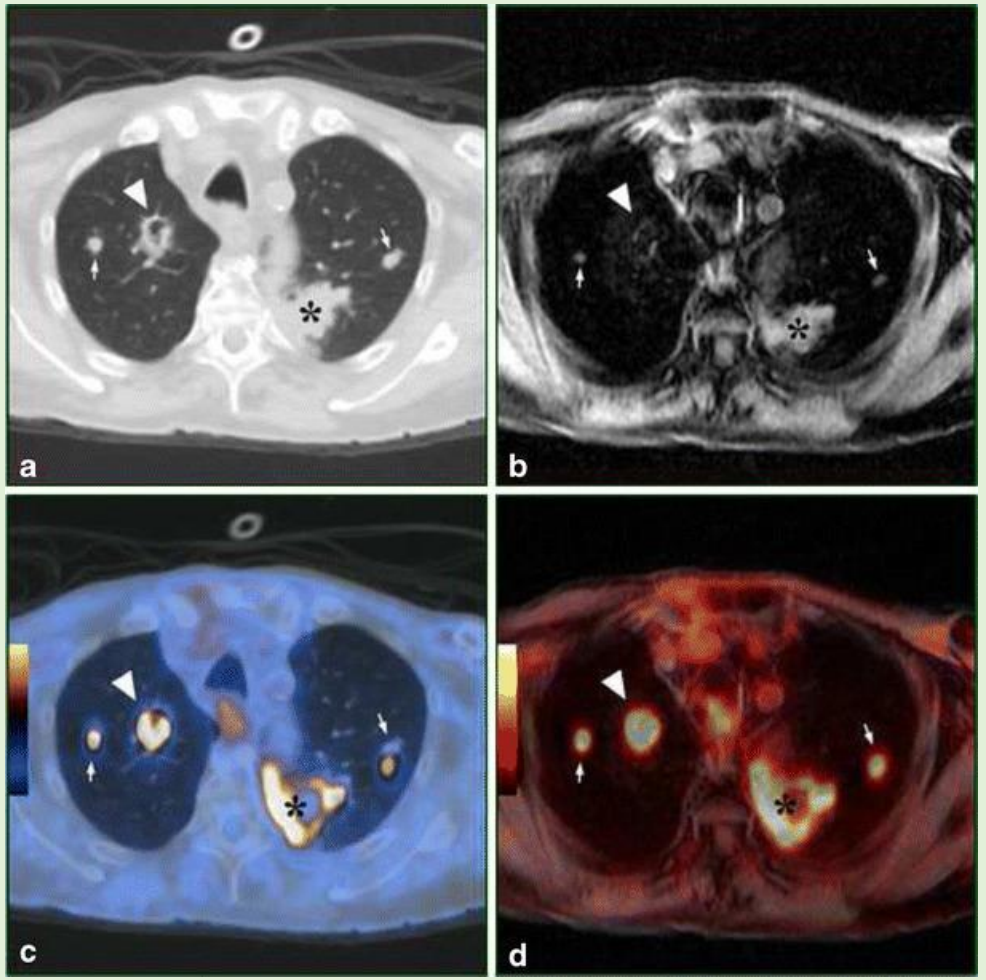
PET-CT & PET-MR



Curtesy of Erik Aatntzen, Department of Radiology and Nuclear Medicine, Radboud University Medical Center, Nijmegen, Netherlands.





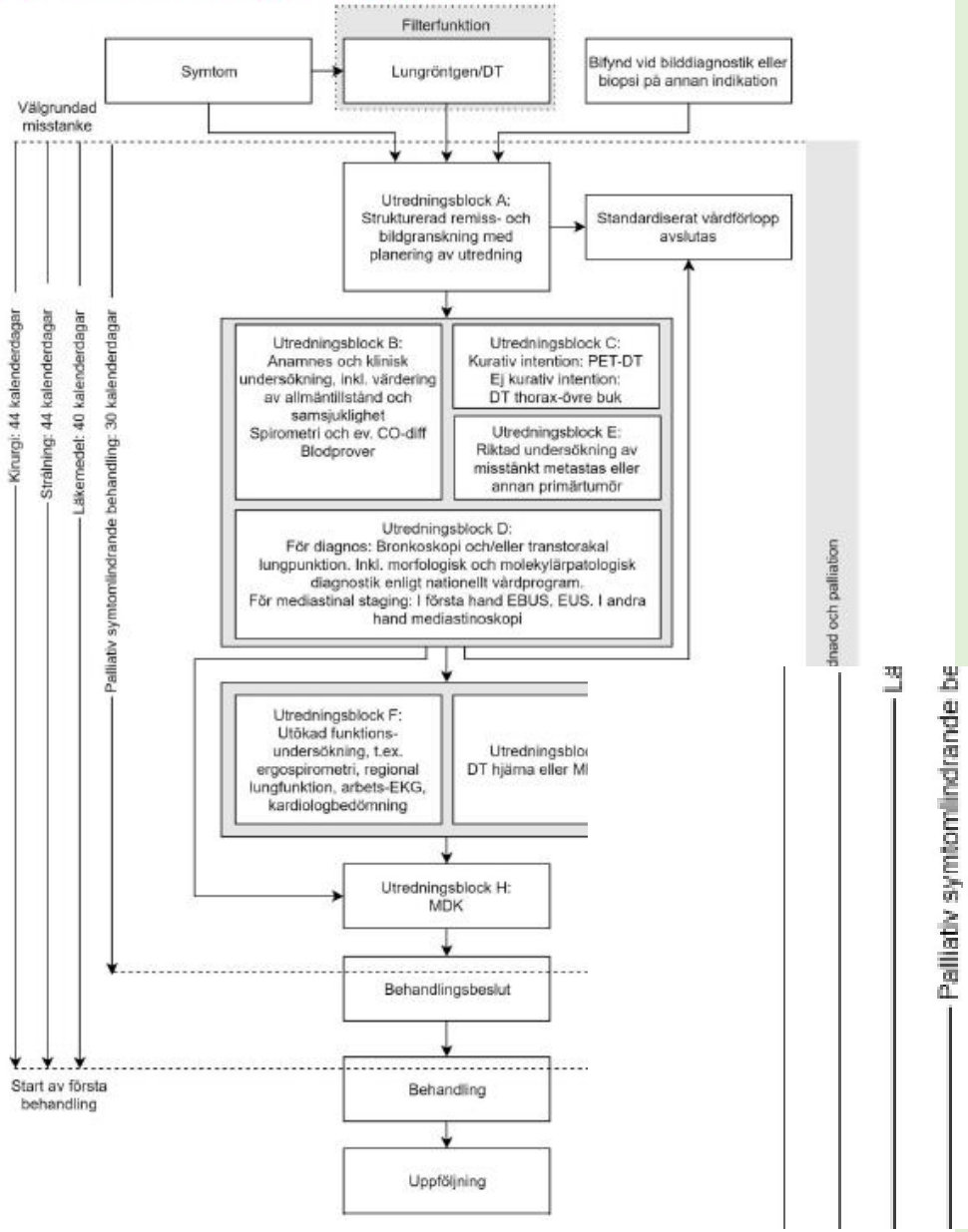


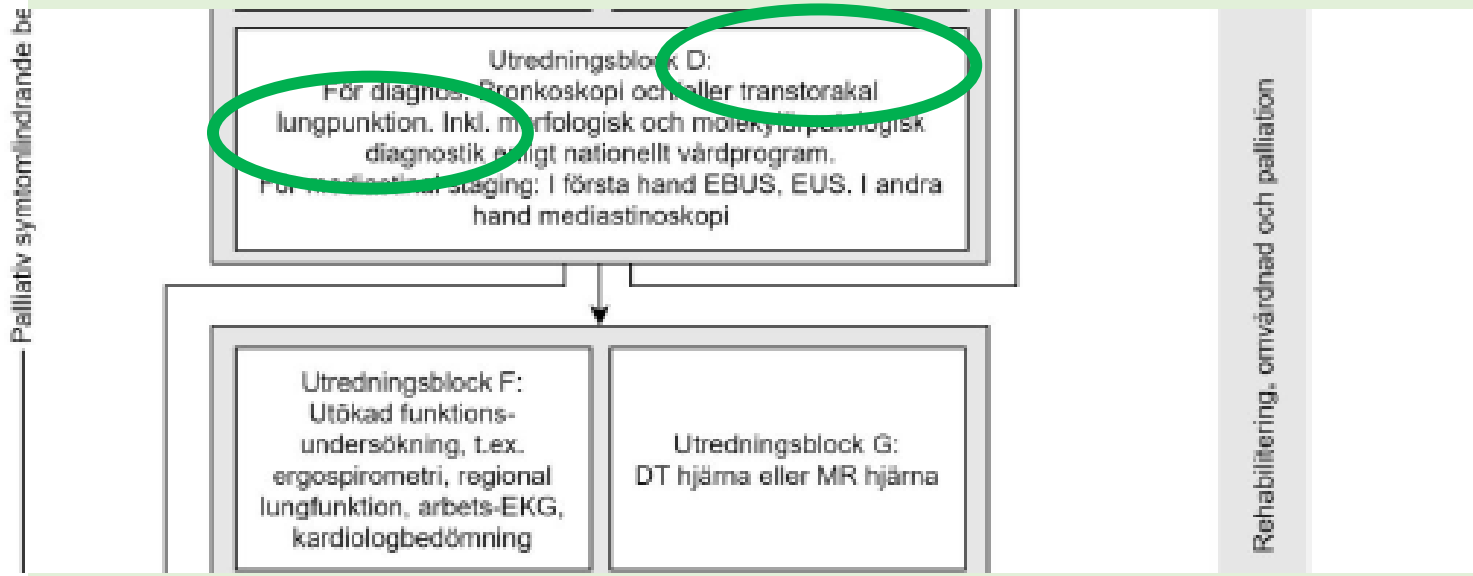
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3731468/pdf/13244_2013_Article_247.pdf

Steg 2

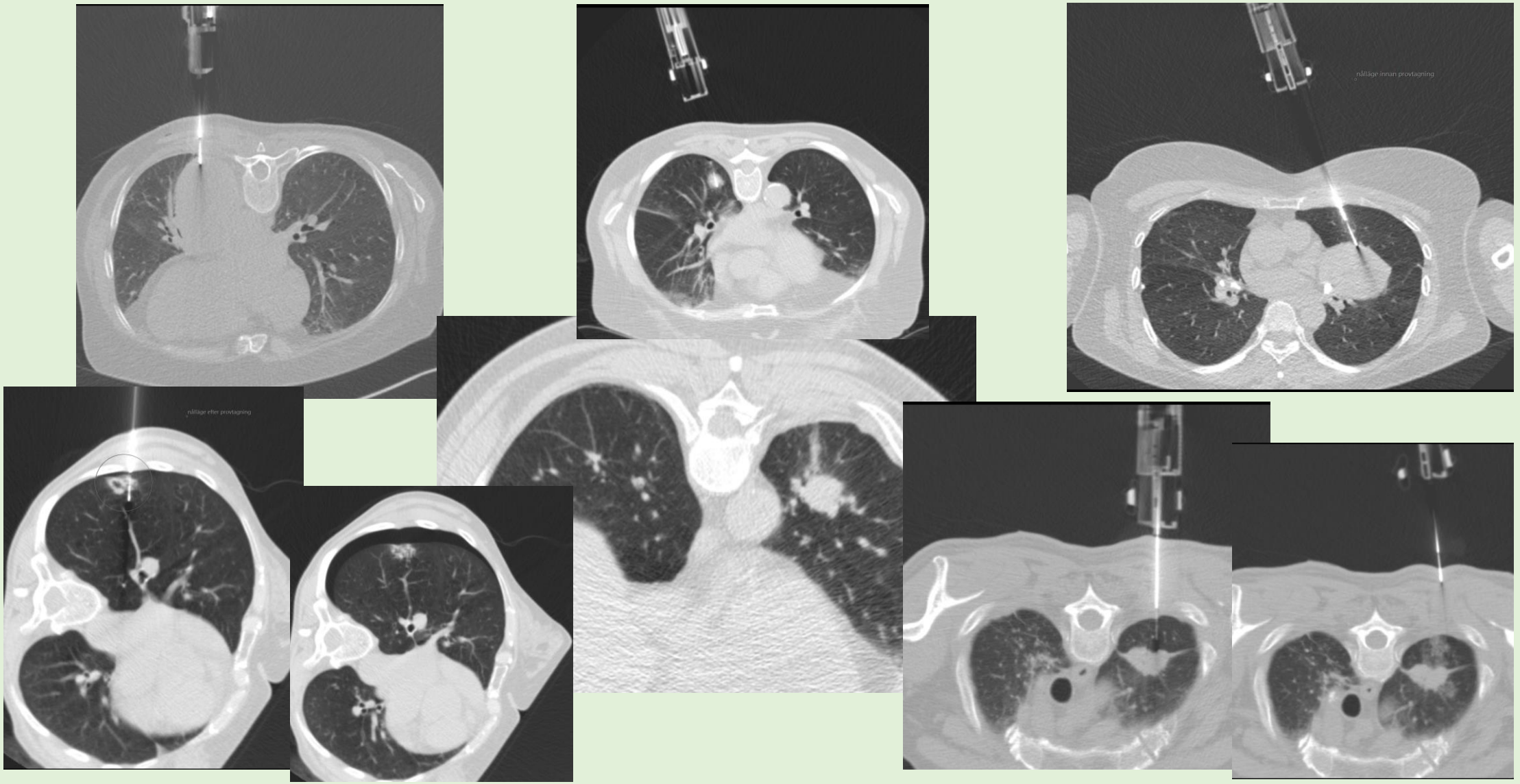
Identifiera spridning.

Flödesschema för vårdförloppet

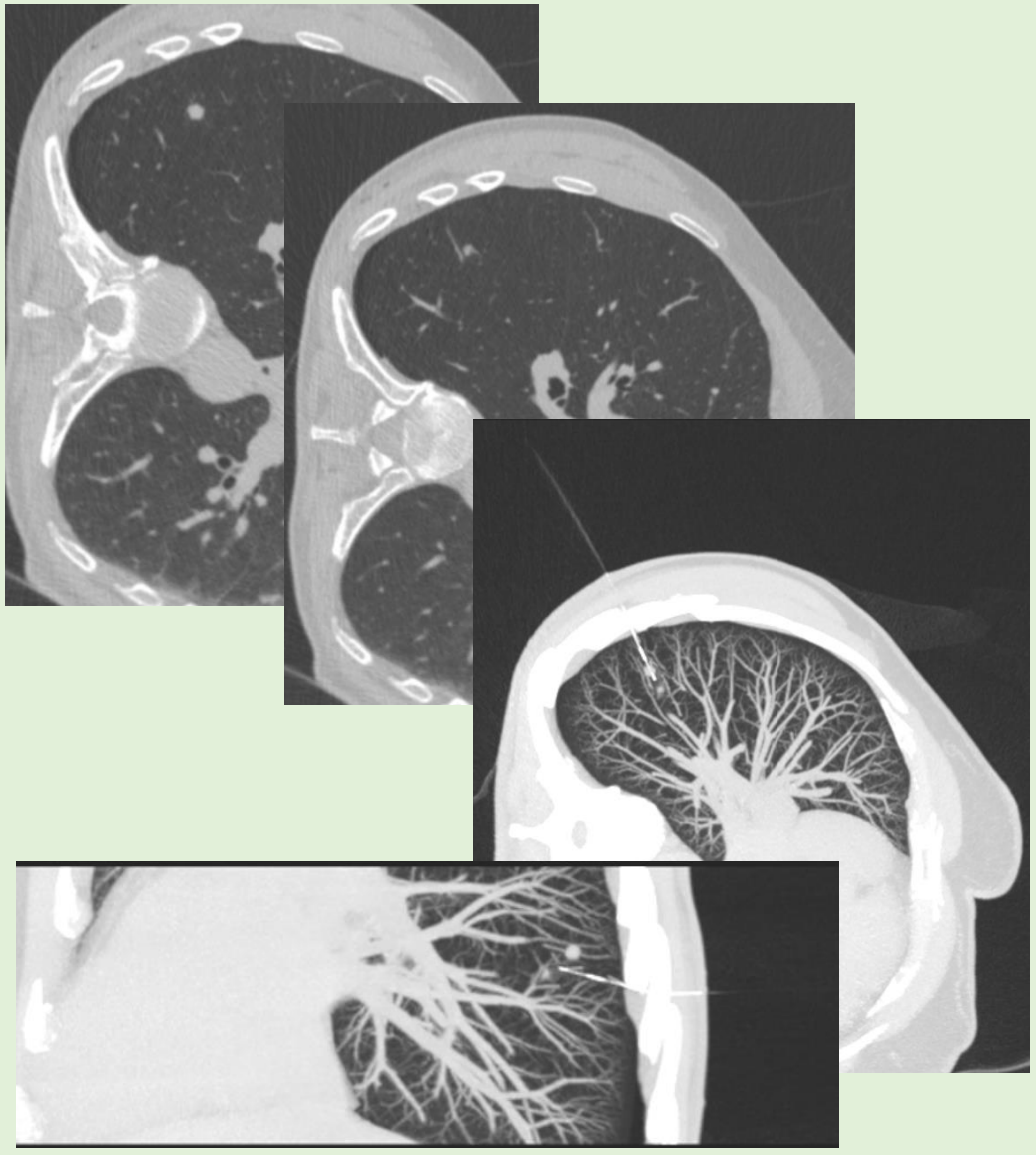


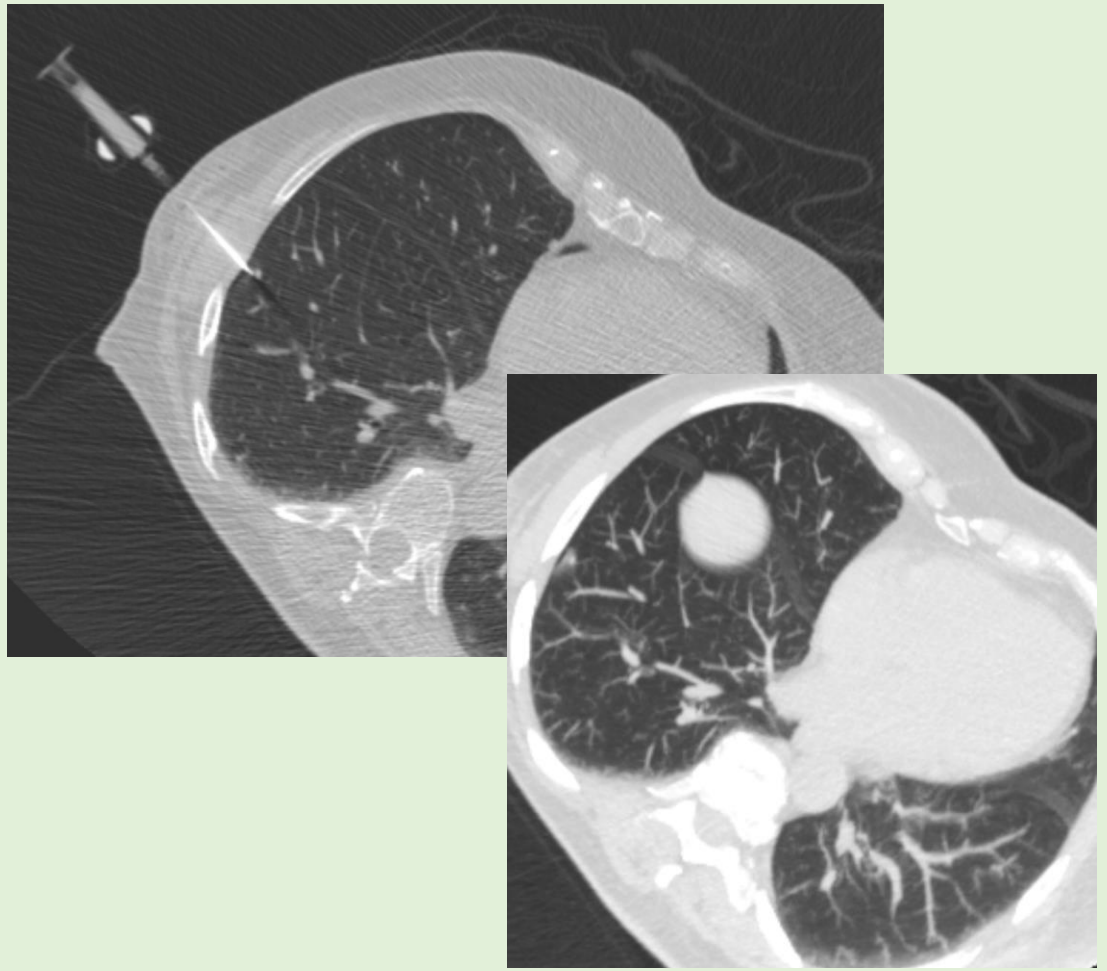


Transtorakal biopsi



Indikering





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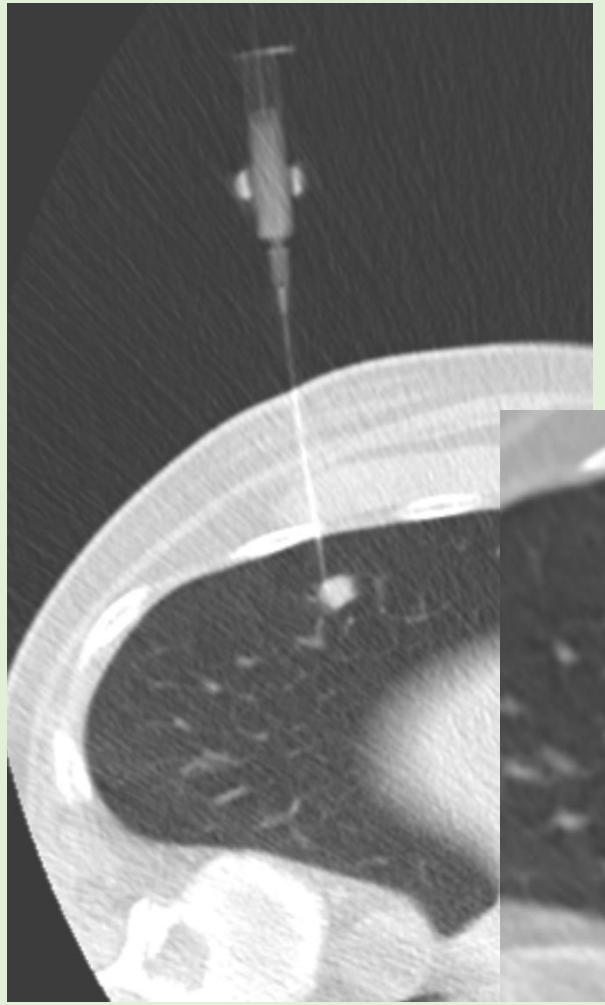
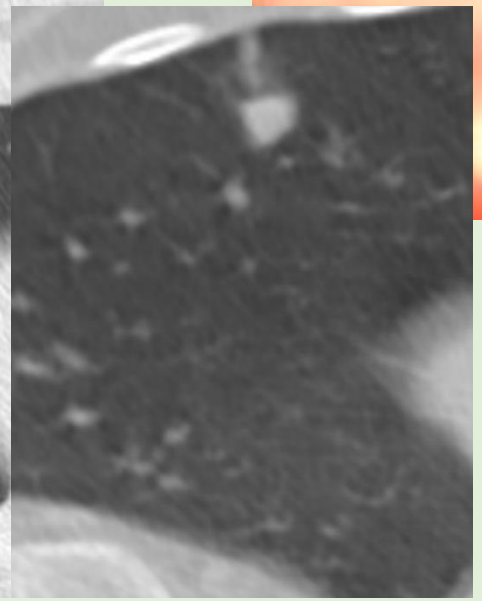
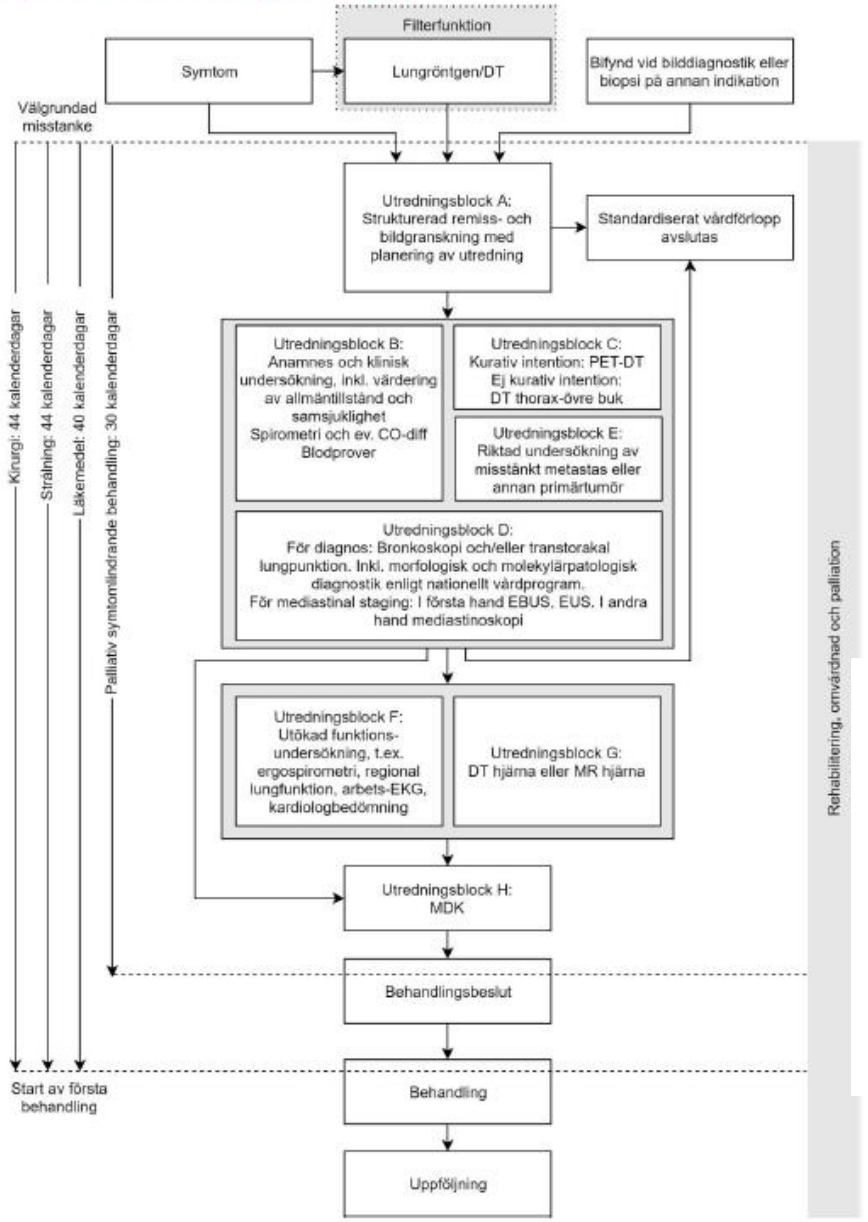


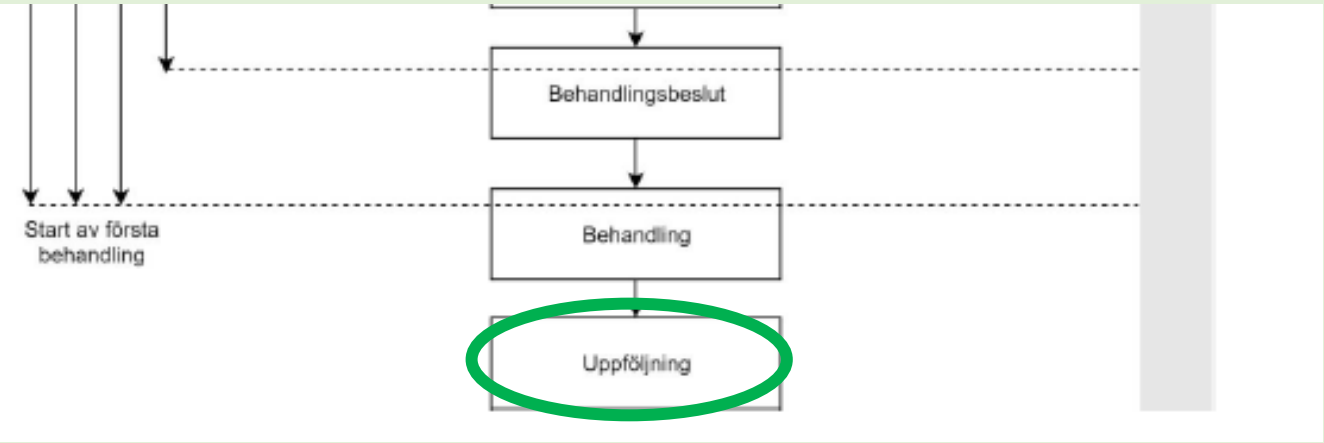


Steg 3

Bistå med transtorakal biopsi vid behov.

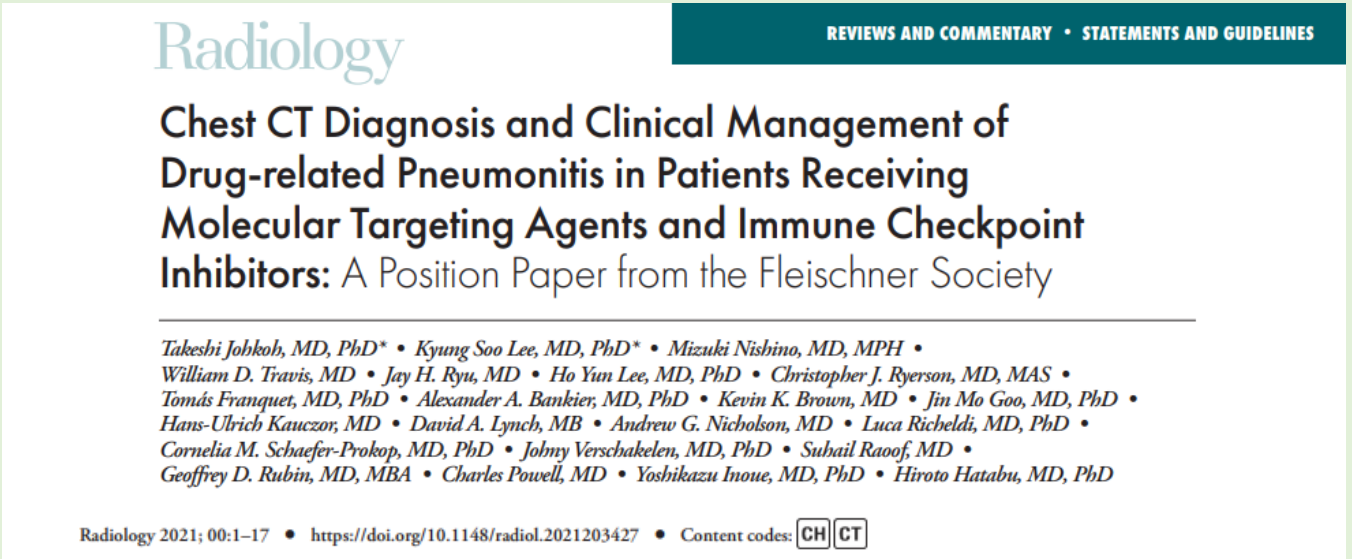
Flödesschema för vårdförloppet





Steg 4

- Progress/regress
- Komplikationer och biverkningar
- Immunmodulerande behandling



Radiology

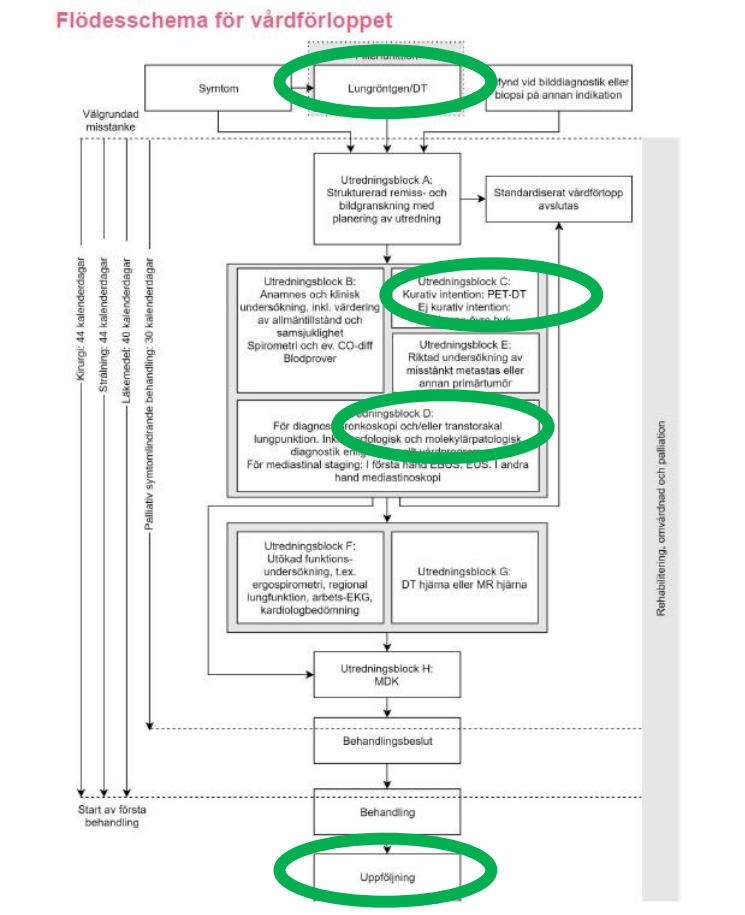
REVIEWS AND COMMENTARY • STATEMENTS AND GUIDELINES

Chest CT Diagnosis and Clinical Management of Drug-related Pneumonitis in Patients Receiving Molecular Targeting Agents and Immune Checkpoint Inhibitors: A Position Paper from the Fleischner Society

Takeshi Johkoh, MD, PhD • Kyung Soo Lee, MD, PhD* • Mizuki Nishino, MD, MPH • William D. Travis, MD • Jay H. Ryu, MD • Ho Yun Lee, MD, PhD • Christopher J. Ryerson, MD, MAS • Tomás Franquet, MD, PhD • Alexander A. Bankier, MD, PhD • Kevin K. Brown, MD • Jin Mo Goo, MD, PhD • Hans-Ulrich Kauczor, MD • David A. Lynch, MB • Andrew G. Nicholson, MD • Luca Richeldi, MD, PhD • Cornelia M. Schaefer-Prokop, MD, PhD • Johny Verschakelen, MD, PhD • Suhail Raoof, MD • Geoffrey D. Rubin, MD, MBA • Charles Powell, MD • Yoshikazu Inoue, MD, PhD • Hiroto Hatabu, MD, PhD*

Radiology 2021; 00:1–17 • https://doi.org/10.1148/radiol.2021203427 • Content codes: CH CT

SVF Lungcancer ur radiologens perspektiv



JA	NEJ
X	
	X
	X
X	

SVF Lungcancer vid lite eftertanke…

Standardiserat Vårdprogram

Filterfunktionen utgörs av **lungröntgen eller DT** med svar till inremitterande.

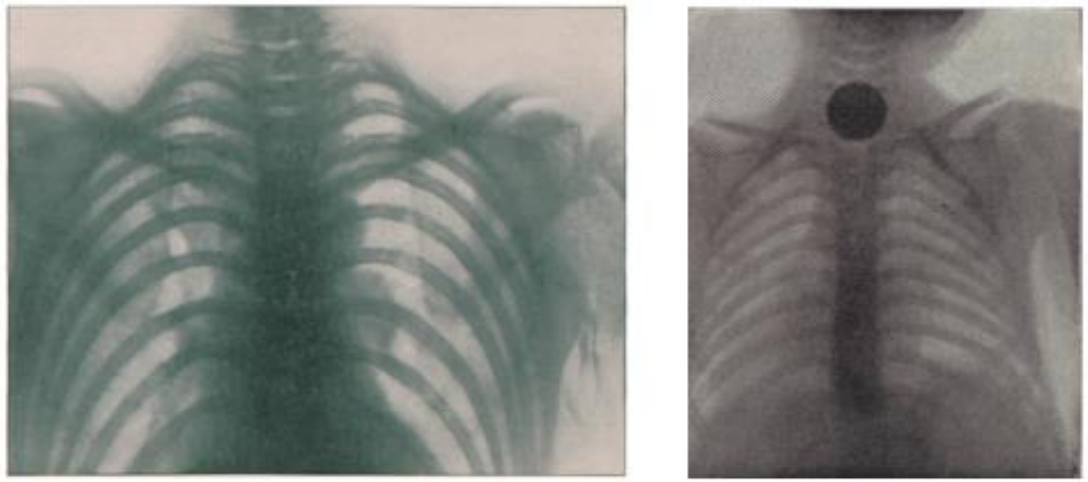
Om lungröntgen eller DT visar **cancermisstanke** ska inremitterande fatta beslut om välgrundad misstanke och remittera till utredning enligt standardiserat vårdförlopp.

Prognosen vid lungcancer är generellt sämre än vid många andra cancersjukdomar, och lungcancer är den vanligaste cancerrelaterade dödsorsaken, män och kvinnor sammantagna (fler kvinnor dör idag av lungcancer än av bröstcancer, medan något fler män dör av prostatacancer än av lungcancer). Den ***relativa 5-årsöverlevnaden är ca 15 procent*** (18 procent för kvinnor och 13 procent för män). Den ***viktigaste orsaken*** till den generellt dåliga prognosen är att flertalet fall ***upptäcks i ett sent skede***. ***Kurativ (botande) behandling kan dock erbjudas i tidiga skeden***.

https://kunskapsbanken.cancercentrum.se/globalassets/cancerdiagnoser/lunga-och-lungsack/vardforlopp/svf-lungcancer.pdf

- Stort ansvar ligger på bilddiagnostiken.
- Lungröntgen eller CT?
- Hur ser en lungcancer ut?
- Hur stor eller liten är en lungcancer?
- Hur mäter man?

Konventionell lungröntgen VS CT Thorax

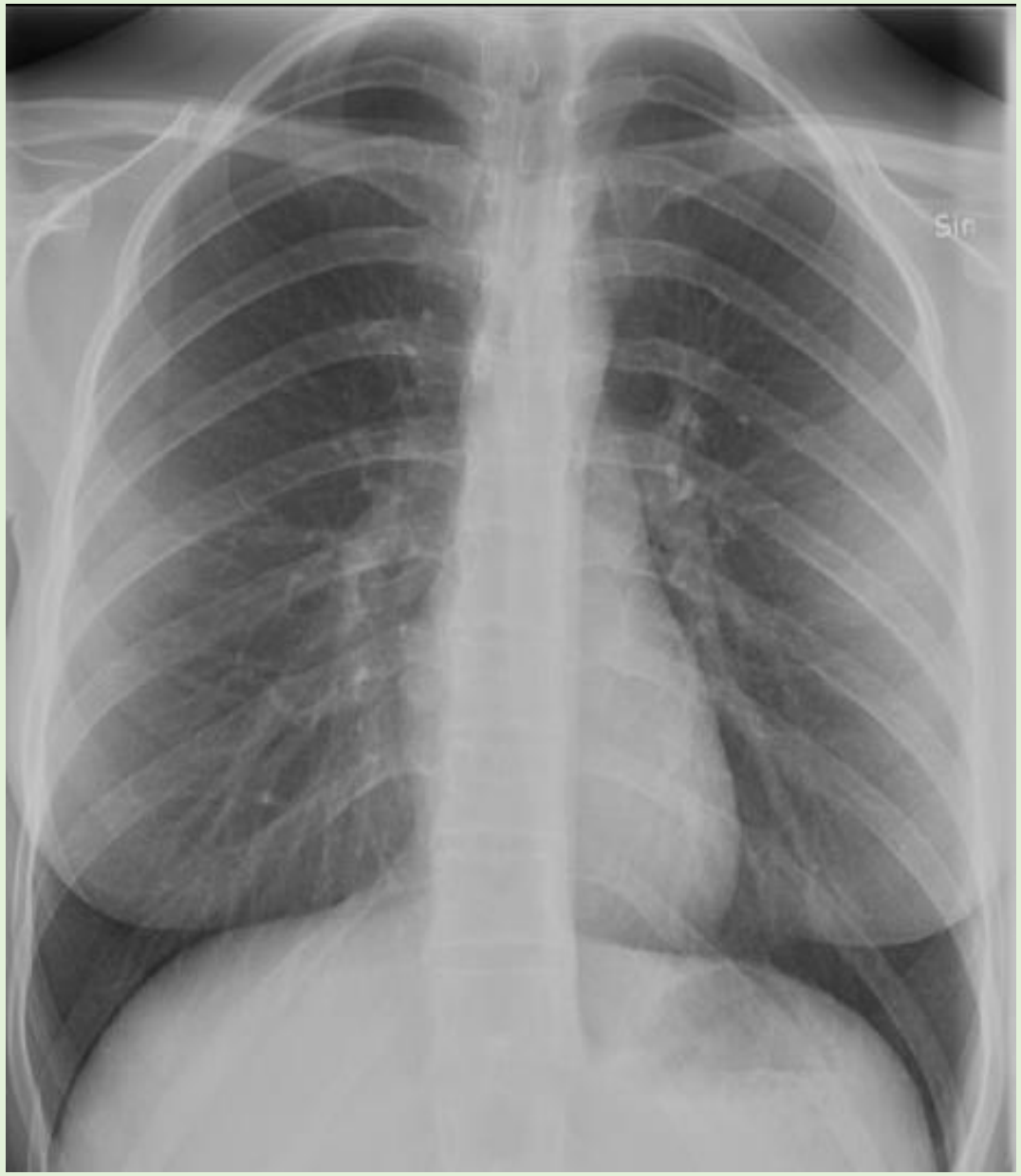


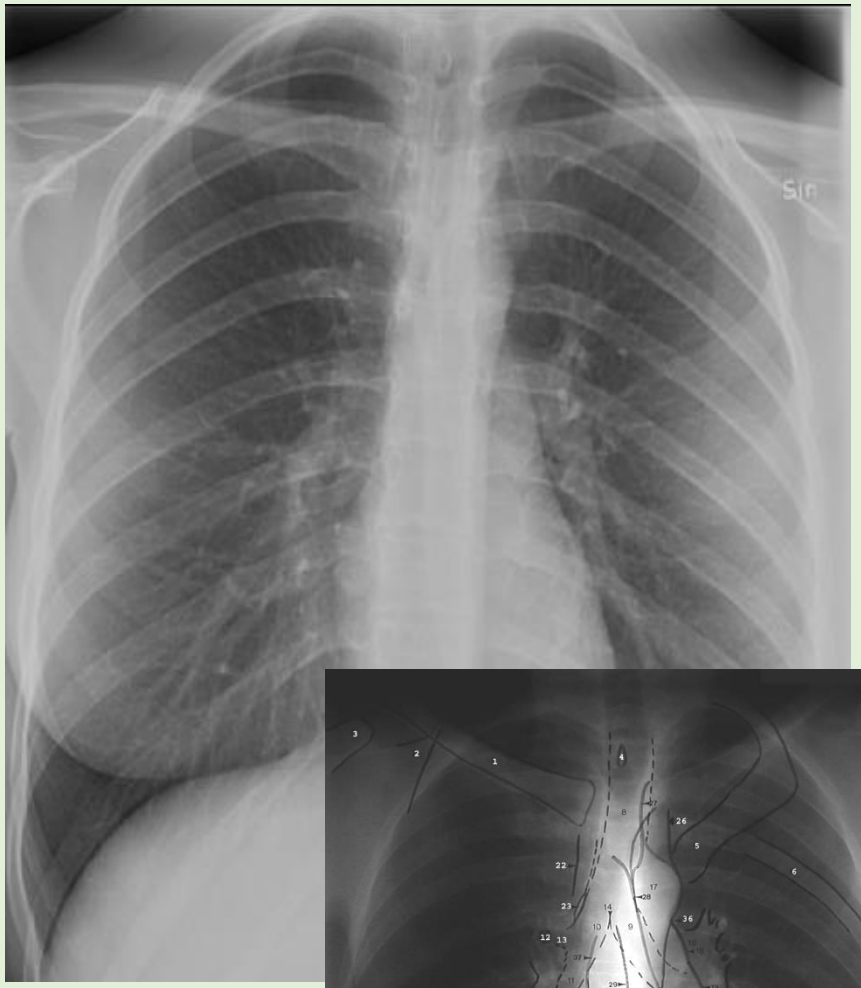
"Thorax from a woman", Figure 3 in. F.H.Williams' publication "Notes on X-rays in Medicine" from 1896 (left) probably represents the first published chest image. In Sweden the first published chest image (right) probably comes from Thor Stenbeck's textbook in medical radiology from 1900. It was the first textbook to be published in Swedish called:"Röntgenstrålarne i medicinens tjenst populär framställning", Wahlström & Widstrand, Stockholm. Photo credit: "Notes on X-rays in Medicine" from 1896 (left) Jens Östman, National Library of Sweden (right).

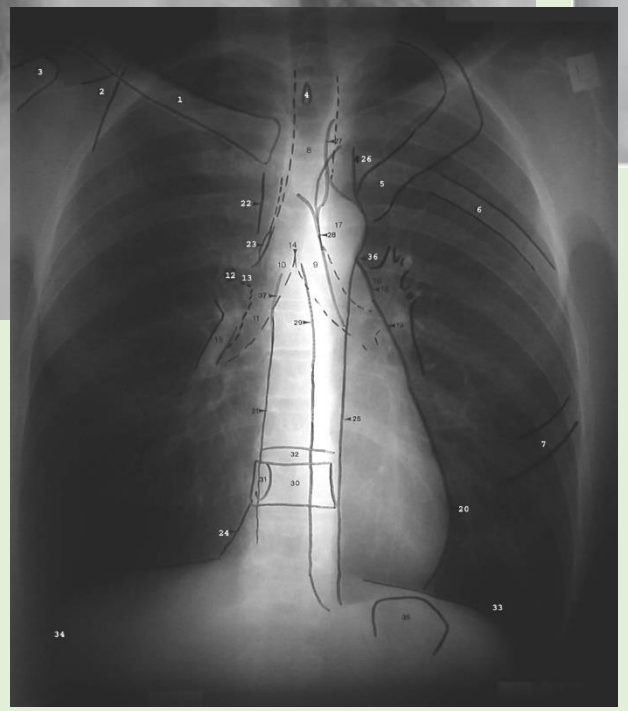
1973

iPhone 1 2007

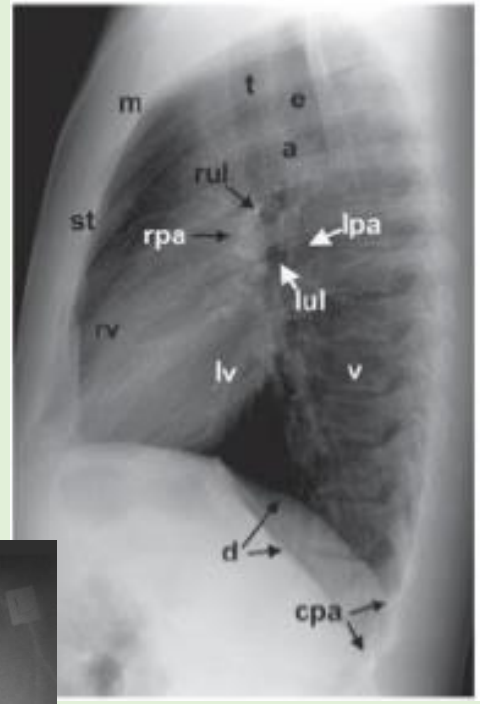
iPhone 16 2024

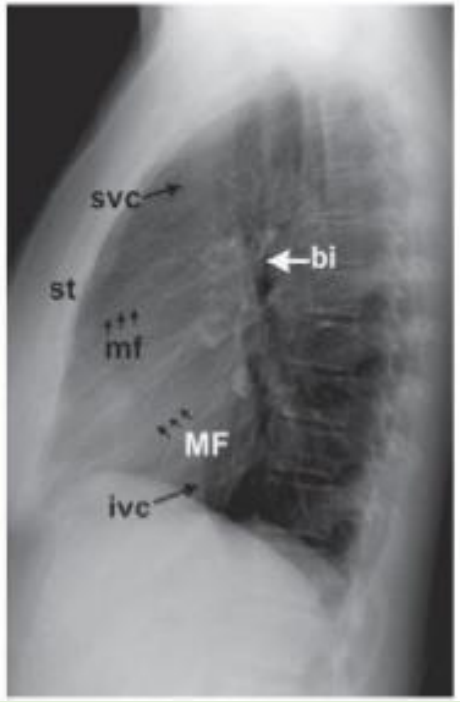






Normal Chest X-ray (lateral view)

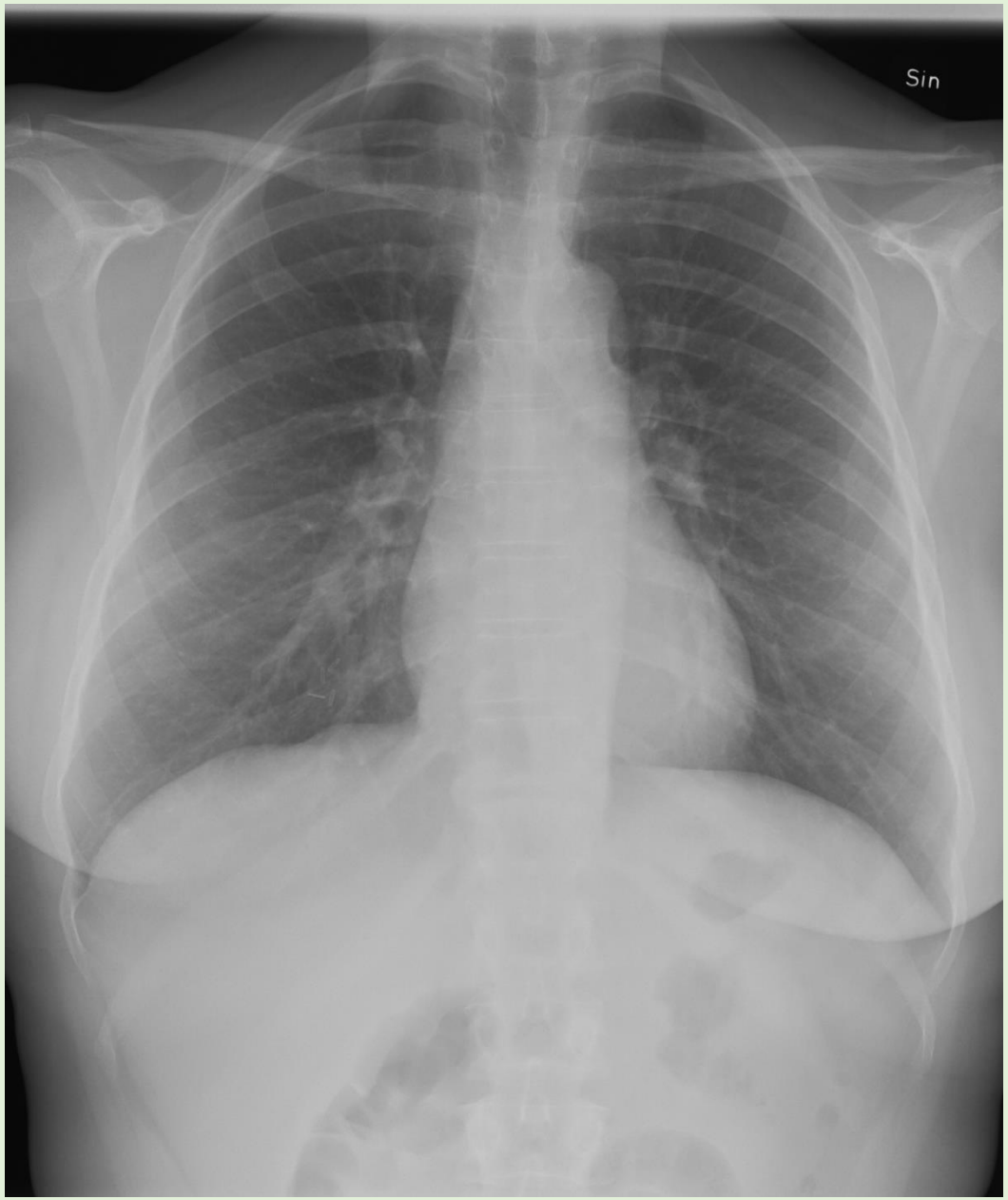




Index:

- a → aorta
- bi → bronchus intermedius
- cpa → costophrenic angle
- d → diaphragm
- e → esophagus
- ivc → inferior vena cava
- lpa → left pulmonary artery
- lul → left upper lobe bronchus
- lv → left ventricle
- m → manubrium
- mf → minor fissure
- MF → major fissure
- rpa → right pulmonary artery
- rul → right upper lobe bronchus
- rv → right ventricle
- st → sternum
- svc → superior vena cava
- t → trachea
- v → vertebral body

- Gammal och beprövad metod som har stått sig bra i mer än ett århundrade
- Ypperlig vid lungdiagnostik då lungan innehåller mycket luft
- Ger mycket information och är tekniskt både enkel och billig
- Kan kompletteras med tomosyntes
- Lite strålning
- Finns i hela världen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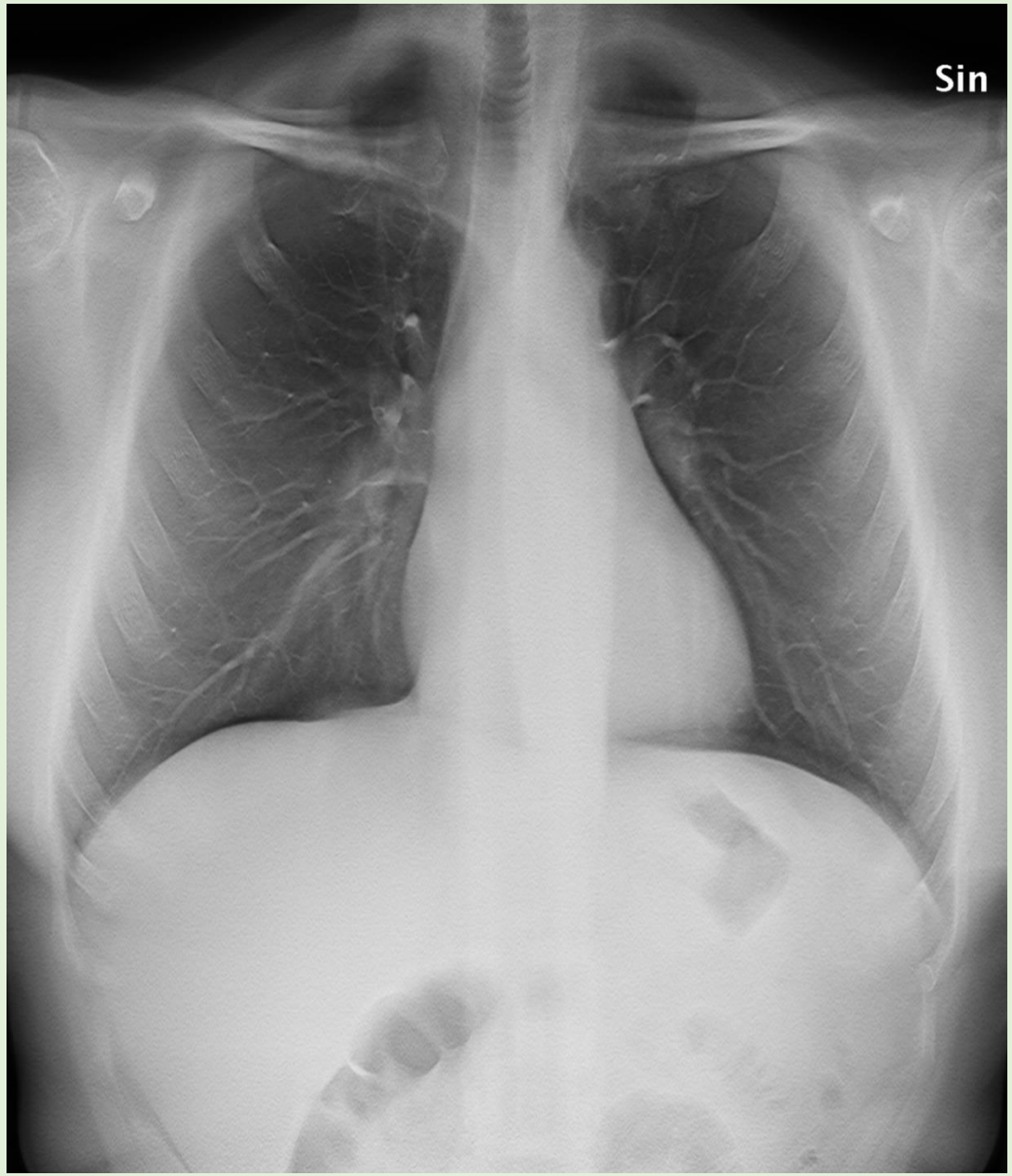
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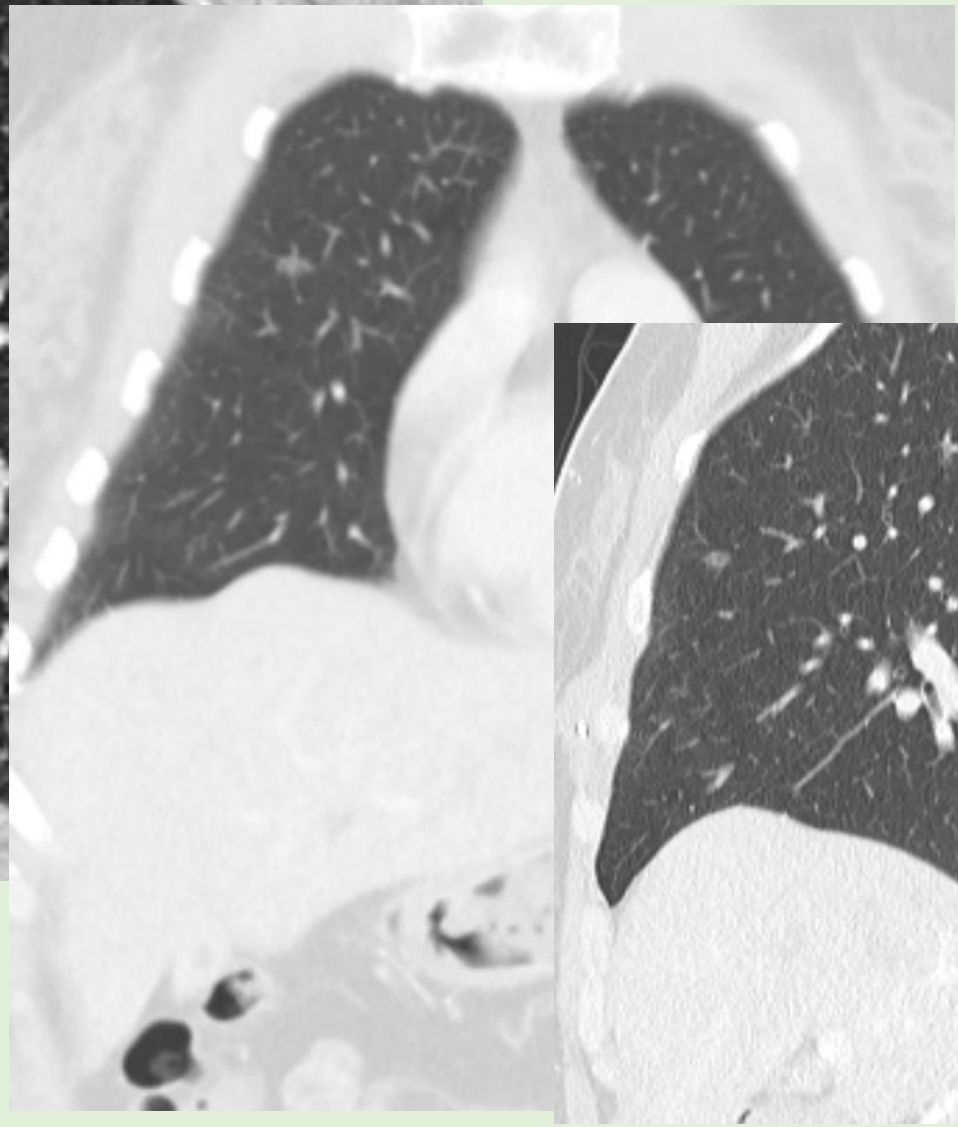

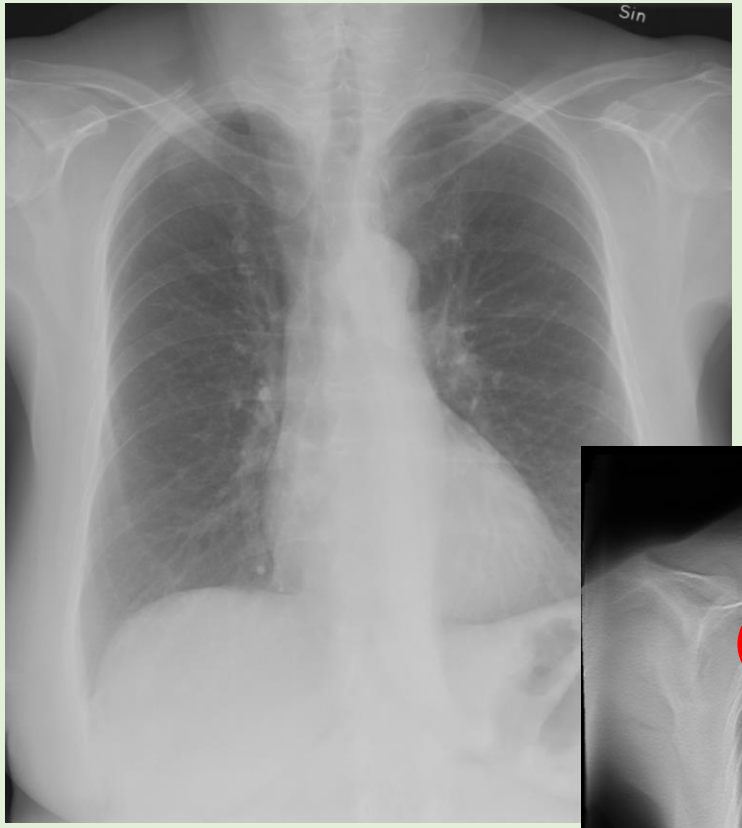
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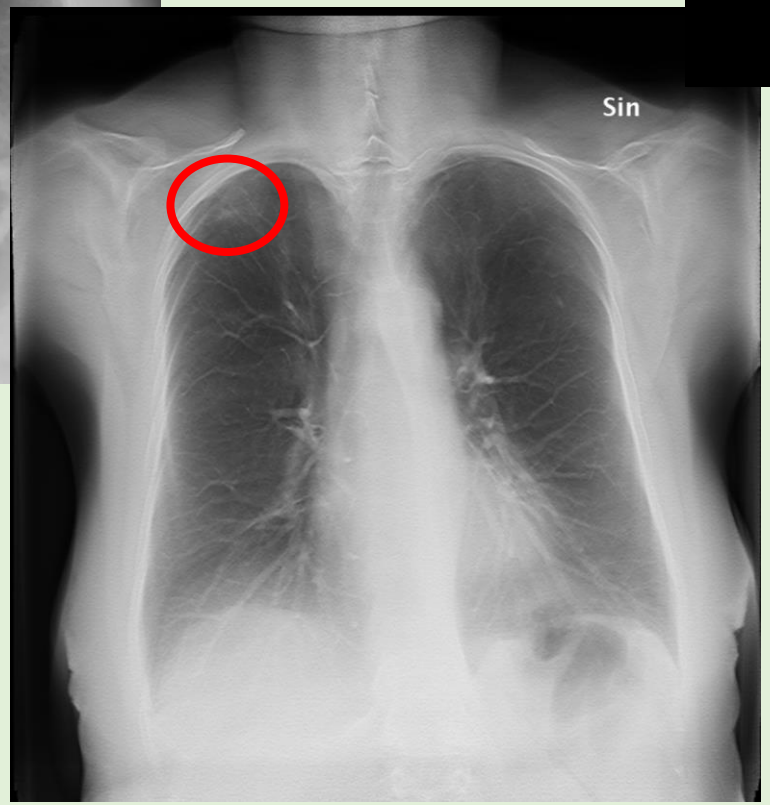
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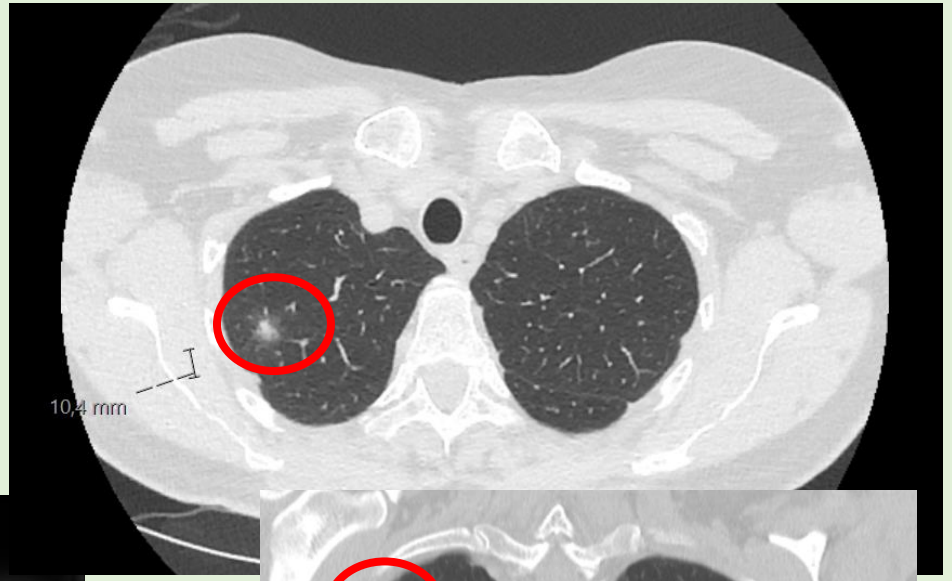
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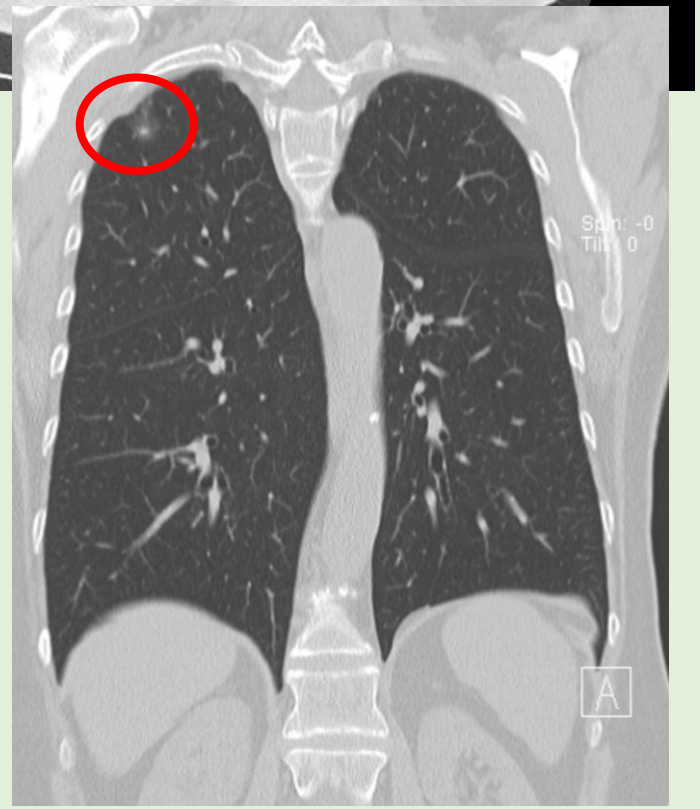


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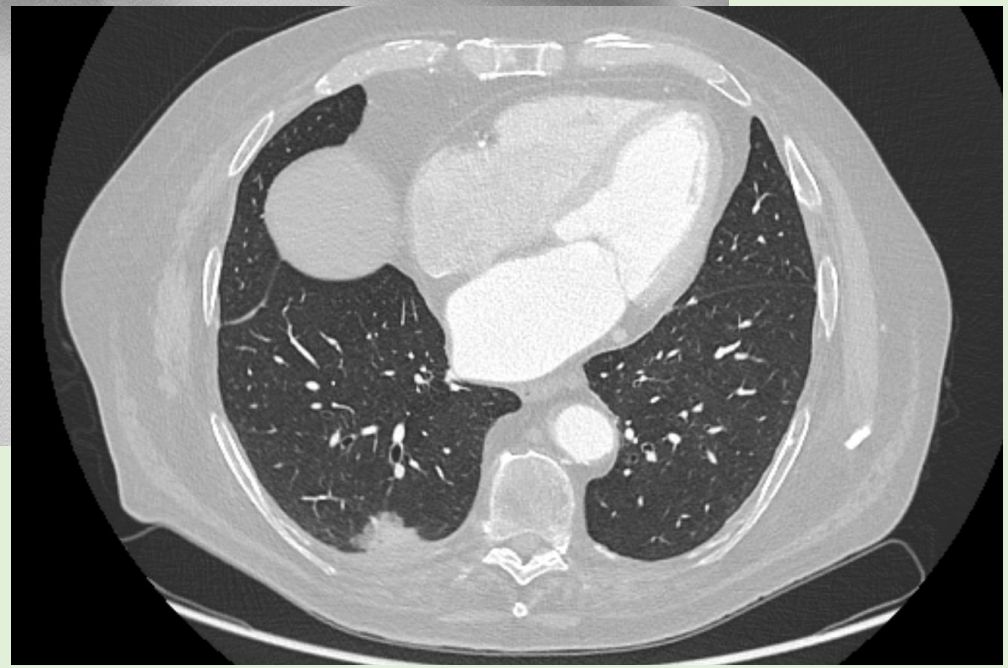
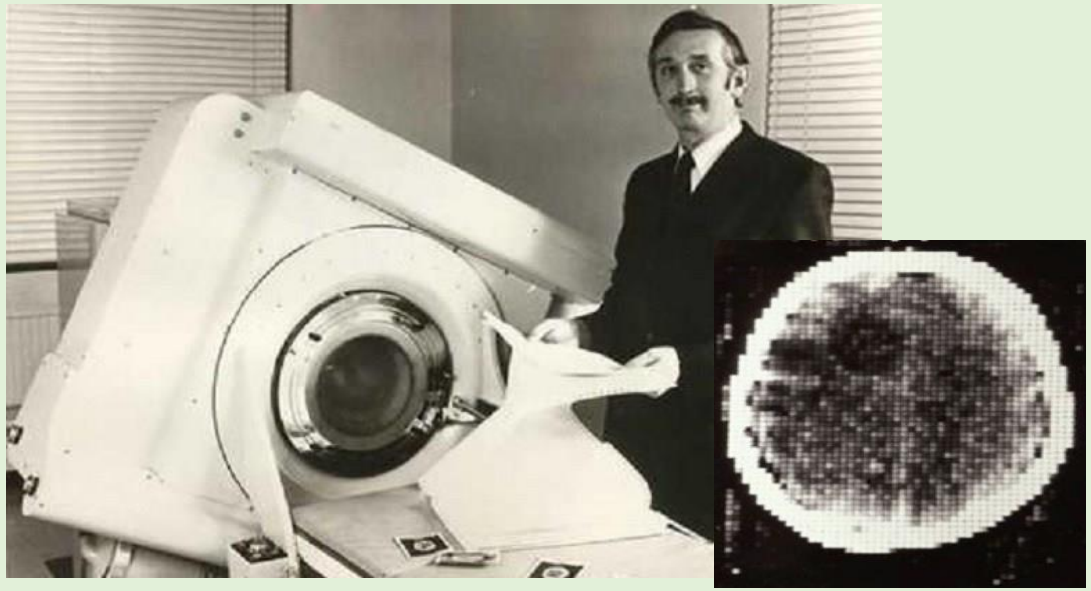
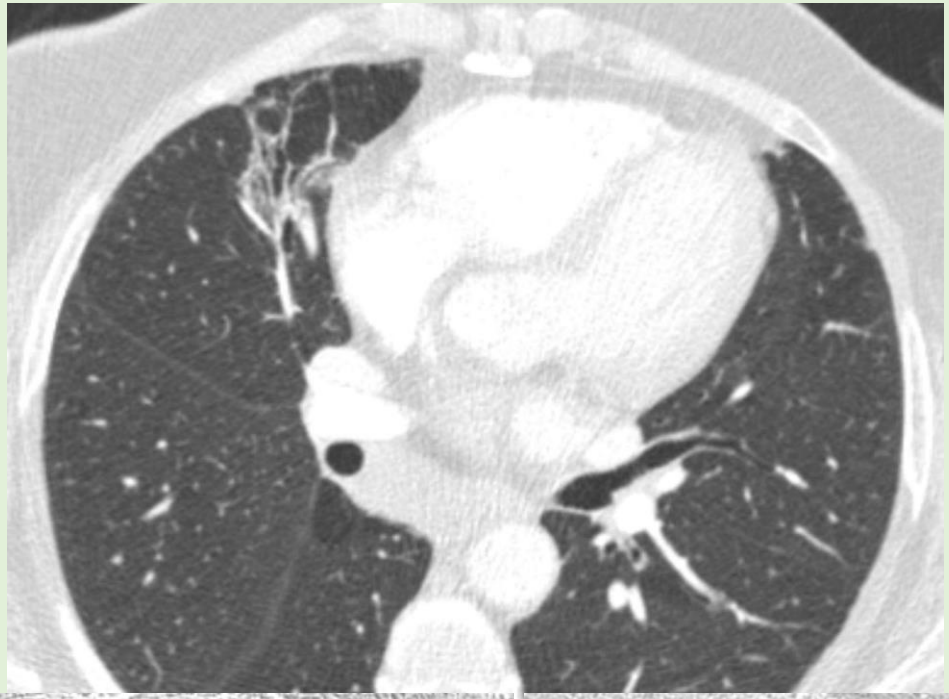
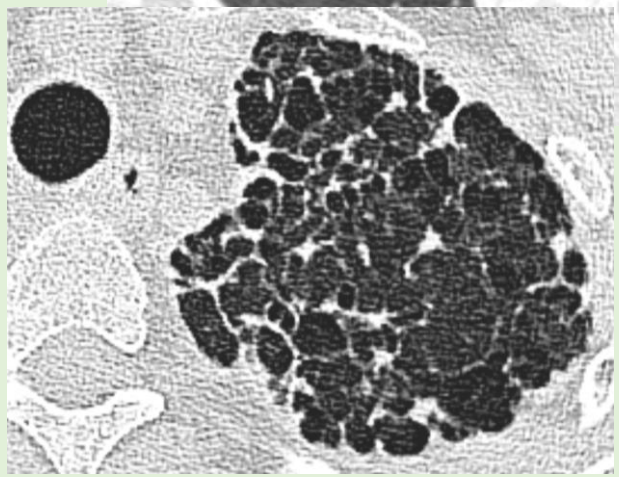
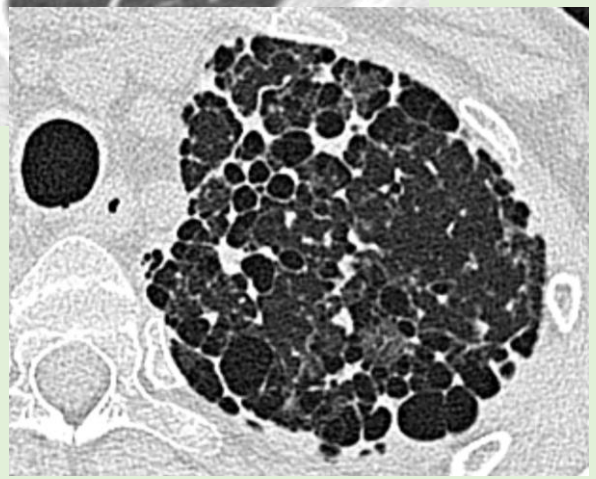


Datortomografi





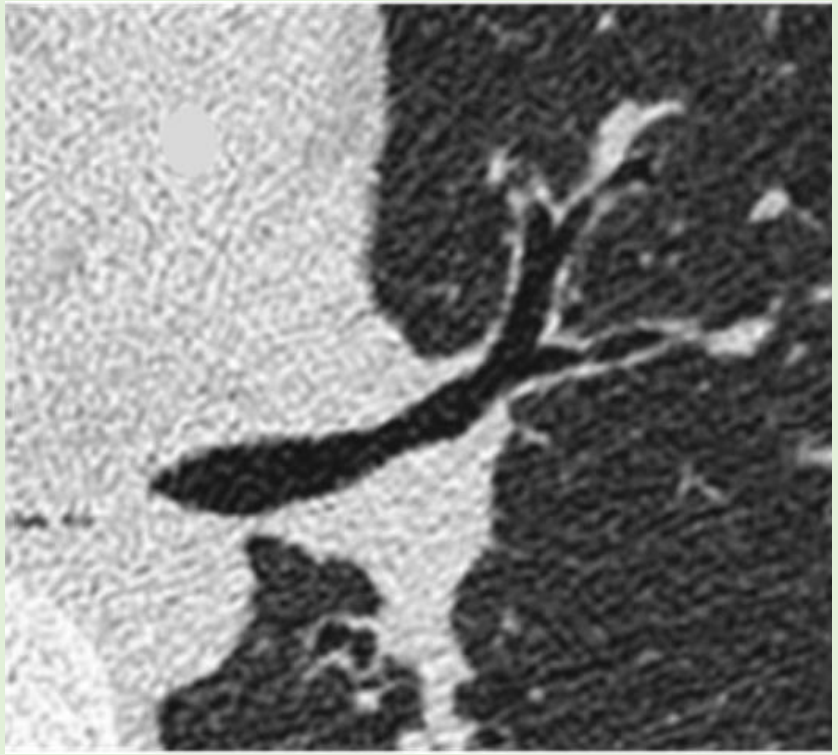


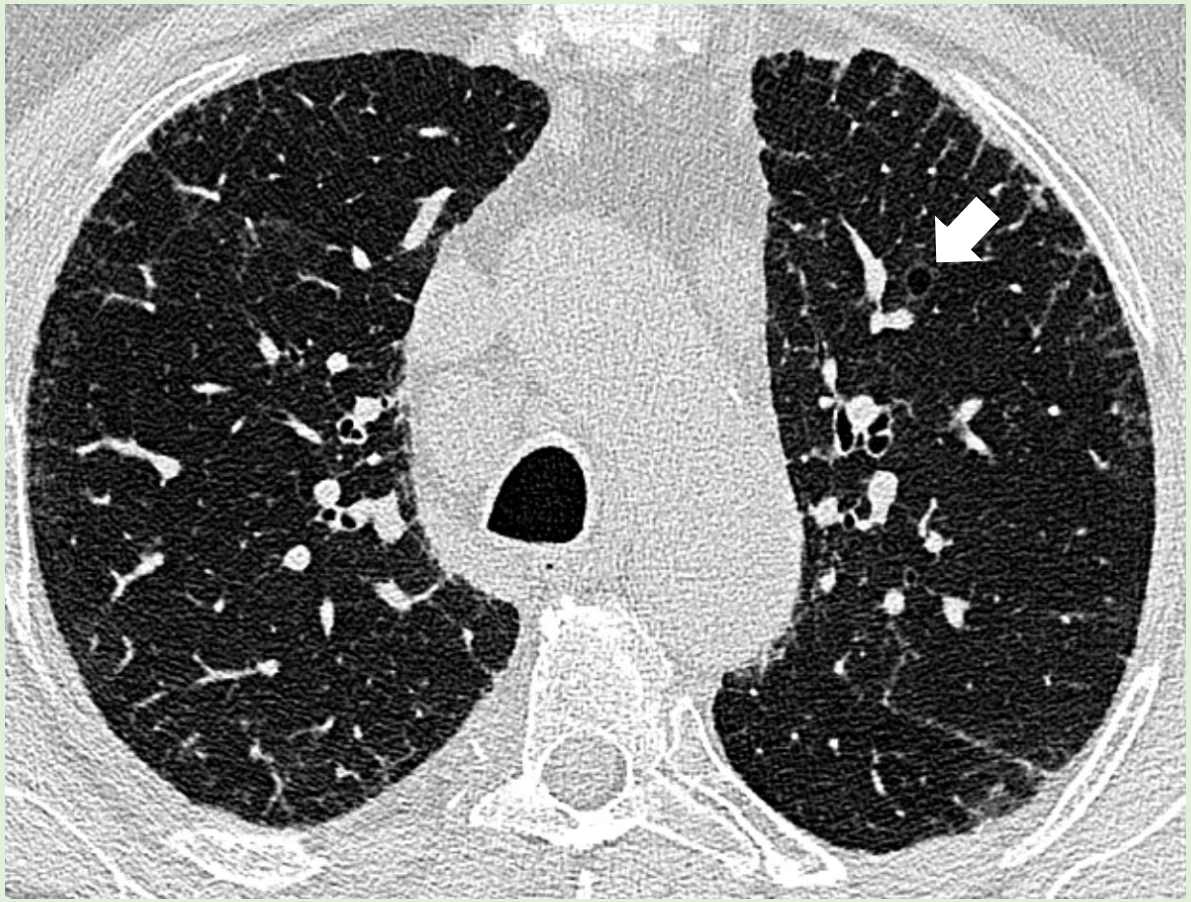


Strålning…ny teknink på ingång…

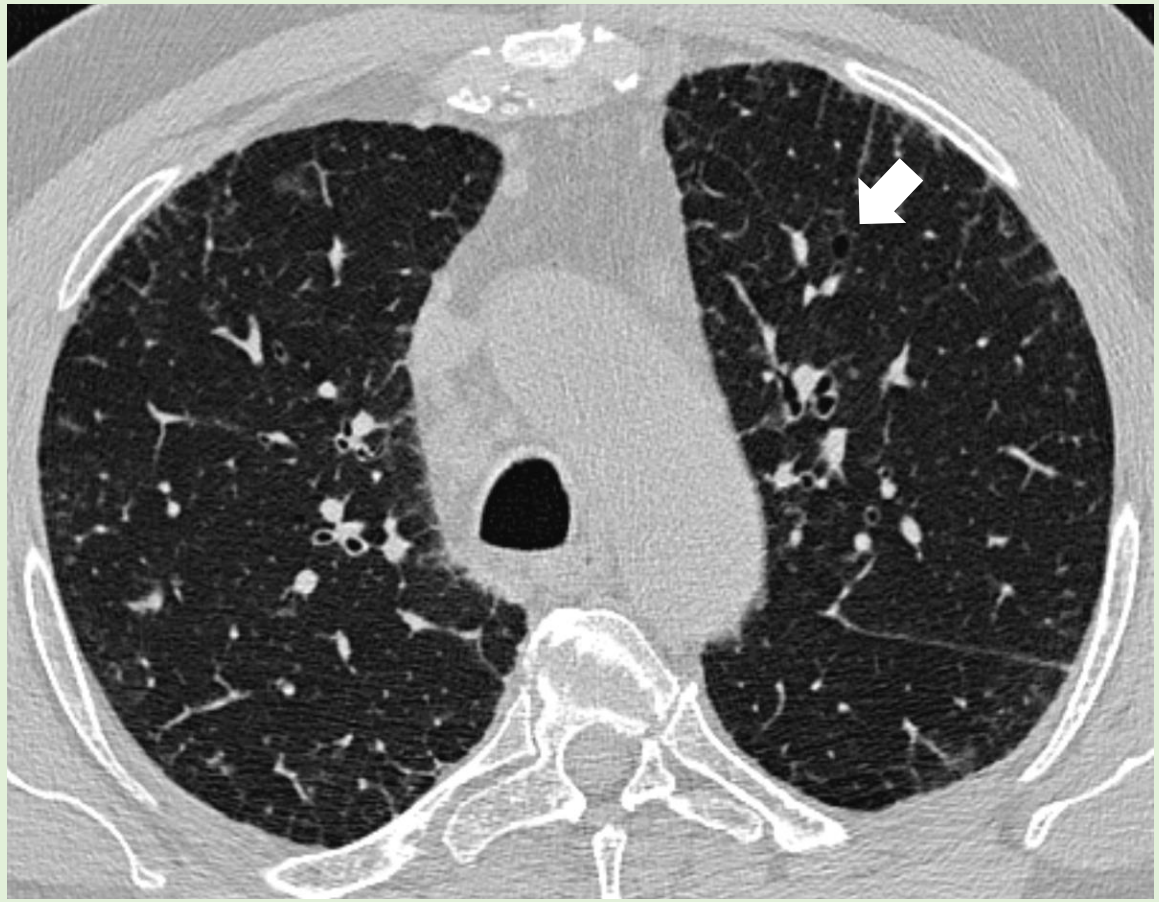
Siemens Naetom Alpha

- Två röntgenrör (2x120kW, vectron)
- Rotationstid (0.25/0.5/1.0s)
- Pitch 3.2 (737mm/s)
- Rörspänning 90/120/140/Sn100/Sn140
- Två detektorer (2xQuantaMax CdTe PcD (6cm))
- UHR 0.2mm
- Seq, Spiral, FlashSpiral, Perfusion 0.4mm





A.



B.

Betydligt mindre strålning

… om DT visar **cancermisstanke**…

Vilka förändringar inger misstanke om lungcancer?

- Storlek
- Utseende: gles/tät, spikulerad eller inte
- Lokalisation: ovanlob
- Utlöpare mot pleura eller inväxt i mediastinum
- Förstorade lymfkörtlar
- Förekomst av pleuravätska
- Emfysem

The Fleischner Society-Thoraxradiologens stora kompass

History

The Fleischner Society is named after Felix Fleischner, M.D., a pioneer in the pathogenesis and diagnosis of lung disease using the chest radiograph. Dr. Fleischner began his career in Vienna and was Chief of Radiology at Vienna Children's Hospital before moving to the United States in 1938. In the U.S., he spent his first two years at Massachusetts General Hospital followed by two years in private practice. Dr. Fleischner joined Beth Israel Hospital in 1942 as their first full-time radiologist. In 1945, he became Chairman of the department and served in that role until 1960. Dr. Fleischner was also named as a Harvard Medical School Professor in 1950 and published 251 articles during his career.

The Society was inaugurated in December of 1969 with the following aims:

- *To stimulate the recognition and development of chest roentgenology as a clinical specialty*
- *To foster continuing improvement of chest radiology as an art and science*
- *To improve the methods of teaching radiologic diagnosis of chest disease*
- *To promote closer fellowship among, and exchange of ideas between members of the profession whose major interests lie in the chest*
- *To provide meetings for the reading and discussion of papers, and dissemination of knowledge*

The Fleischner Society is now well into its fifth decade. With a membership comprised of thought-leading physicians from around the world, the Society continues to play an essential role in the advancement of knowledge in the diagnosis and treatment of diseases of the chest.

Radiology

Fleischner Society: Glossary of Terms for Thoracic Imaging[1]

David M. Hansell, MD, FRCP, FRCR
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Heber MacMahon, MB, BCh, BAO
Theresa C. McLoud, MD
Nestor L. Müller, MD, PhD
Jacques Remy, MD

Members of the Fleischner Society compiled a glossary of terms for thoracic imaging that replaces previous glossaries published in 1984 and 1996 for thoracic radiography and computed tomography (CT), respectively. The need to update the previous versions came from the recognition that new words have emerged, others have become obsolete, and the meaning of some terms has changed. Brief descriptions of some diseases are included, and pictorial examples (chest radiographs and CT scans) are provided for the majority of terms.

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Radiology

REVIEWS AND COMMENTARY • STATEMENTS AND GUIDELINES

Fleischner Society: Glossary of Terms for Thoracic Imaging

Alexander A. Bankier, MD, PhD • Heber MacMahon, MB, BCh • Thomas Colby, MD • Pierre Alain Gevenois, MD, PhD • Jin Mo Goo, MD, PhD • Ann N.C. Leung, MD • David A. Lynch, MB, BCh • Cornelia M. Schaefer-Prokop, MD • Noriyuki Tomiyama, MD, PhD • William D. Travis, MD • Johny A. Verschakelen, MD, PhD • Charles S. White, MD • David P. Naidich, MD

Columbia, Canada (N.L.M.); and Department of Radiology, CHRU de Lille, Hôpital Calmette, Lille, France (J.R.). Received April 21, 2007; revision requested May 29; revision received June 6; accepted August 7; final version accepted September 19. **Address correspondence to:** D.M.H. (e-mail: *d.hansell@rbht.nhs.uk*).

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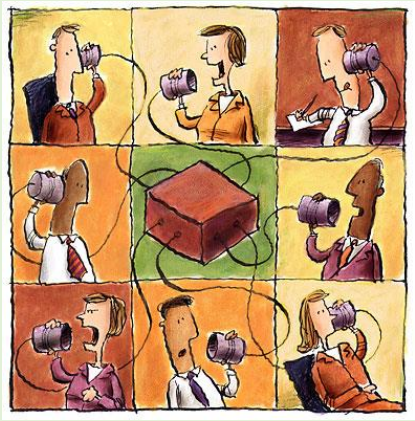
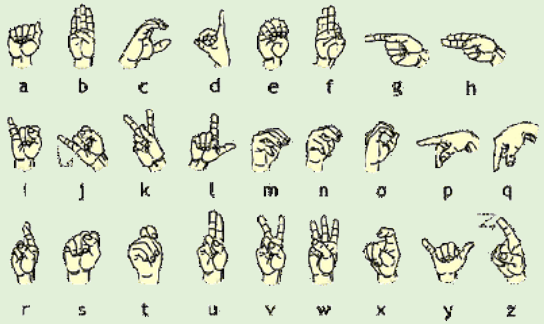
https:fleischner.memberclicks.net/white-papers



Kommunikation



Radiology

REVIEWS AND COMMENTARY · STATEMENTS AND GUIDELINES

Fleischner Society: Glossary of Terms for Thoracic Imaging

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Bronchiectasis (Pathology) (Figs 28, 45)

Bronchiectasis indicates a clinical condition of irreversible bronchial dilatation. In the absence of established chronicity, we recommend using the term "bronchial dilatation." Bronchiectasis can be secondary to chronic inflammation, congenital, or caused by chronic infection and obstruction of more central airways*. It is often accompanied by bronchial wall thickening and/or mucoid impaction*. At CT, bronchiectasis manifests as dilatation of the bronchus relative to the accompanying pulmonary artery (signet ring sign*), lack of tapering, and presence of visible bronchi within 1 cm of the pleural surface ("tram-tracking"). Bronchial walls can be thickened and accompanied by scarring of the adjacent parenchyma (43,44).

- Traction bronchiectasis (pathology): Dilatation of the bronchial lumen associated with thickened, irregular* bronchial walls, caused by fibrosis* (45). This term should only be used in the context of fibrosis (Fig 28).

- Traction bronchiolectasis (pathology): Dilatation of bronchioles (bronchiole*) within the central portions of the secondary pulmonary lobule* typically associated with fibrosis* and honeycombing* (46).

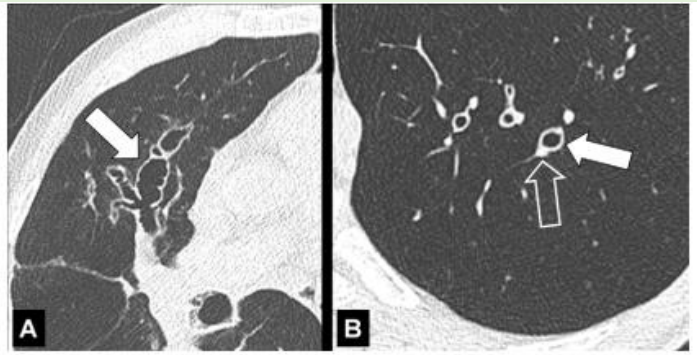


Figure 45: Bronchiectasis: Transverse CT images of the lungs in two different patients show severe bronchiectasis (solid arrow) in **(A)** right upper lobe and milder bronchiectasis (solid arrow) in **(B)** left lower lobe. Note the smaller diameter of the accompanying pulmonary artery (signet ring sign) (open arrow).

Opacity (Anatomy/Pathology) [Descriptor] (Fig 74)

Opacity refers to any focal or diffuse nonspecific area of increased attenuation. The term is a general descriptor that does not indicate the nature of the condition causing the opacity. The term has sometimes been used synonymously with the now obsolete and nonrecommended term "infiltrate" (111).

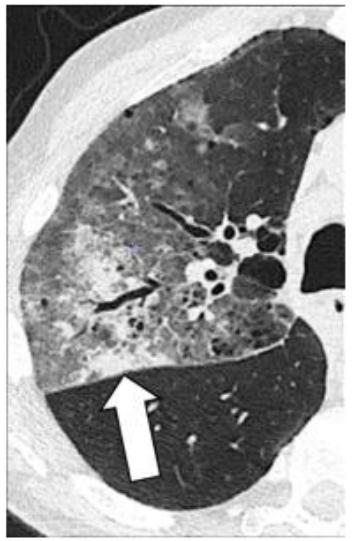


Figure 74: Ground-glass opacities and consolidation: Transverse CT image of the right lung shows ground-glass opacities and focal consolidation (arrow). *click to return to page 6, page 9*

infiltrate

Radiographs and CT scans.—Formerly used as a term to describe a region of pulmonary opacification caused by airspace or interstitial disease seen on radiographs and CT scans. *Infiltrate* remains controversial because it means different things to different people (69). The term is no longer recommended, and has been largely replaced by other descriptors. The term *opacity*, with relevant qualifiers, is preferred.

[Fleischner Society: Glossary of Terms for Thoracic Imaging (rsna.org)]

~~INFILTRAT~~

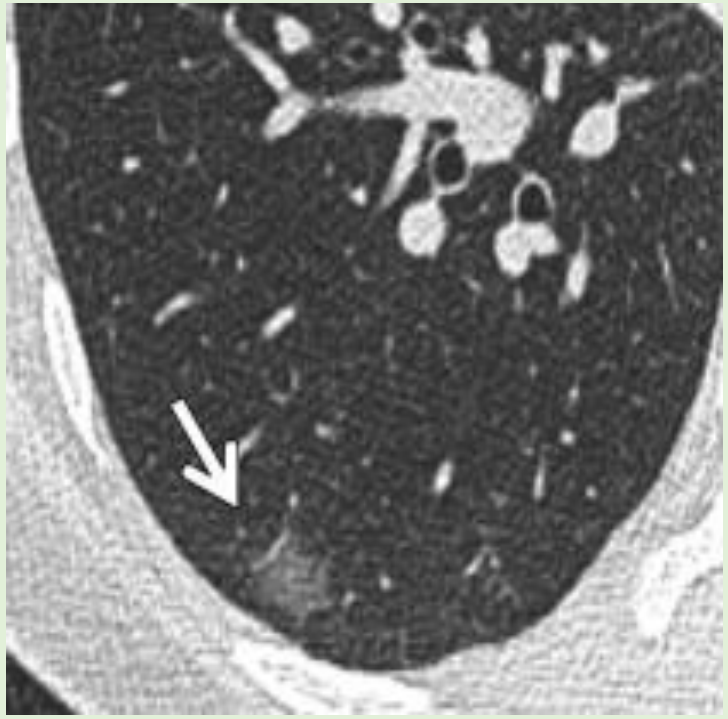
FÖRTÄTNING

GGO är varje förtätning som är så gles att man fortfarande kan se kärl och luftvägar genom den.

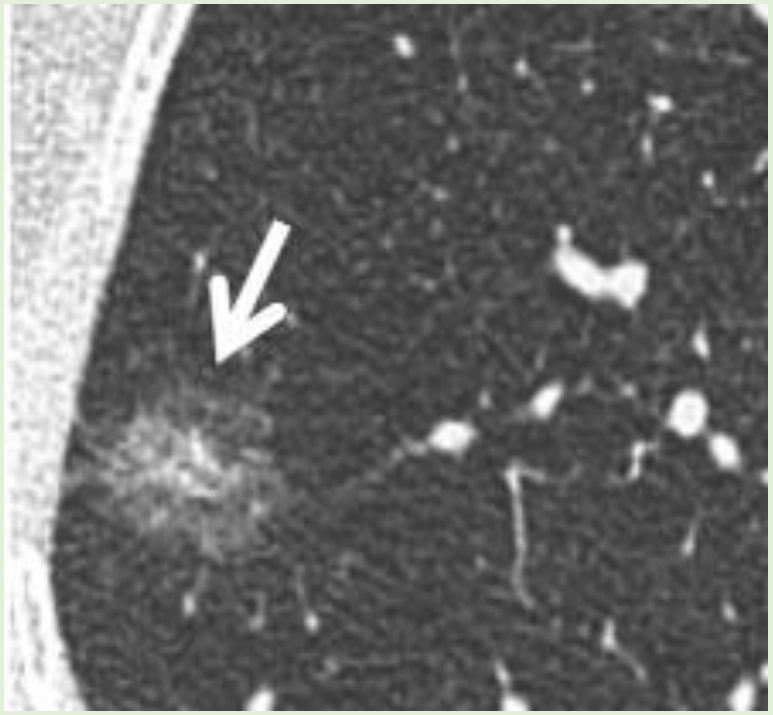
När kärl och luftvägar inte syns är det en *konsolidering* om volymen är bevarad och *atelektas* om den är volymsreducerad.

Utan distribuering, andra tecken eller klinisk information är detta ett OSPECIFIKT fynd.

Utseende av nodulära förändringar

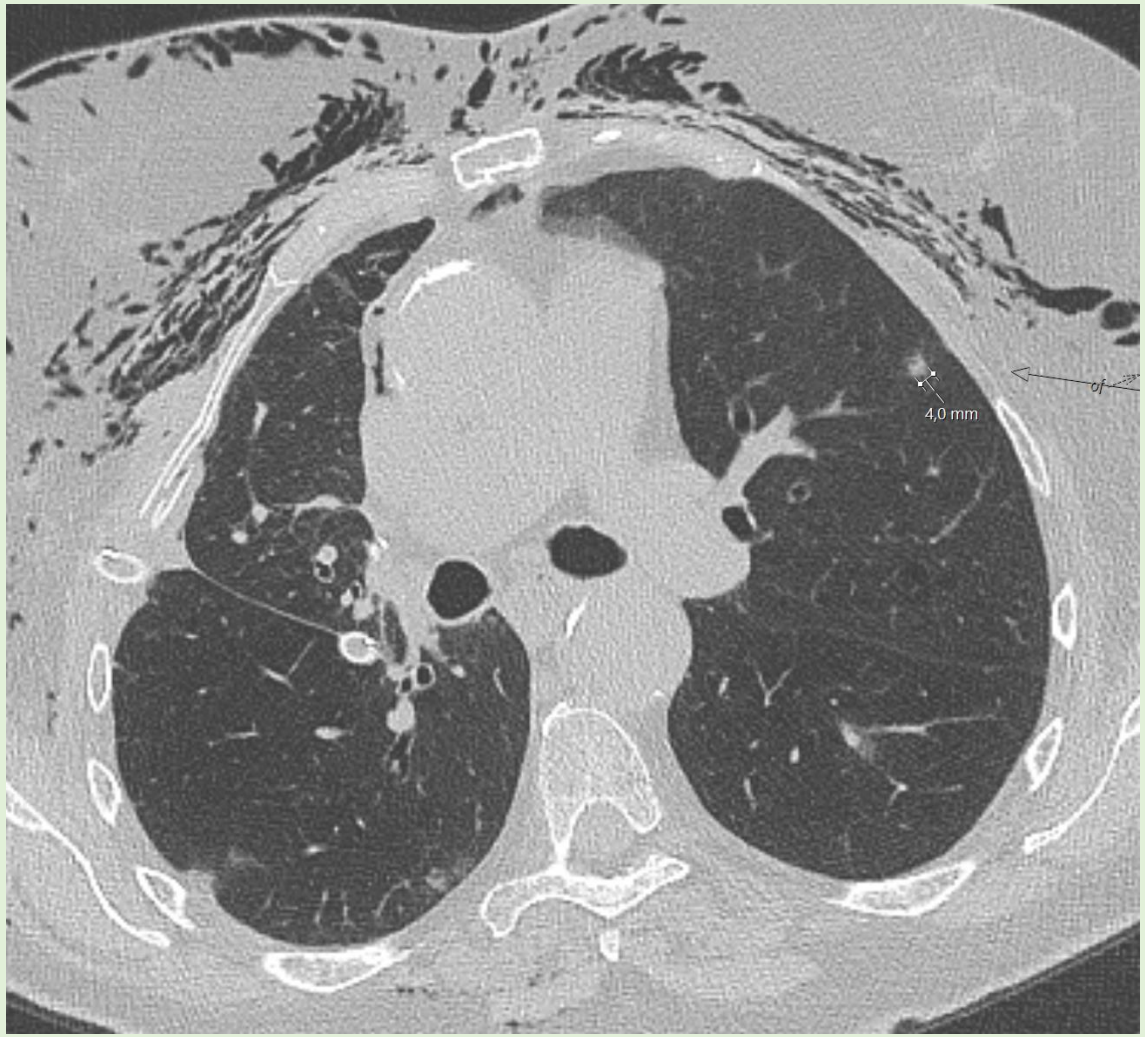


GGO



Part solid (Semisolid)

Solid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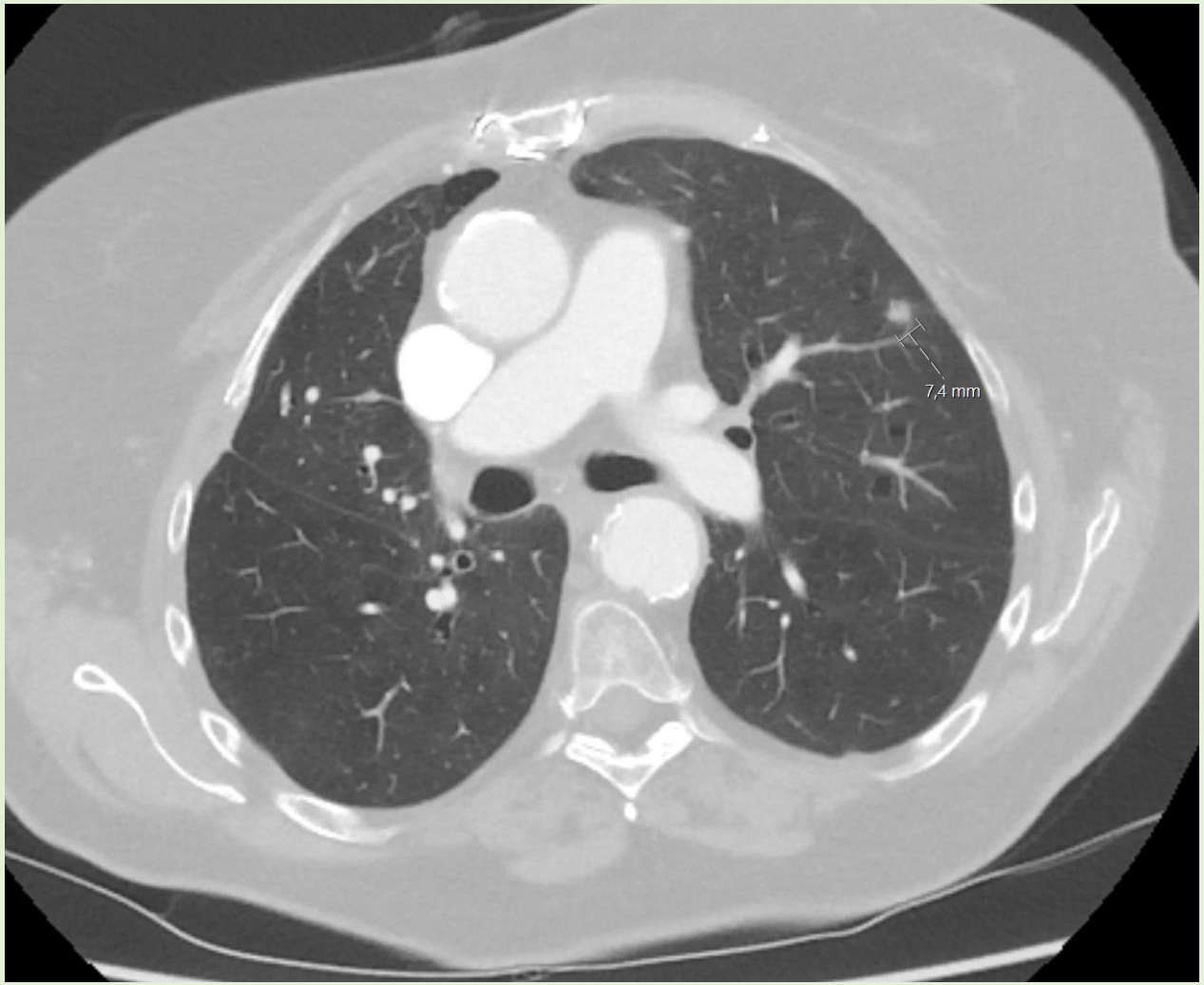
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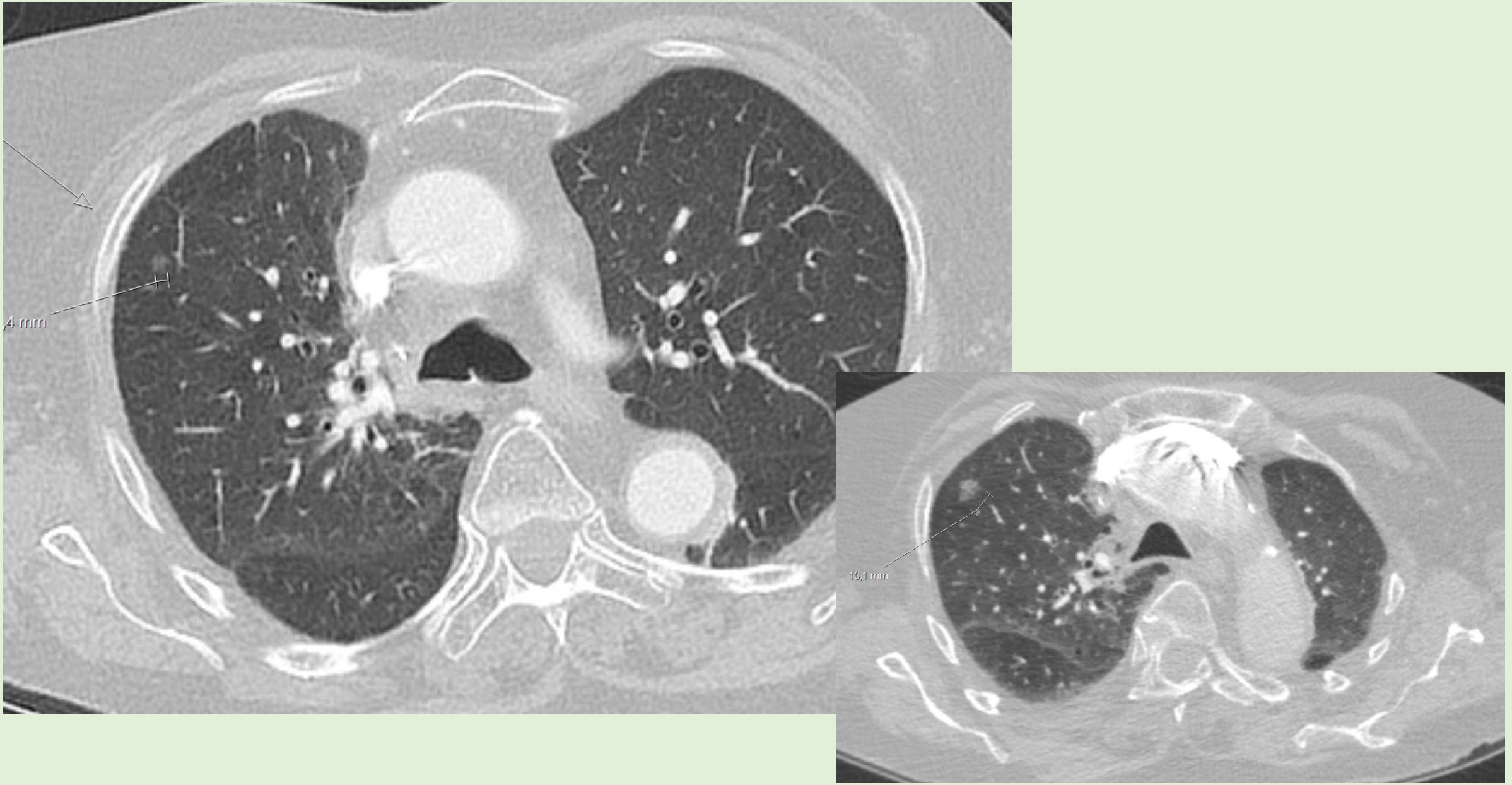
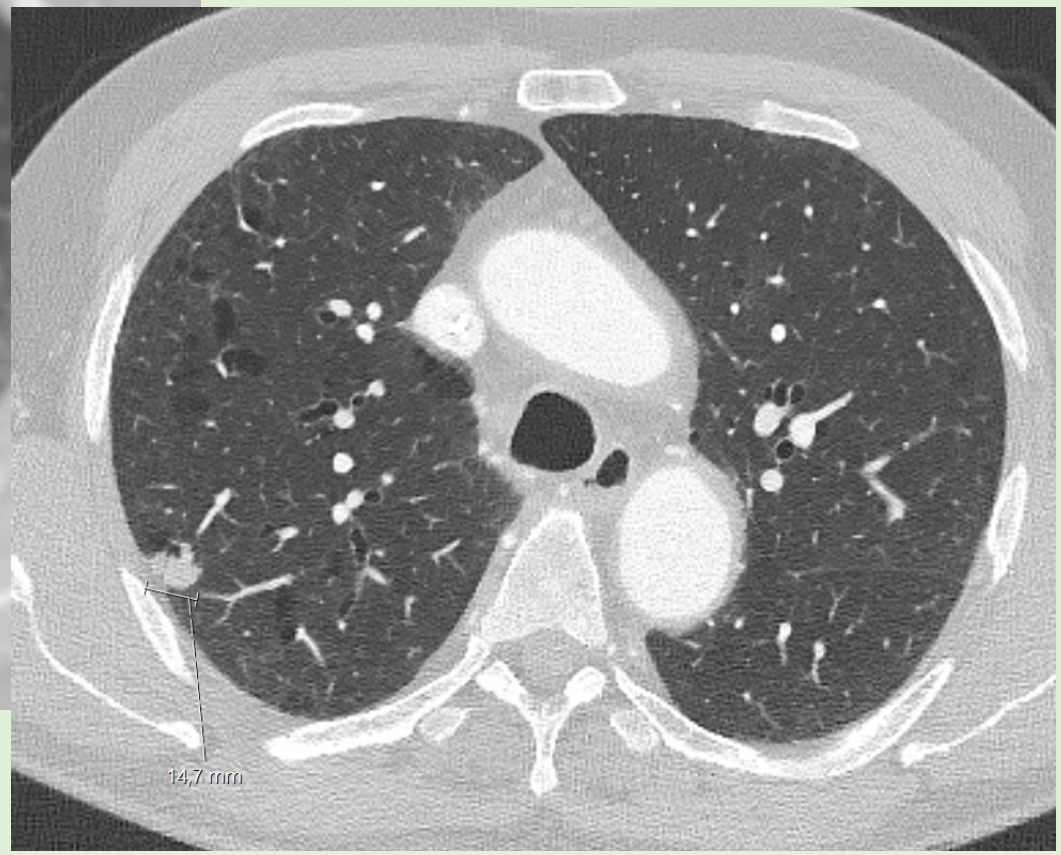

,4 mm
10,1 mm


4,1 mm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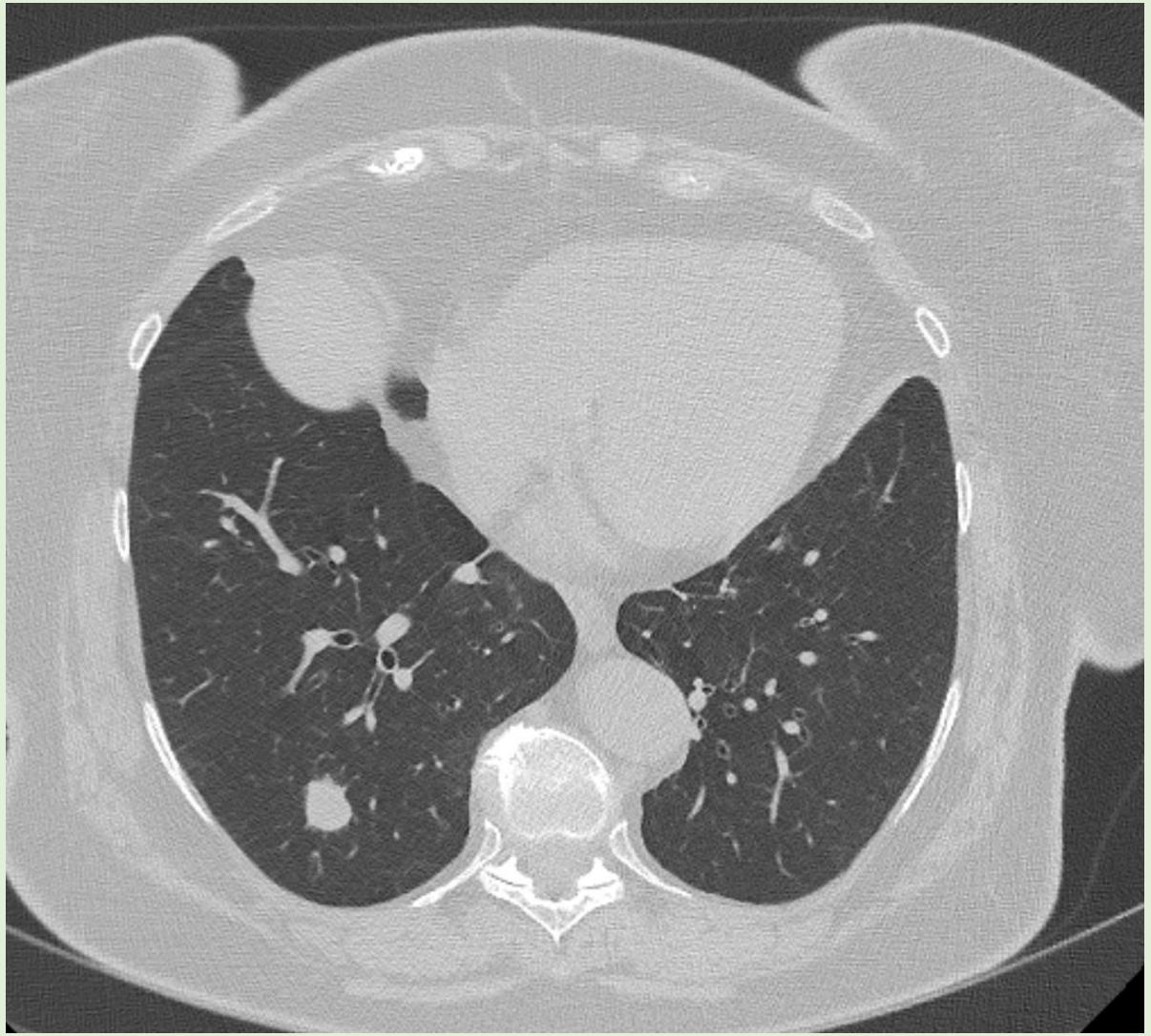


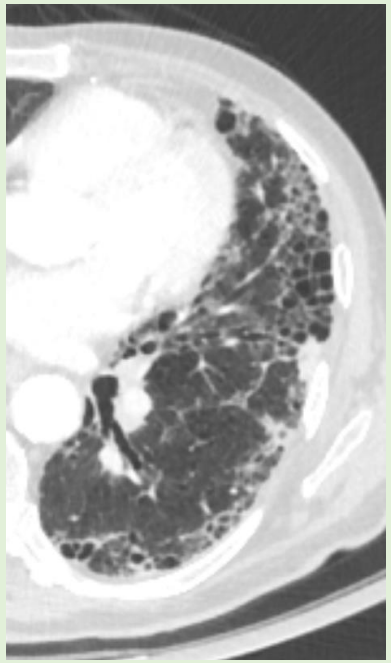

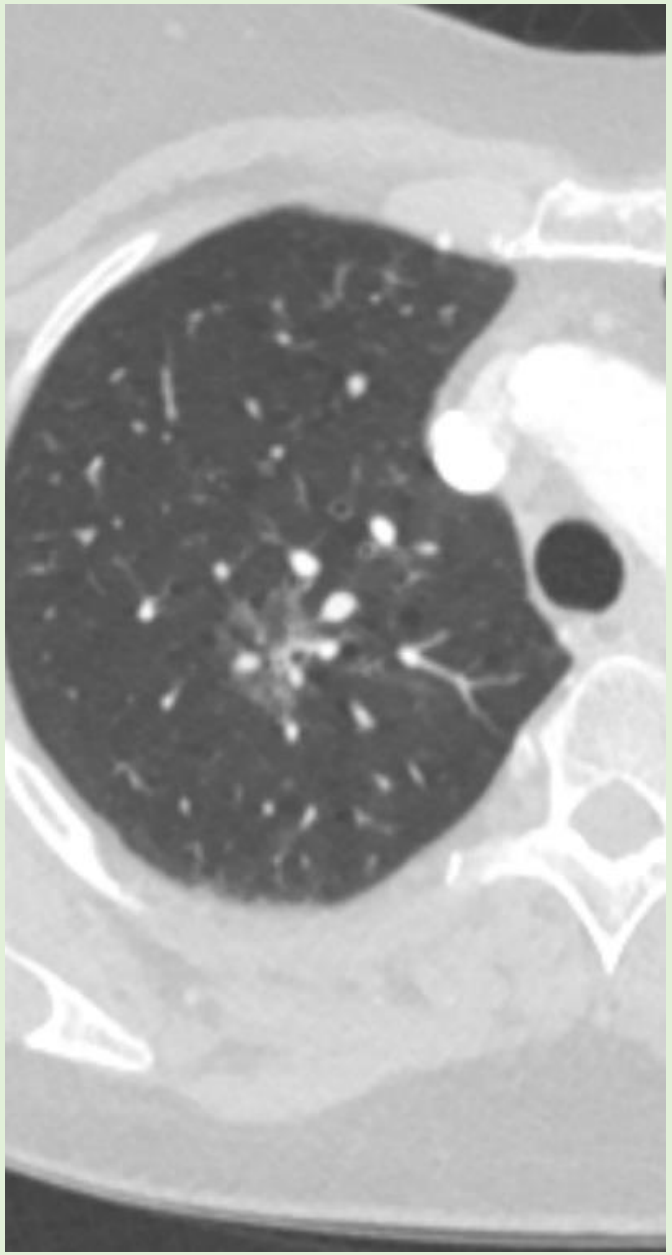


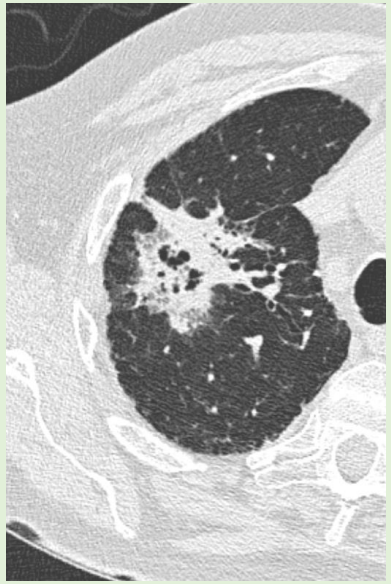
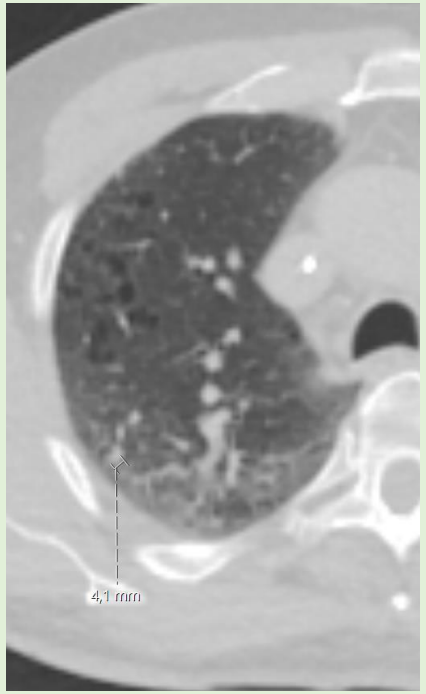
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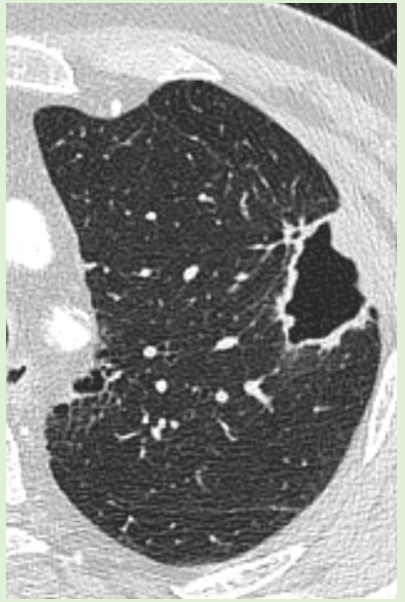

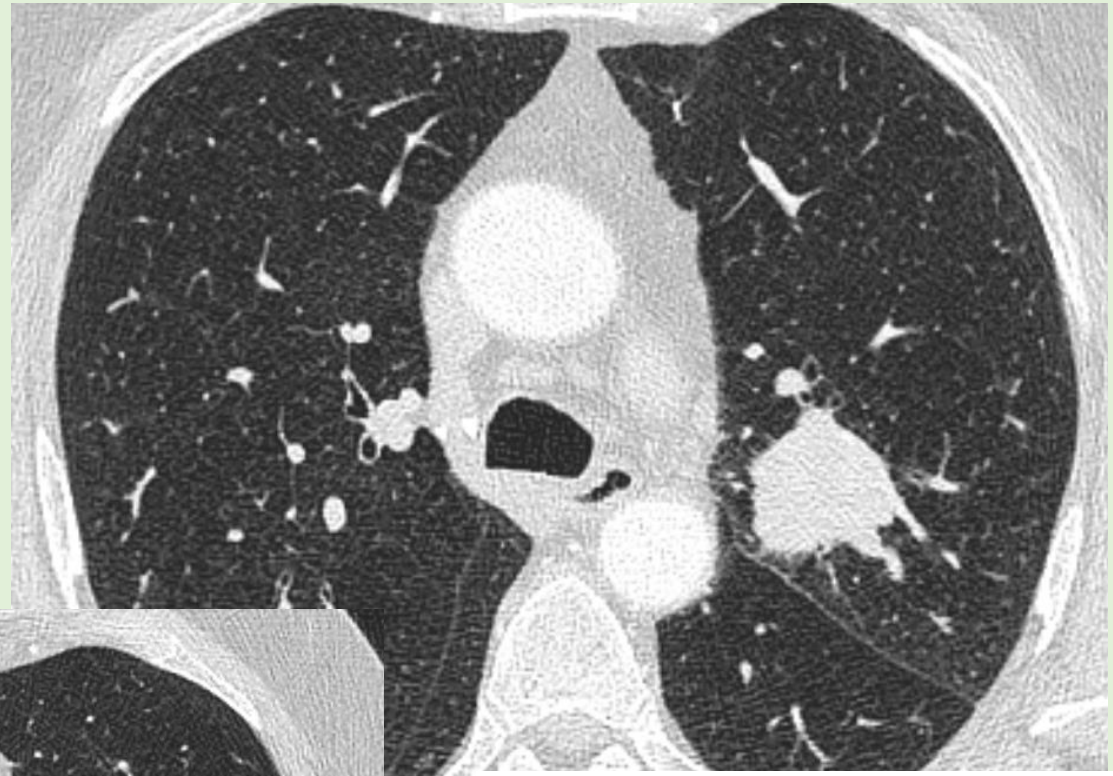

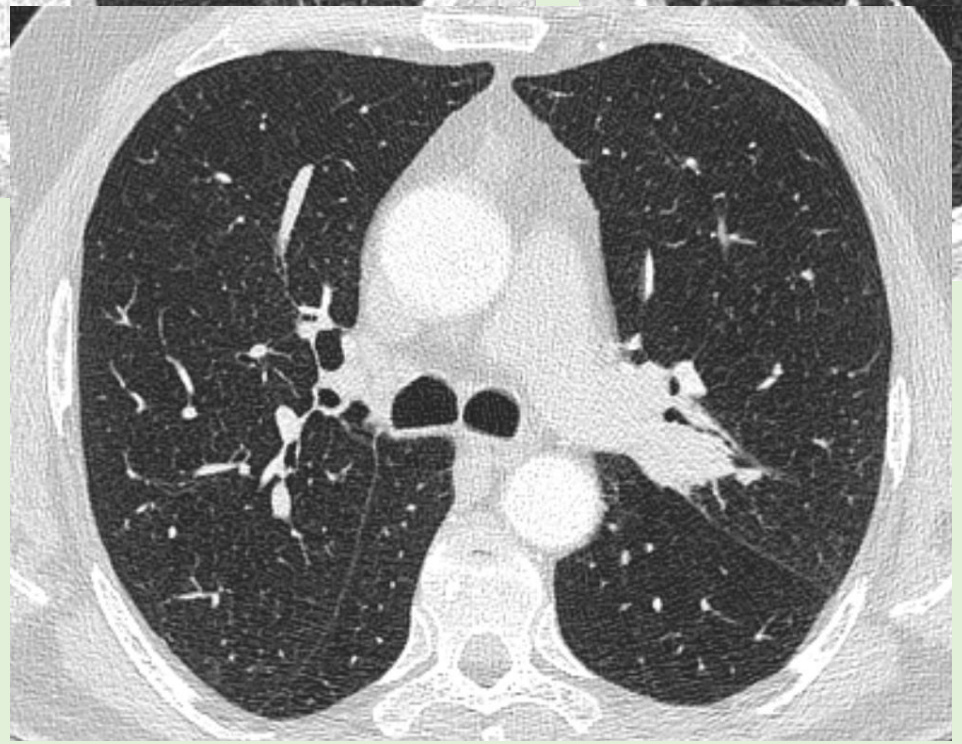

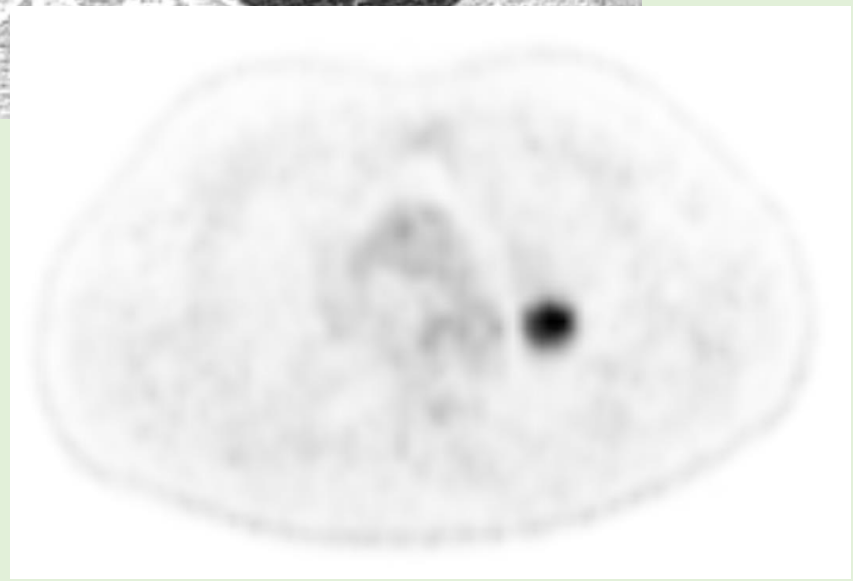

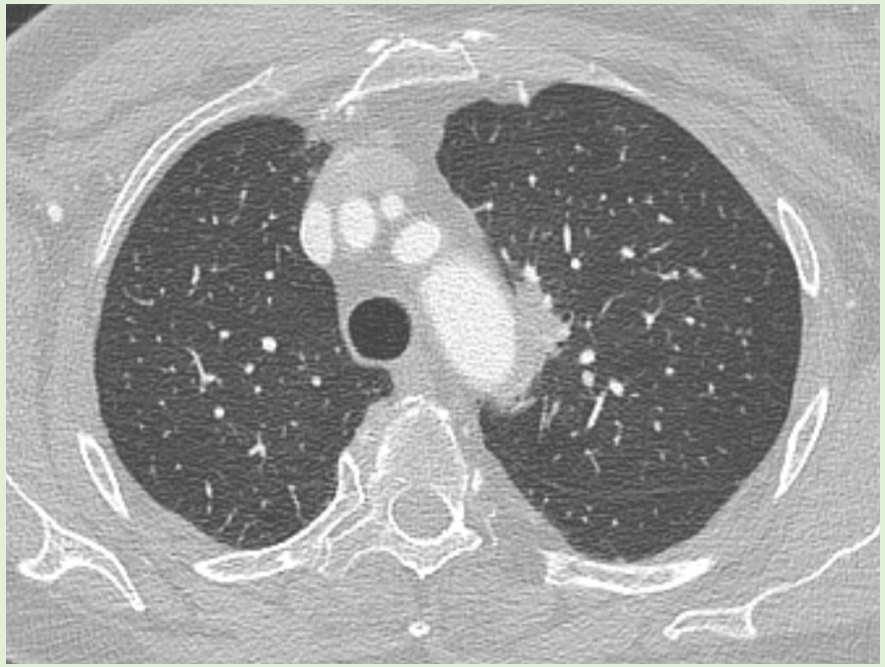

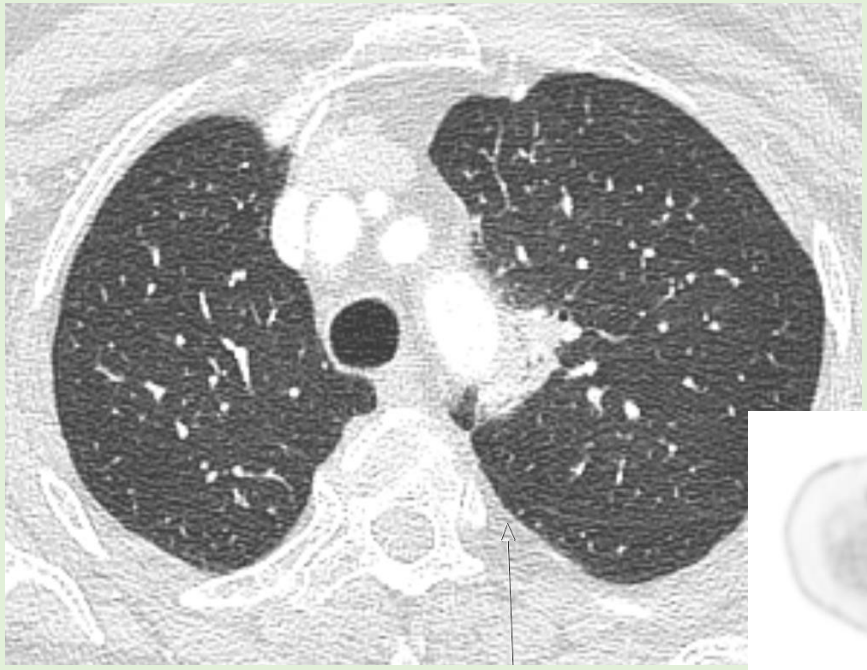

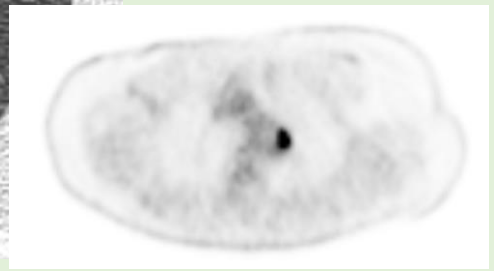

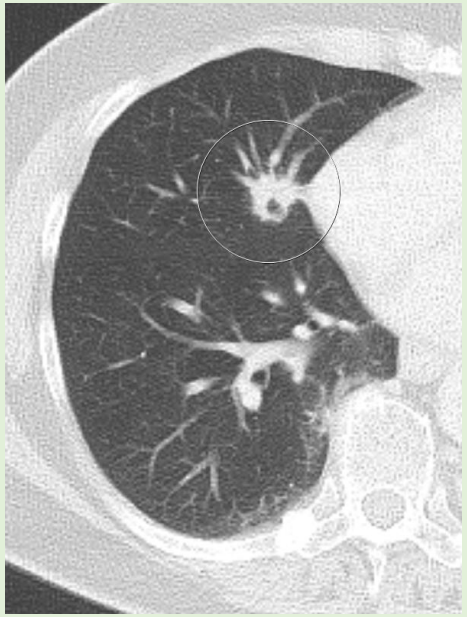

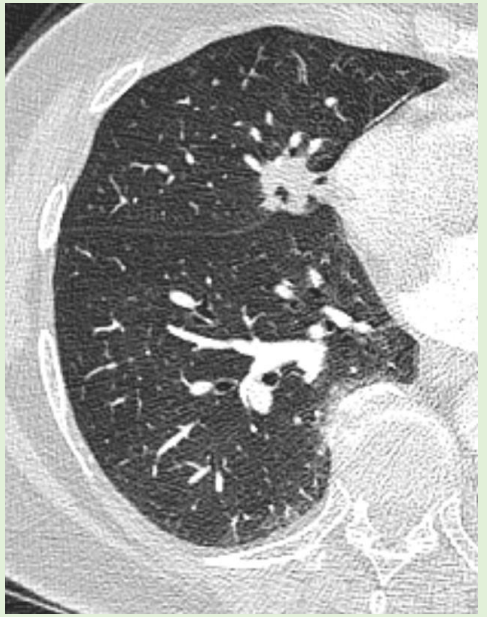

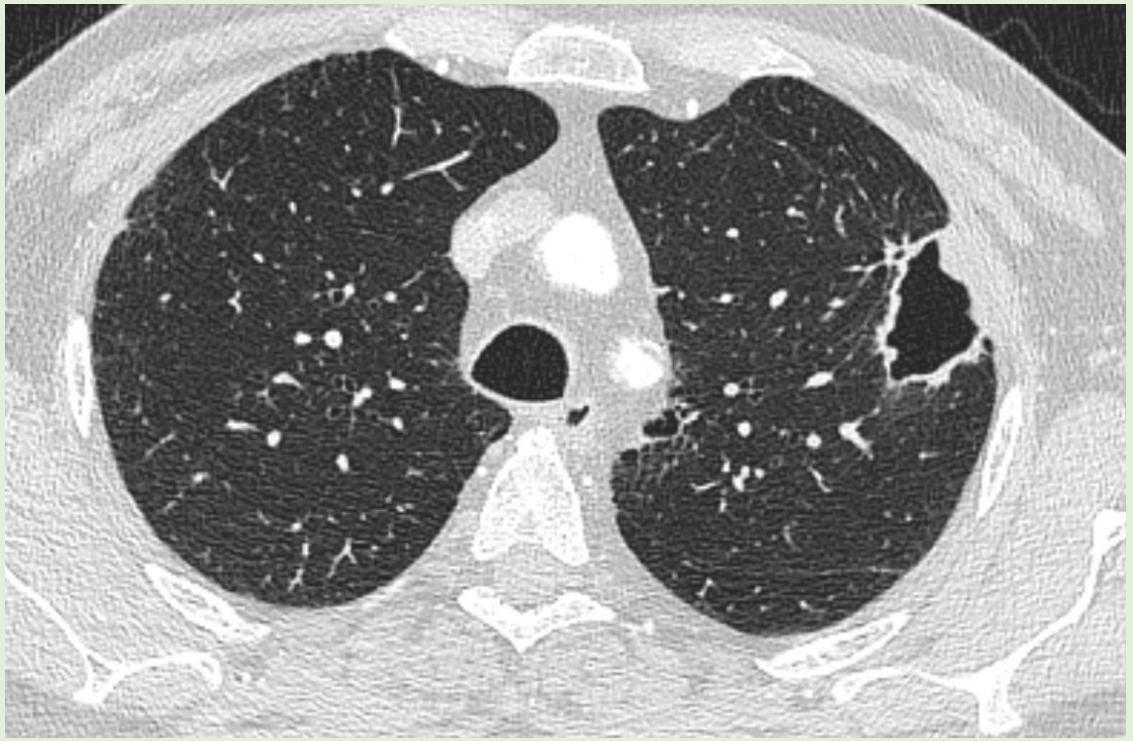

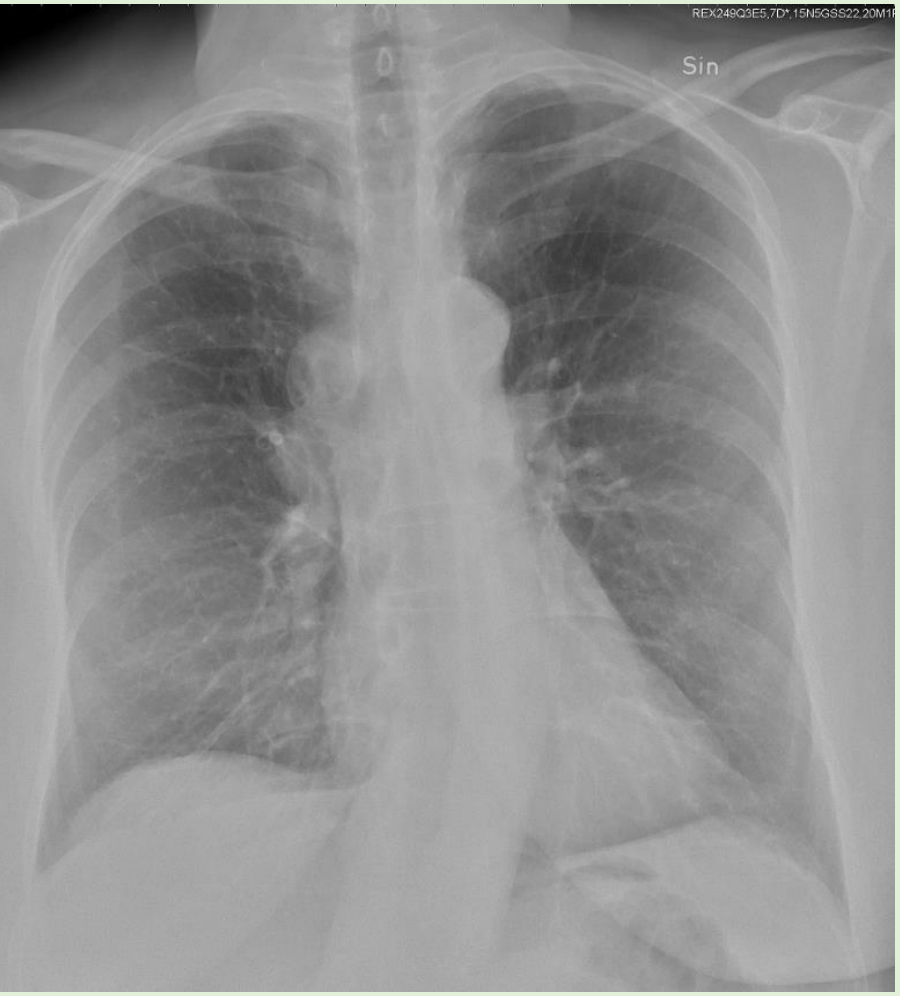
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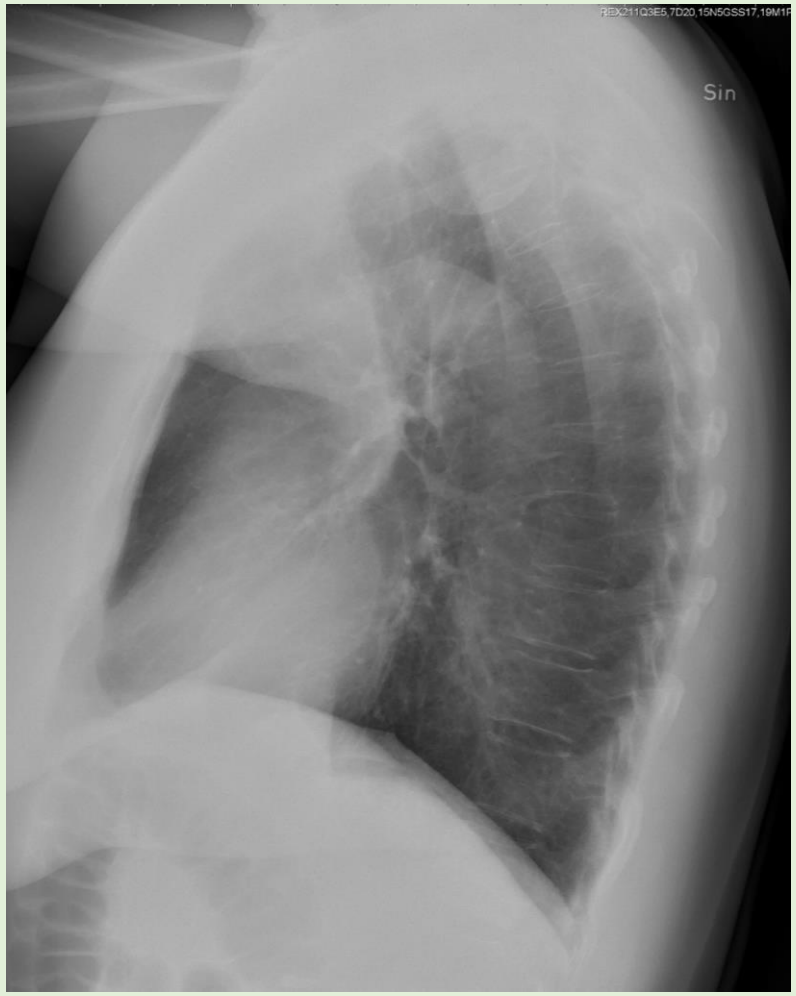
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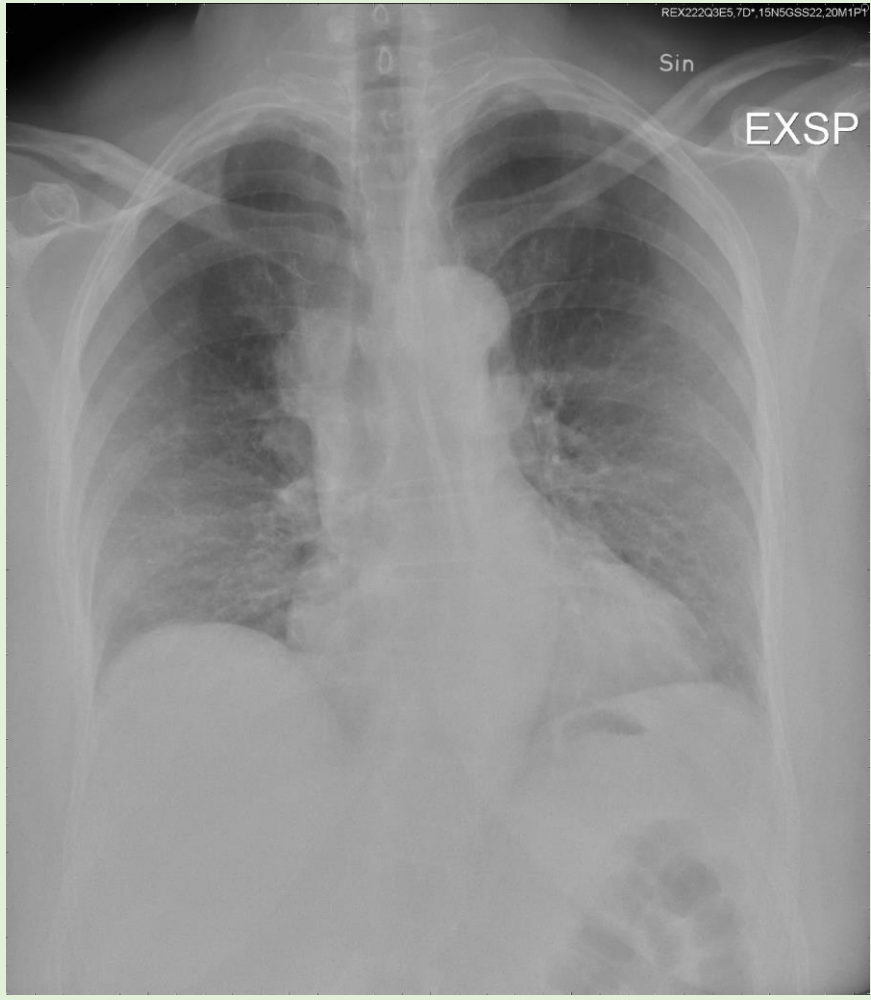
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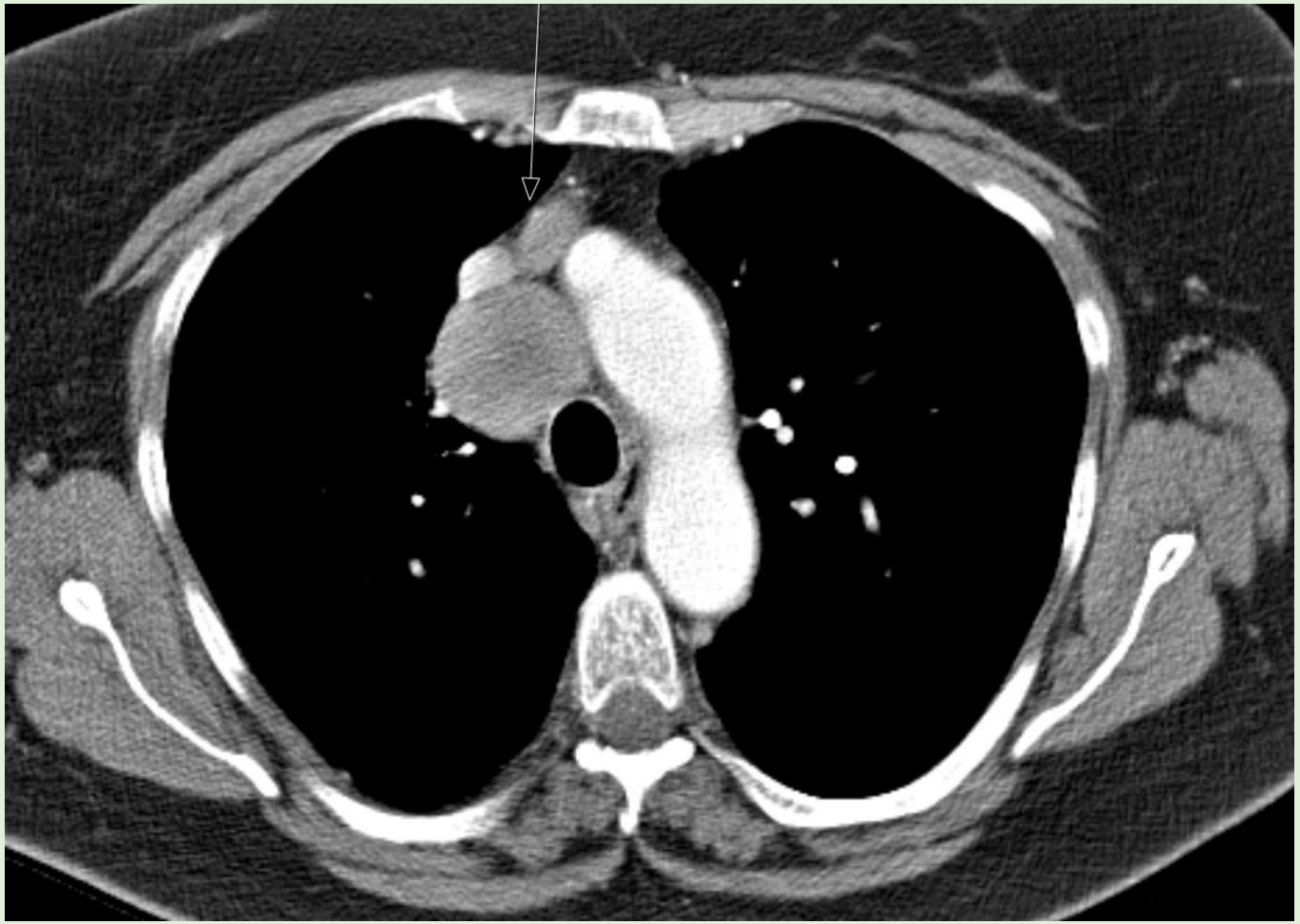

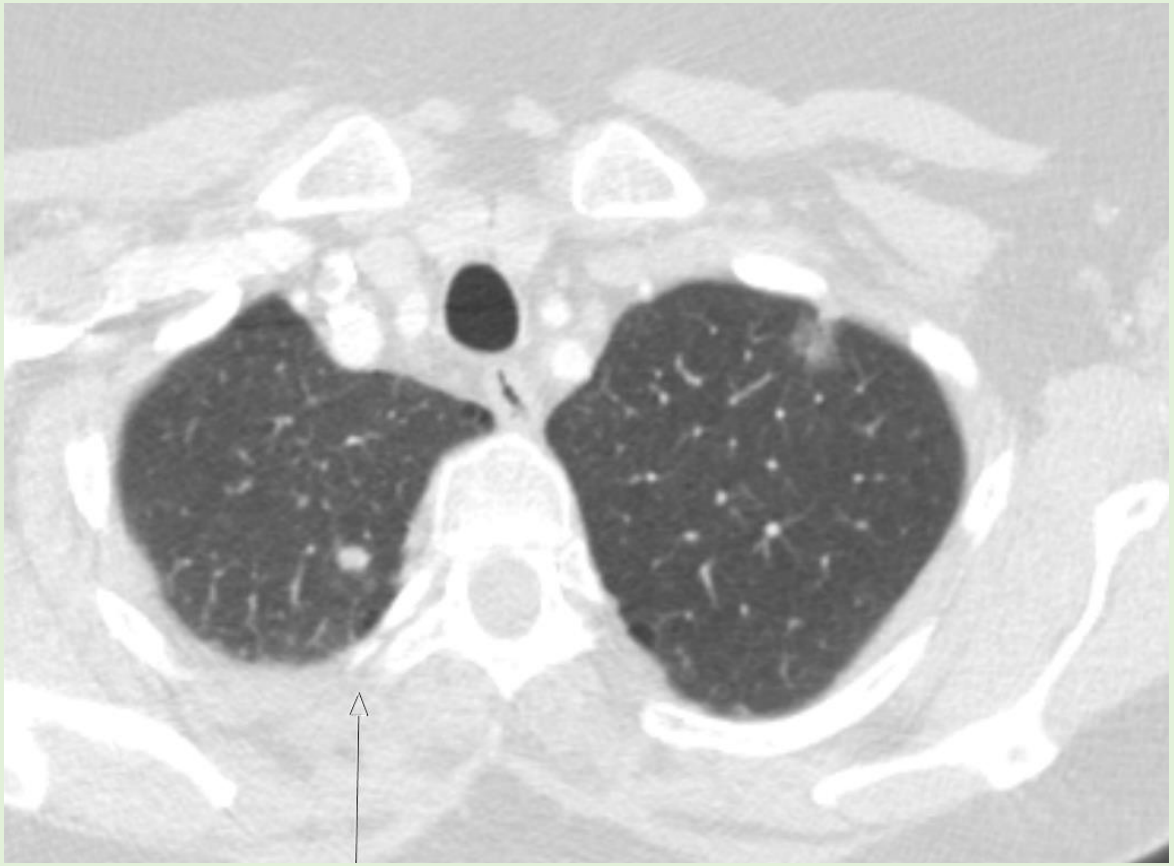

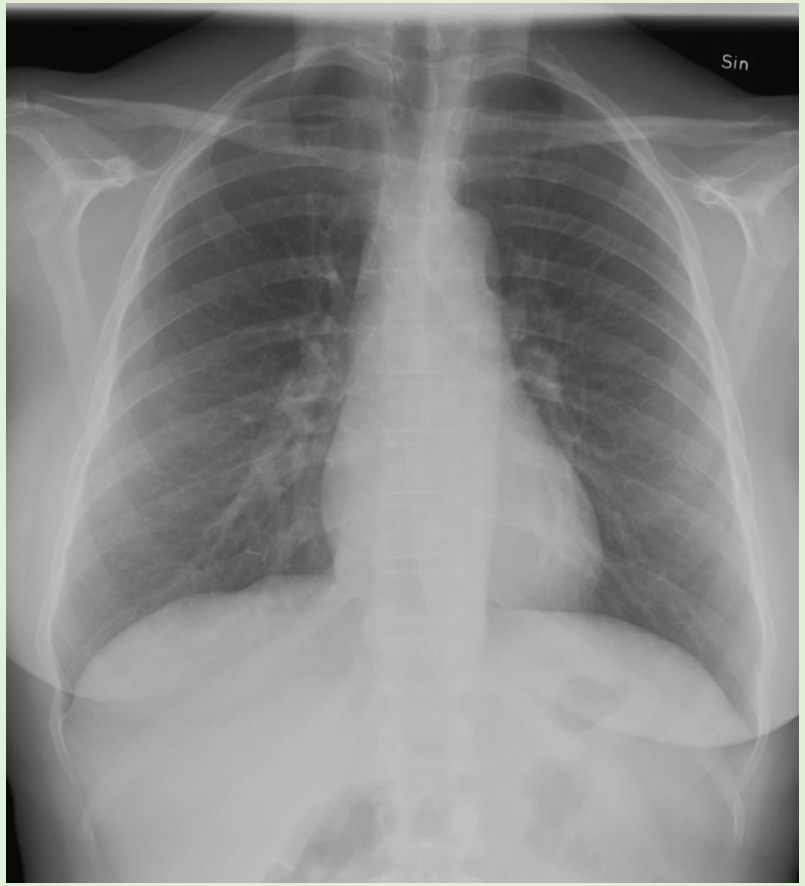
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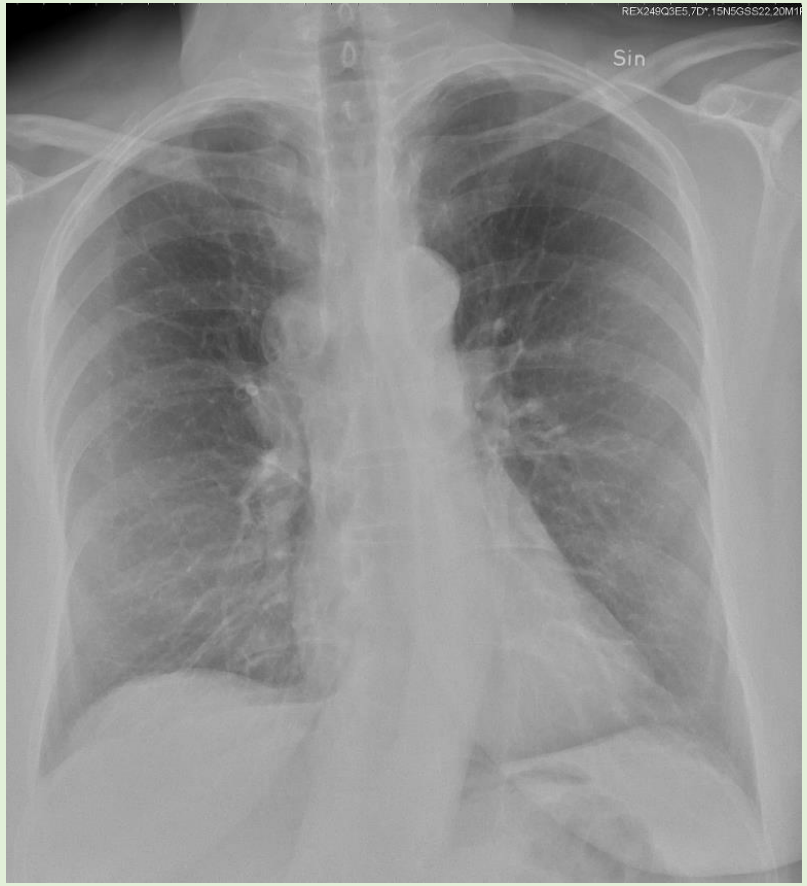
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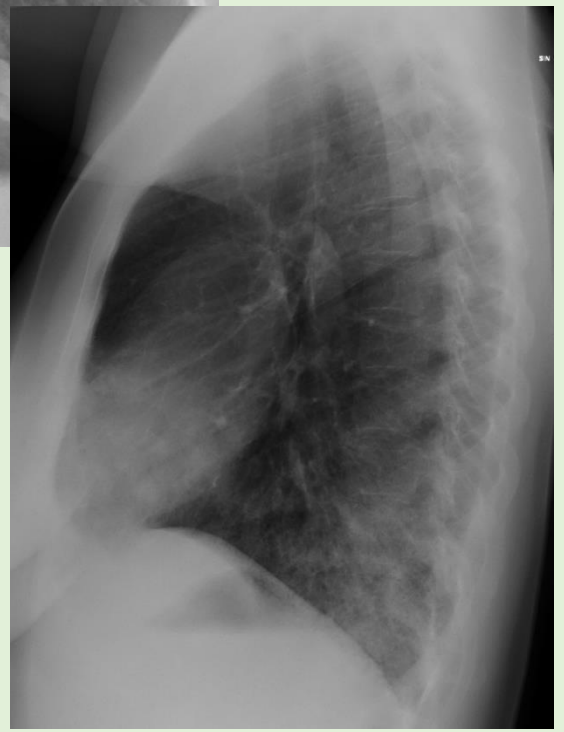


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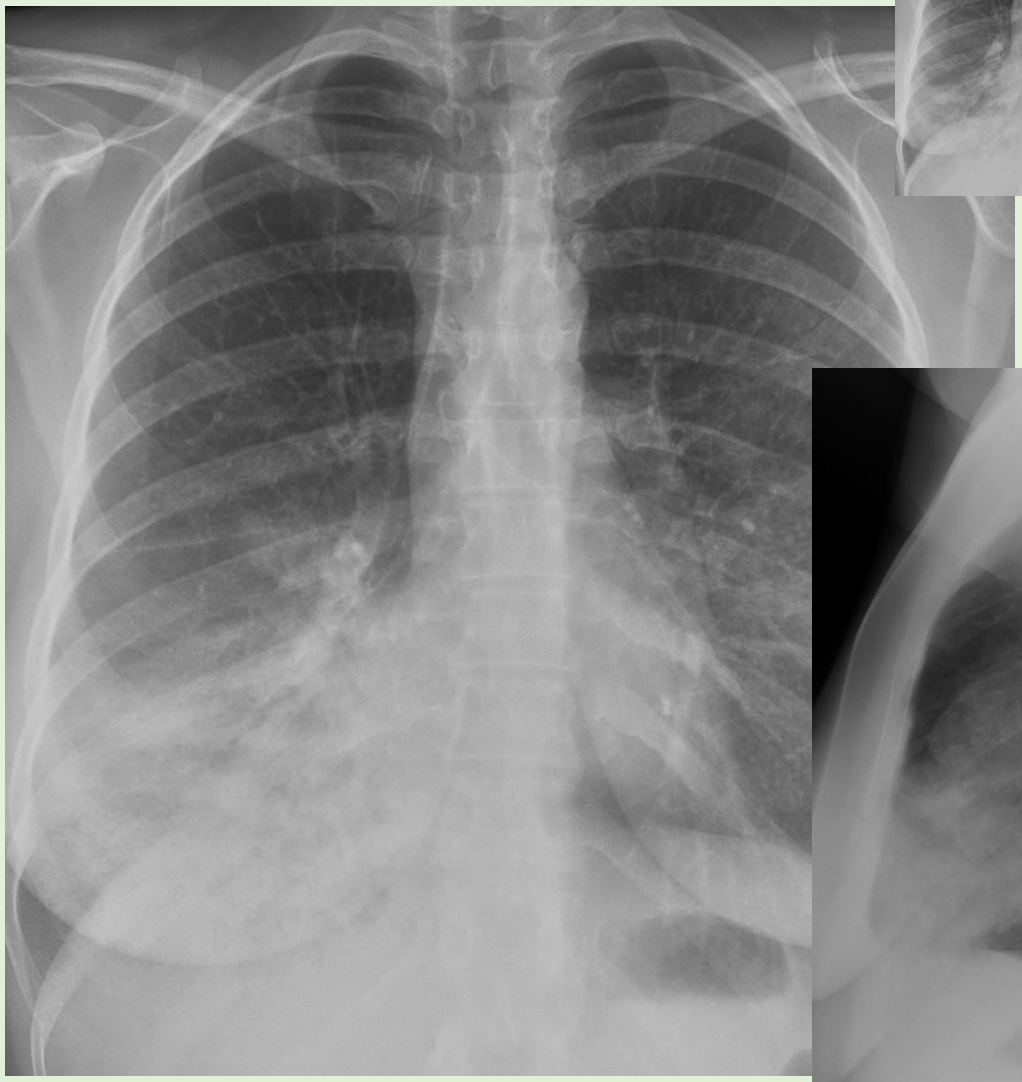

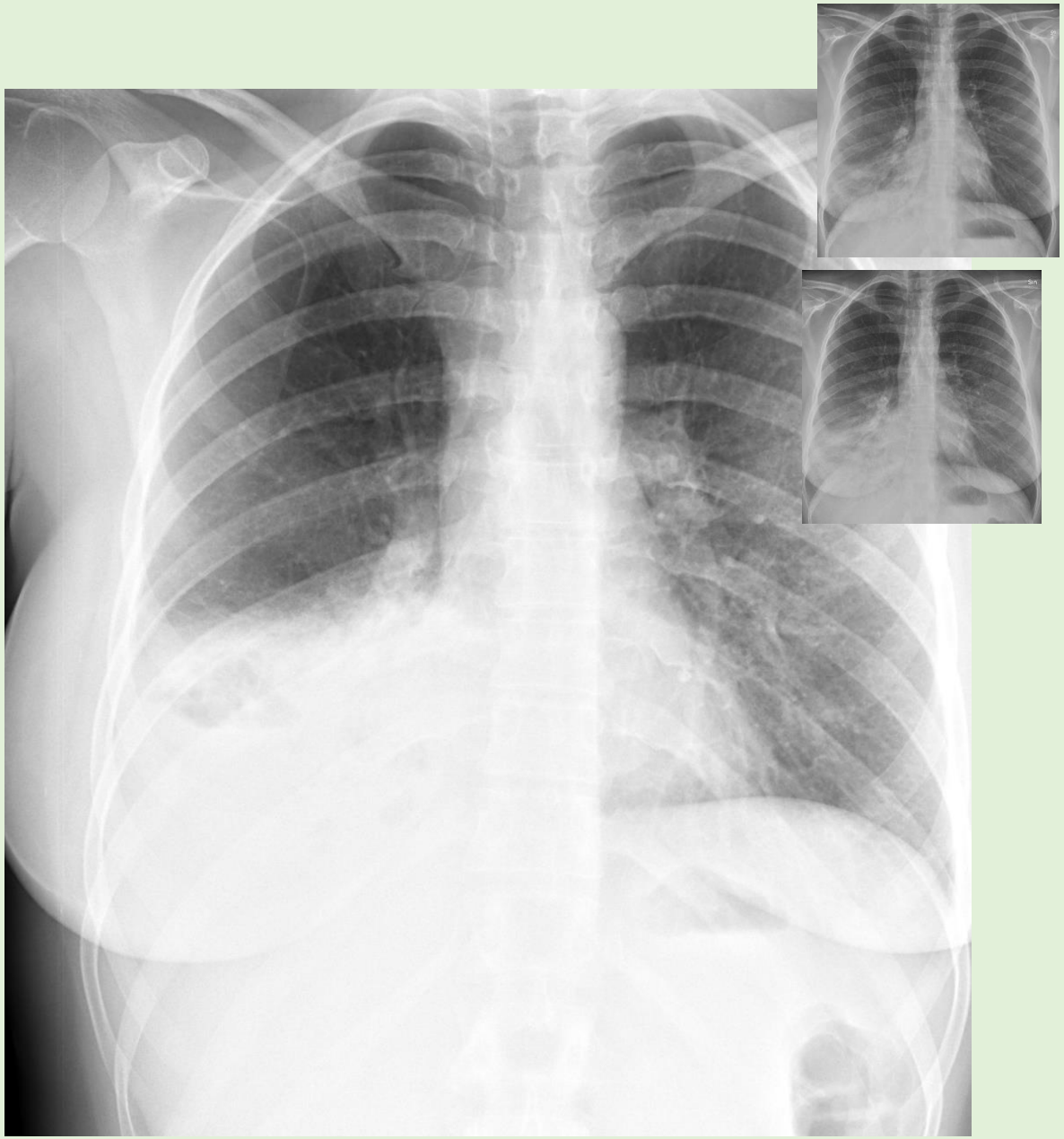

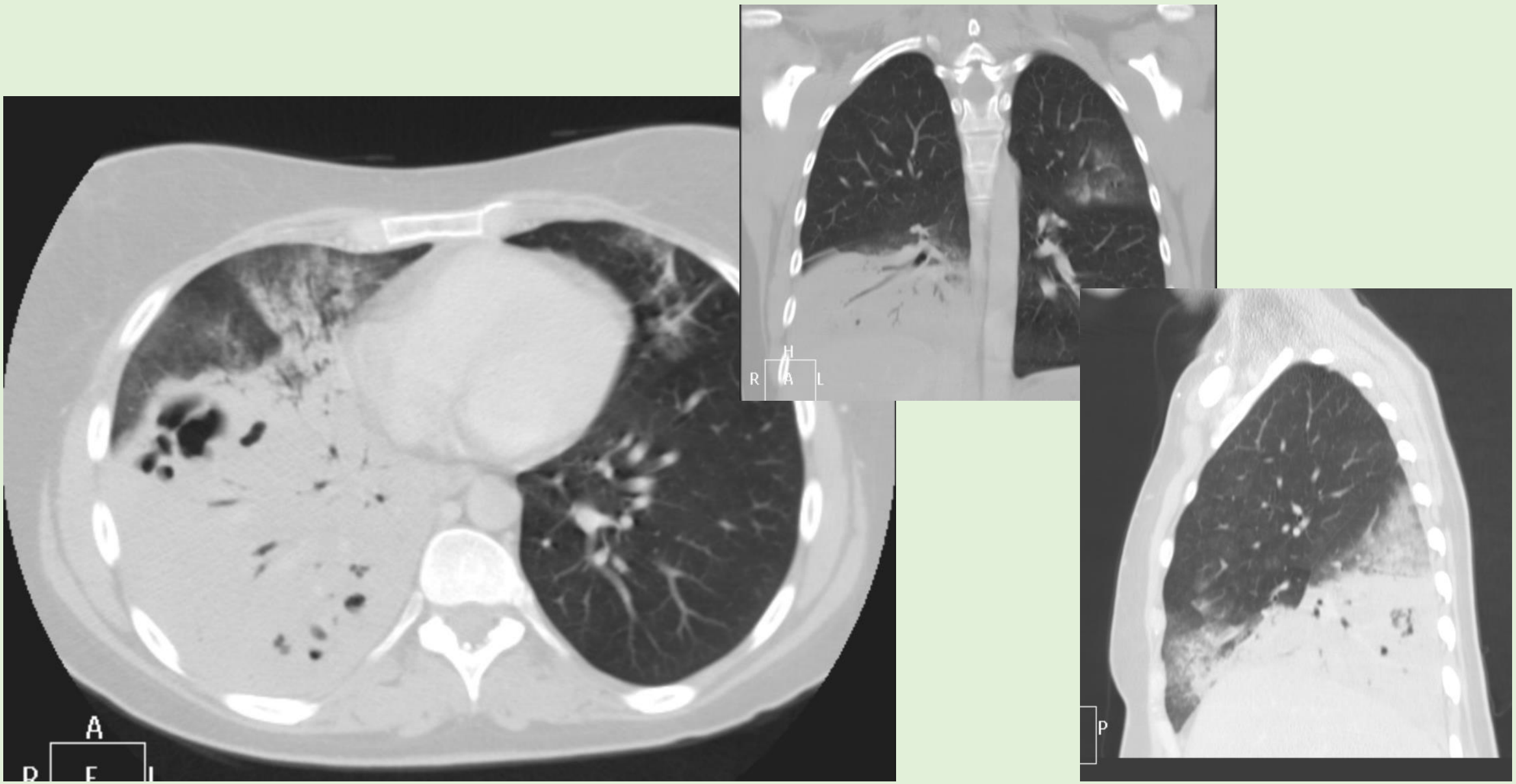
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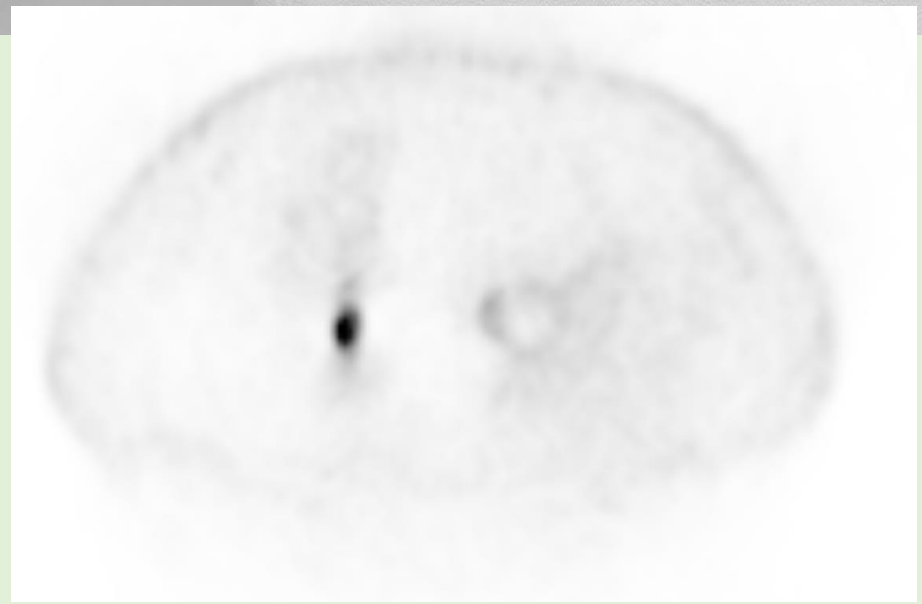
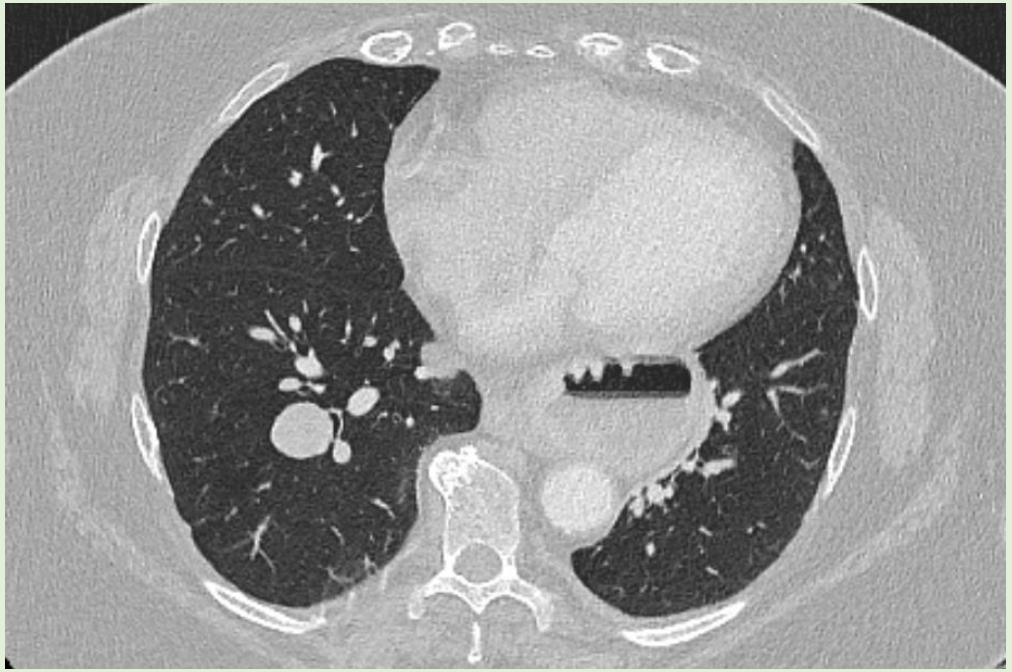
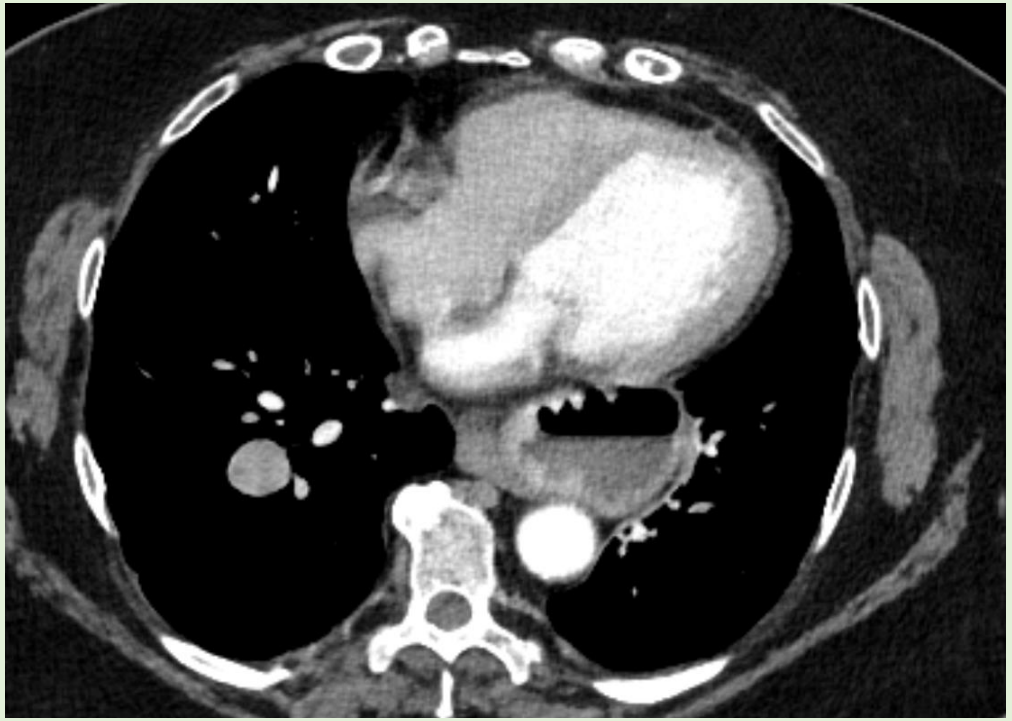
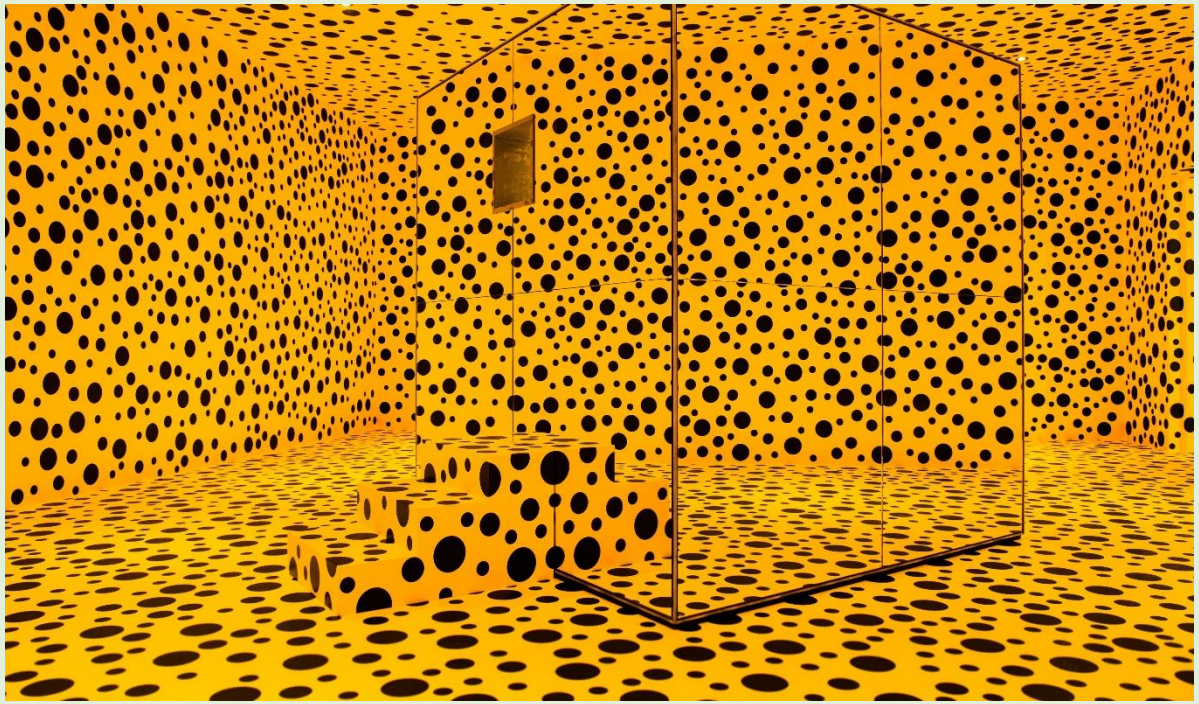






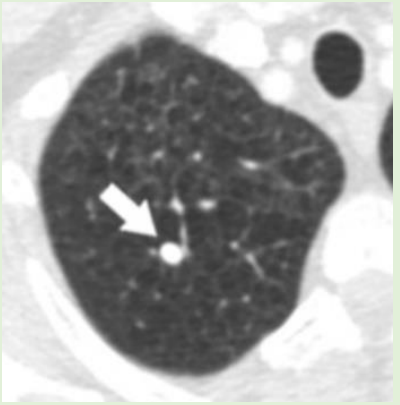
Thoraxradiologens vardag

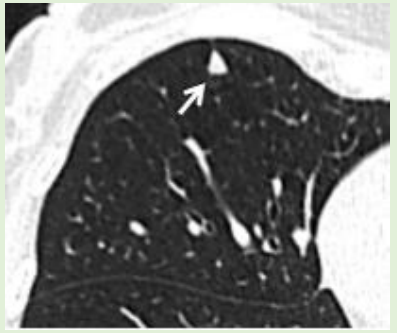


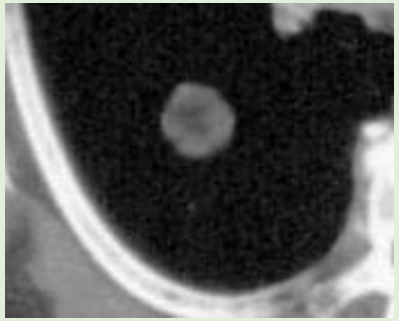
Hur tänker man?

- Vad är det för typ av patient?
- Ålder?
- Rökning/Emfysem?
- Andra fynd?
- Underliggande sjukdom?

- Hur ser ”pricken” ut?
- Form
- Lokalisation
- Täthet, Ca++
- Avgränsning
- Storlek







ORIGINAL RESEARCH ■ SPECIAL REPORT

Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017[1]

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The Fleischner Society Guidelines for management of solid nodules were published in 2005, and separate guidelines for subsolid nodules were issued in 2013. Since then, new information has become available; therefore, the guidelines have been revised to reflect current thinking on nodule management. The revised guidelines incorporate several substantive changes that reflect current thinking on the management of small nodules. The minimum thresh-
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Radiology

Working Group Updating Fleischner Lung Nodule *Fleischner Publication*

https://pubs.rsna.org/doi/10.1148/rg.2018180017

Fleischner Society 2017 Guidelines for Management of Incidentally Detected Pulmonary Nodules in Adults

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).

B: Subsolid Nodules*

Nodule Type	Size: <6 mm (<100 mm³)	Size: ≥6 mm (>100 mm³)	Comments
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).

Note.—These recommendations do not apply to lung cancer screening, patients with immunosuppression, or patients with known primary cancer.

* Dimensions are average of long and short axes, rounded to the nearest millimeter.

† Consider all relevant risk factors (see Risk Factors).

Klinisk uppföljning

Uppföljning av lungcancer görs inom specialiserad vård.

Uppföljning av små nodulära förändringar

Uppföljningen gäller incidentella fynd av små nodulära förändringar på DT lungor hos patient 35 år eller äldre. Patient med känd malignitet eller immunsuppression kräver särskild uppföljning.

Låg risk för malignitet föreligger vid:

•lägre ålder
•mindre rökning, ingen tidigare cancer
•nodulär förändring med liten storlek, jämna kanter, lokalisation i mellan- eller underlob.

Hög risk för malignitet föreligger vid:

•högre ålder
•tyngre rökning, tidigare cancer
•nodulär förändring med större storlek, ojämna kanter, lokalisation i överlob.

Rekommenderat uppföljningsintervall baseras på lungförändring, malignitetsrisk och stabilitet över tid. Vid storleksökning bör patienten remitteras till lungmottagning.

Solida nodulära förändringar < 6 mm

•Solitär eller multipla med låg risk – ingen rutinmässig uppföljning
•Solitär eller multipla med hög risk – överväg ny DT efter 12 månader

Solida nodulära förändringar 6–8 mm

•Solitär med låg risk – ny DT efter 6–12 månader, överväg även efter 18–24 månader
•Solitär med hög risk – ny DT efter 6–12 månader samt efter 18–24 månader
•Multipla med låg risk – ny DT efter 3–6 månader, överväg även efter 18–24 månader
•Multipla med hög risk – ny DT efter 3–6 månader samt efter 18–24 månader

Solida nodulära förändringar > 8 mm

•Solitär med låg eller hög risk – remiss till lungmottagning
•Multipla med låg risk – ny DT efter 3–6 månader, överväg även efter 18–24 månader
•Multipla med hög risk – ny DT efter 3–6 månader samt efter 18–24 månader

Subsolida nodulära förändringar

Subsolida nodulära förändringar kan indelas i rena groundglass-förändringar och semisolida förändringar som har en solid komponent med omgivande groundglass-komponent.

•Solitär eller multipla med låg eller hög risk – remiss till lungmottagning

ACR AMERICAN COLLEGE OF RADIOLOGY

Lung-RADS® 2022

Release Date: November 2022

Lung-RADS	Category Descriptor	Findings	Management
0	**Incomplete** Estimated Population Prevalence: ~ 1%	Prior chest CT examination being located for comparison (see note 9)	Comparison to prior chest CT;
		Part or all of lungs cannot be evaluated	Additional lung cancer screening CT imaging needed;
		Findings suggestive of an inflammatory or infectious process (see note 10)	1-3 month LDCT
1	**Negative** Estimated Population Prevalence: 39%	**No lung nodules OR**	12-month screening LDCT
		Nodule with benign features: • Complete, central, popcorn, or concentric ring calcifications **OR** • Fat-containing	
2	**Benign** Based on imaging features or indolent behavior Estimated Population Prevalence: 45%	**Juxtapleural nodule:** • < 10 mm (524 mm^3) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	
		Solid nodule: • < 6 mm (< 113 mm^3) at baseline **OR** • New < 4 mm (< 34 mm^3)	
		Part-solid nodule: • < 6 mm total mean diameter (< 113 mm^3) at baseline	
		Non-solid nodule (GGN): • < 30 mm (< 14,137 mm^3) at baseline, new, or growing **OR** • ≥ 30 mm (≥ 14,137 mm^3) stable or slow-growing (see note 7)	
		Airway nodule, subsegmental at baseline, new, or stable (see note 11)	
		Category 3 nodule that is stable or decreased in size at 6-month follow-up CT, **OR** Category 3 or 4A nodules that resolve on follow-up, **OR** Category 4B findings proven to be benign in etiology following appropriate diagnostic workup	
3	**Probably Benign** Based on imaging features or behavior Estimated Population Prevalence: 9%	**Solid nodule:** • ≥ 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: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component < 6 mm (< 113 mm^3) at baseline **OR** • New < 6 mm total mean diameter (< 113 mm^3)	
		Non-solid nodule (GGN): • ≥ 30 mm (≥ 14,137 mm^3) at baseline or new	
		Atypical pulmonary cyst (see note 12) • Growing cystic component (mean diameter) of a thick-walled cyst	
		Category 4A nodule that is stable or decreased in size at 3-month follow-up CT (excluding airway nodules)	
4A	**Suspicious** Estimated Population Prevalence: 4%	**Solid nodule:** • ≥ 8 to < 15 mm (≥ 268 to < 1,767 mm^3) at baseline **OR** • Growing < 8 mm (< 268 mm^3) **OR** • New 6 to < 8 mm (113 to < 268 mm^3)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) solid nodule or solid component
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm^3) at baseline **OR** • New or growing < 4 mm (< 34 mm^3) solid component	
		Airway nodule, segmental or more proximal at baseline or new (see note 11)	
		Atypical pulmonary cyst (see note 12) • Thick-walled cyst **OR** • Multilocular cyst at baseline **OR** • Thin- or thick-walled cyst that becomes multilocular	
4B	**Very Suspicious** Estimated Population Prevalence: 2%	**Airway nodule**, segmental or more proximal, and stable or growing (see note 11)	Referral for further clinical evaluation
		Solid nodule: • ≥ 15 mm (≥ 1767 mm^3) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm^3)	Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) solid nodule or solid component; tissue sampling; and/or referral for further clinical evaluation Management depends on clinical evaluation, patient preference, and the probability of malignancy (see note 13)
		Part-solid nodule: • Solid component ≥ 8 mm (≥ 268 mm^3) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm^3) solid component	
		Atypical pulmonary cyst (see note 12) • Thick-walled cyst with growing wall thickness/nodularity **OR** • Growing multilocular cyst (mean diameter) **OR** • Multilocular cyst with increased loculation or new/increased opacity (nodular, ground glass, or consolidation)	
		Slow-growing-solid or part-solid nodule that demonstrates growth over multiple screening exams (see note 8)	
4X	Estimated Population Prevalence: < 1%	Category 3 or 4 nodules with additional features or imaging findings that increase suspicion for lung cancer (see note 14)	
S	**Significant or Potentially Significant** Estimated Population Prevalence: 10%	**Modifier:** May add to category 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer (see note 15)	As appropriate to the specific finding

NOTES

1. **Lung-RADS Category:** Each exam should be coded 0-4 based on the nodule with the highest degree of suspicion.
2. **Lung-RADS Management:** The timing of follow-up imaging is from the date of the exam being interpreted. For example, 12-month screening LDCT for Lung-RADS 2 is from the date of the current exam. Also note that management of category 3 and 4A nodules follows a stepped approach based on follow-up stability or decrease in size. If nodules resolve on follow-up, reclassify according to the most concerning finding.
3. **Practice Audit Definitions:** A negative screen is defined as categories 1 and 2; a positive screen is defined as categories 3 and 4. A negative screen does not mean that an individual does not have lung cancer.
4. **Nodule Measurement:** To calculate nodule mean diameter, measure both the long and short axis to one decimal point in mm, and report mean nodule diameter to one decimal point. The long and short axis measurements may be in any plane to reflect the true size of the nodule. Volumes, if obtained, should be reported to the nearest whole number in mm^3.
5. **Size Thresholds:** Apply to nodules at first detection and that enlarge, reaching a higher size category. When a nodule crosses a new size threshold for other Lung-RADS categories, even if not meeting the definition of growth, the nodule should be reclassified based on size and managed accordingly.
6. **Growth:** An increase in mean diameter size of > 1.5 mm (> 2 mm^3) within a 12-month interval.
7. **Slow-Growing–Non-Solid (Ground-Glass) Nodules:** A ground-glass nodule (GGN) that demonstrates growth over multiple screening exams but does not meet the > 1.5 mm threshold increase in size for any 12-month interval may be classified as Lung-RADS 2 until the nodule meets findings criteria of another category, such as developing a solid component (then manage per part-solid nodule criteria).
8. **Slow-Growing-Solid or Part-Solid Nodules:** A solid or part-solid nodule that demonstrates growth over multiple screening exams but does not meet the > 1.5 mm threshold increase in size for any 12-month interval is suspicious and may be classified as a Lung-RADS 4B. Slow-growing nodules may not have increased metabolic activity on PET/CT; therefore, biopsy, if feasible, or surgical evaluation may be the most appropriate management recommendation.
9. **Prior Exams:** If waiting on prior exams (either a prior screening or diagnostic CT), the Lung-RADS 0 category is temporary until the comparison study is available and a new Lung-RADS category is assigned.
10. **Suspected Infectious or Inflammatory Findings:**
    a. Lung-RADS 0 with 1-3 month follow-up LDCT may be recommended for pulmonary findings suggesting an indeterminate infectious or inflammatory process. Such findings may include segmental or lobar consolidation, multiple new nodules (more than six), large solid nodules (≥ 8 mm) appearing in a short interval, and new nodules in certain clinical contexts (eg, immunocompromised patient). At 1-3 month follow-up, a new Lung-RADS classification and management recommendation should be provided based on the most suspicious nodule.
    b. New solid or part-solid nodules with imaging features more concerning for malignancy than an infectious or inflammatory process meeting Lung-RADS 4B size criteria may be classified as such with appropriate diagnostic and/or clinical evaluation.
    c. Some findings indicative of an infectious or infectious process may not warrant short-term follow-up (eg, tree-in-bud nodules or new < 3 cm ground glass nodules). These nodules may be evaluated using existing size criteria with a Lung-RADS classification and management recommendation based on the most suspicious finding.
11. **Airway Nodules:**
    a. Endotracheal or endobronchial abnormalities that are segmental or more proximal are classified as Lung-RADS 4A.
    b. Subsegmental and/or multiple tubular endobronchial abnormalities favor an infectious process; if no underlying obstructive nodule is identified, these findings may be classified as Lung-RADS 0 (likely infectious or inflammatory) or 2 (benign).
    c. The presence of air in segmental or more proximal airway abnormalities often favors secretions; if no underlying soft tissue nodule is identified, these findings may be classified as Lung-RADS 2.
    d. Segmental or more proximal airway nodules that are stable or growing on 3-month follow-up CT are upgraded to Lung-RADS 4B with management recommendation for further clinical evaluation (typically bronchoscopy).
12. **Atypical Pulmonary Cysts:**
    a. Thin-walled Cyst: Unilocular with uniform wall thickness < 2 mm. Thin-walled cysts are considered benign and are not classified or managed in Lung-RADS.
    b. Thick-walled Cyst: Unilocular with uniform wall thickness, asymmetric wall thickening, or nodular wall thickening ≥ 2 mm (cystic component is the dominant feature); manage as an atypical pulmonary cyst.
    c. Multilocular Cyst: Thick- or thin-walled cyst with internal septations. Manage as an atypical pulmonary cyst.
    d. Cavitary Nodule: Wall thickening is the dominant feature; manage as a solid nodule (total mean diameter).
    e. Cyst with an Associated Nodule: Any cyst with adjacent internal (endophytic) or external (exophytic) nodule (solid, part-solid, or ground-glass). Management is based upon Lung-RADS criteria for the most concerning feature.
    f. Growth: > 1.5 mm increase in nodule size (mean diameter), wall thickness, and/or size of the cystic component (mean diameter) occurring within a 12-month interval.
    g. Fluid-containing cysts may represent an infectious process and are not classified in Lung-RADS unless other concerning features are identified.
    h. Multiple cysts may indicate an alternative diagnosis such as Langerhans cell histiocytosis (LCH) or lymphangioleiomyomatosis (LAM) and are not classified in Lung-RADS unless other concerning features are identified. (Reference: Seaman DM, Meyer CA, Gilman MD, McCormack FX. Diffuse Cystic Lung Disease at High-Resolution CT. AJR 2011;196: 1305-1311)
13. **Category 4B:** Management is predicated on clinical evaluation (comorbidities), patient preference, and risk of malignancy. Radiologists are encouraged to use the McWilliams, et al Assessment Tool when making recommendations (https://brocku.ca/lung-cancer-screening-and-risk-prediction/risk-calculators/).
14. **Category 4X:** Category 3 or 4 nodules with additional imaging findings that increase the suspicion of lung cancer, such as spiculation, lymphadenopathy, frank metastatic disease, a GGN that doubles in size in 1 year, etc. 4X is a distinct Lung-RADS category; X should not be used as a modifier.
15. **Exam Modifier:** An S modifier may be added to Lung-RADS categories 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer.
    a. Management should adhere to available ACR Incidental Findings management recommendations (https://www.acr.org/Clinical-Resources/Incidental-Findings). The ACR Lung Cancer Screening CT Incidental Findings Quick Reference Guide summarizes common findings and management (https://www.acr.org/-/media/ACR/Files/Lung-Cancer-Screening-Resources/LCS-Incidental-Findings-Quick-Guide.pdf).
    b. Findings that are already known, and have been or are in the process of clinical evaluation DO NOT require an S modifier. Any evidence of a concerning change in a known significant or potentially significant finding that is unexpected warrants renewed

Fleischner Society 2017 Guidelines for Management of Incidentally Detected Pulmonary Nodules in Adults

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).

B: Subsolid Nodules*

Nodule Type	Size: <6 mm (<100 mm³)	Size: ≥6 mm (>100 mm³)	Comments
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).

Note.—These recommendations do not apply to lung cancer screening, patients with immunosuppression, or patients with known primary cancer.

* Dimensions are average of long and short axes, rounded to the nearest millimeter.

† Consider all relevant risk factors (see Risk Factors).

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Lung-RADS® 2022

Release Date: November 2022

Lung-RADS	Category Descriptor	Findings	Management
0	**Incomplete** Estimated Population Prevalence: ~1%	Prior chest CT examination being located for comparison (see note 9)	Comparison to prior chest CT;
		Part or all of lungs cannot be evaluated	Additional lung cancer screening CT imaging needed;
		Findings suggestive of an inflammatory or infectious process (see note 10)	1-3 month LDCT
1	**Negative** Estimated Population Prevalence: 39%	**No lung nodules OR**	12-month screening LDCT
		Nodule with benign features: • Complete, central, popcorn, or concentric ring calcifications **OR** • Fat-containing	
2	**Benign** Based on imaging features or indolent behavior Estimated Population Prevalence: 45%	**Juxtapleural nodule:** • < 10 mm (524 mm³) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	
		Solid nodule: • < 6 mm (< 113 mm³) at baseline **OR** • New < 4 mm (< 34 mm³)	
		Part-solid nodule: • < 6 mm total mean diameter (< 113 mm³) at baseline	
		Non-solid nodule (GGN): • < 30 mm (< 14,137 mm³) at baseline, new, or growing **OR** • ≥ 30 mm (≥ 14,137 mm³) stable or slow-growing (see note 7)	
		Airway nodule, subsegmental at baseline, new, or stable (see note 11)	
		Category 3 nodule that is stable or decreased in size at 6-month follow-up CT, **OR** Category 3 or 4A nodules that resolve on follow-up, **OR** Category 4B findings proven to be benign in etiology following appropriate diagnostic workup	
3	**Probably Benign** Based on imaging features or behavior Estimated Population Prevalence: 9%	**Solid nodule:** • ≥ 6 to < 8 mm (≥ 113 to < 268 mm³) at baseline **OR** • New 4 mm to < 6 mm (34 to < 113 mm³)	6-month LDCT
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm³) with solid component < 6 mm (< 113 mm³) at baseline **OR** • New < 6 mm total mean diameter (< 113 mm³)	
		Non-solid nodule (GGN): • ≥ 30 mm (≥ 14,137 mm³) at baseline or new	
		Atypical pulmonary cyst: (see note 12) • Growing cystic component (mean diameter) of a thick-walled cyst	
		Category 4A nodule that is stable or decreased in size at 3-month follow-up CT (excluding airway nodules)	
4A	**Suspicious** Estimated Population Prevalence: 4%	**Solid nodule:** • ≥ 8 to < 15 mm (≥ 268 to < 1,767 mm³) at baseline **OR** • Growing < 8 mm (< 268 mm³) **OR** • New 6 to < 8 mm (113 to < 268 mm³)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm³) solid nodule or solid component
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm³) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm³) at baseline **OR** • New or growing < 4 mm (< 34 mm³) solid component	
		Airway nodule, segmental or more proximal at baseline or new (see note 11)	
		Atypical pulmonary cyst: (see note 12) • Thick-walled cyst **OR** • Multilocular cyst at baseline **OR** • Thin- or thick-walled cyst that becomes multilocular	
4B	**Very Suspicious** Estimated Population Prevalence: 2%	**Airway nodule**, segmental or more proximal, and stable or growing (see note 11)	Referral for further clinical evaluation
		Solid nodule: • ≥ 15 mm (≥ 1767 mm³) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm³)	Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm³) solid nodule or solid component; tissue sampling; and/or referral for further clinical evaluation Management depends on clinical evaluation, patient preference, and the probability of malignancy (see note 13)
		Part-solid nodule: • Solid component ≥ 8 mm (≥ 268 mm³) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm³) solid component	
		Atypical pulmonary cyst: (see note 12) • Thick-walled cyst with growing wall thickness/nodularity **OR** • Growing multilocular cyst (mean diameter) **OR** • Multilocular cyst with increased loculation or new/increased opacity (nodular, ground glass, or consolidation)	
		Slow-growing-solid or part-solid nodule that demonstrates growth over multiple screening exams (see note 8)	
4X	Estimated Population Prevalence: <1%	Category 3 or 4 nodules with additional features or imaging findings that increase suspicion for lung cancer (see note 14)	
S	**Significant or Potentially Significant** Estimated Population Prevalence: 10%	**Modifier:** May add to category 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer (see note 15)	As appropriate to the specific finding

Hur mäter man?

Radiology. 2004 May;231(2):453-8. doi: 10.1148/radiol.2312030167.

Are two-dimensional CT measurements of small noncalcified pulmonary nodules reliable?

Marie-Pierre Revel [1], Alvine Bissery, Marie Bienvenu, Laetitia Aycard, Catherine Lefort, Guy Frija

Affiliations + expand

PMID: 15128990 DOI: 10.1148/radiol.2312030167

Abstract

Purpose: To evaluate the intra- and interreader agreement of two-dimensional computed tomographic (CT) measurements of pulmonary nodules less than 2 cm in diameter.

Materials and methods: Three readers independently made three serial measurements of each of 54 pulmonary nodules measuring 3-18 mm that had been observed on standard-dose multisection CT images obtained in 24 patients who ranged in age from 36 to 81 years (mean age, 54.6 years). There were 14 women (58%), who ranged in age from 43 to 81 years (mean age, 58.9 years), and 10 men (42%), who ranged in age from 36 to 65 years (mean age, 48.5 years). The largest transverse cross-sectional diameter of each nodule was measured at picture archiving and communication system, or PACS, workstations by using high-spatial-resolution reconstructed CT images and identical window settings. Intra- and interreader agreement were determined by using methods described by Bland and Altman: the coefficient of repeatability for intrareader agreement, and methods derived from the 95% limits of agreement defined by Bland and Altman for interreader agreement.

Results: The repeatability coefficients were 1.70, 1.32, and 1.51 mm for readers 1, 2, and 3, respectively. The 95% limits of agreement for the difference among readers were -1.73 and 1.73.

Conclusion: Two-dimensional CT measurements are not reliable in the evaluation of small noncalcified pulmonary nodules.

Variation mellan flera mätningar av samma prick upprepat av samma radiolog liksom utfört av olika radiologer.

Det betyder att 3.5mm stora förändringar ligger inom felmarginalen och inte kan mätas.

Det betyder INTE att förändringarna inte finns.

ORIGINAL RESEARCH ■ SPECIAL REPORT

Recommendations for Measuring Pulmonary Nodules at CT: A Statement from the Fleischner Society[1]

Alexander A. Bankier, MD, PhD
Heber MacMahon, MB, BCh
Jin Mo Goo, MD, PhD
Geoffrey D. Rubin, MD
Cornelia M. Schaefer-Prokop, MD, PhD
David P. Naidich, MD

These recommendations for measuring pulmonary nodules at computed tomography (CT) are a statement from the Fleischner Society and, as such, incorporate the opinions of a multidisciplinary international group of thoracic radiologists, pulmonologists, surgeons, pathologists, and other specialists. The recommendations address nodule size measurements at CT, which is a topic of importance, given that all available guidelines for nodule management are essentially based on nodule size or changes thereof.

Radiology

https://pubs.rsna.org/doi/pdf/10.1148/radiol.2017162894 · PDF-fil

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Conclusion: Two-dimensional CT measurements are not reliable in the evaluation of small noncalcified pulmonary nodules.

Figure 5

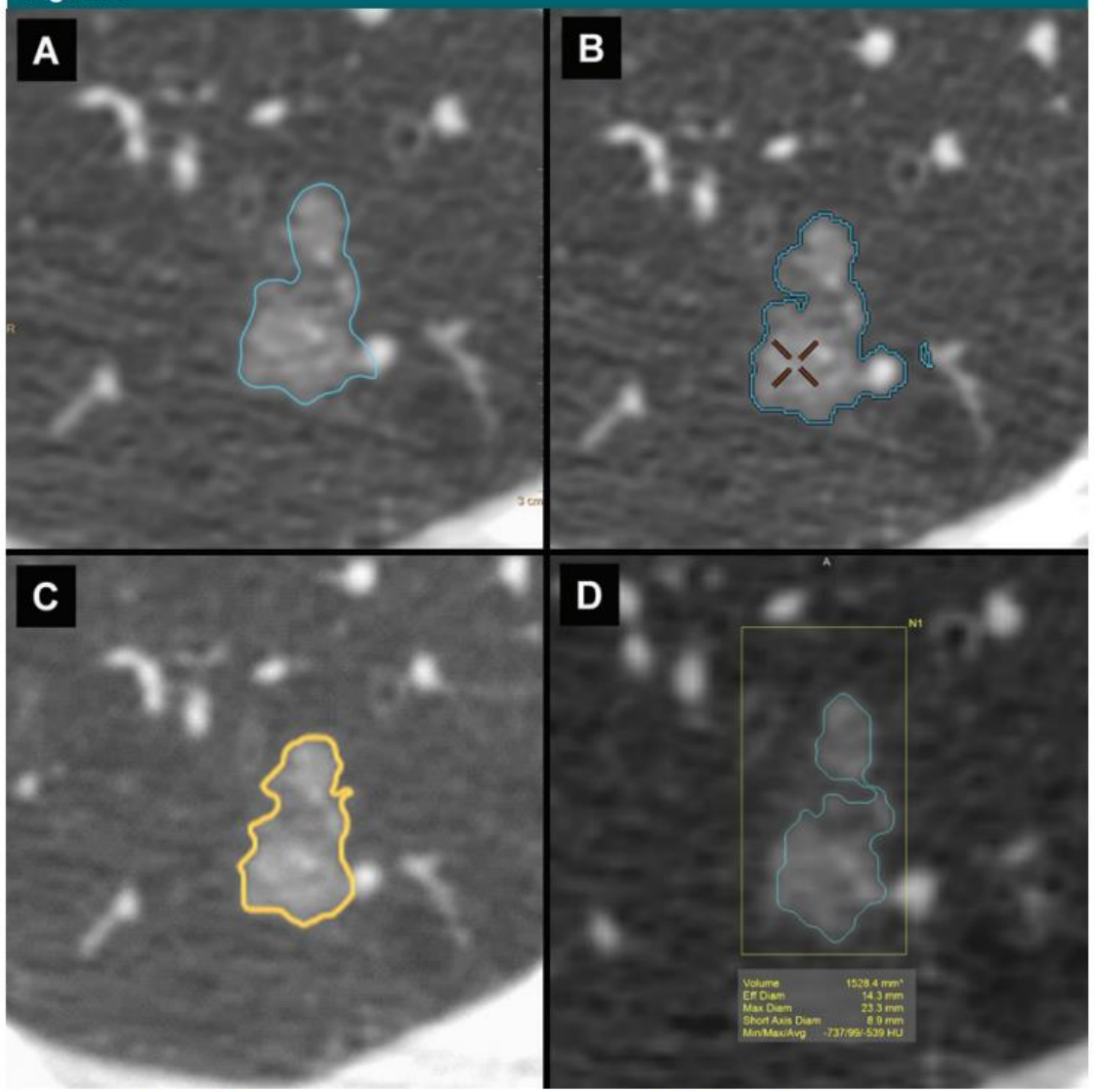

Figure 5: Segmentation and volumetry of a ground-glass nodule with four different software packages. The nodule volumes calculated were, *A*, 2019, *B*, 2059, *C*, 1949, and, *D*, 1528 mm^3, resulting in a maximum difference of 531 mm^3 between measurements.

Figure 2

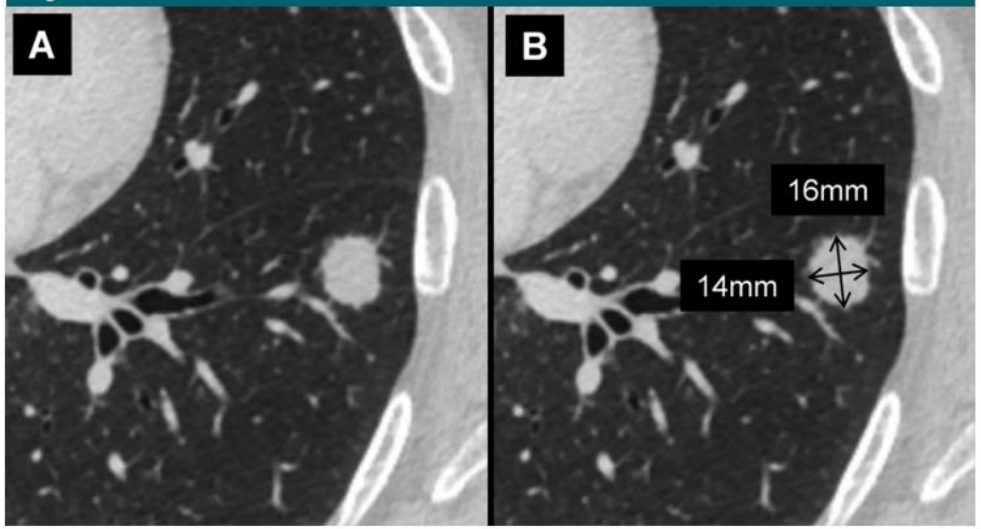

Figure 2: Transverse CT sections of a solid nodule in the left lower lobe. *A,* The nodule is anatomically well defined. *B,* First, the maximal long-axis diameter is measured (16 mm, vertical arrow). Then, perpendicular to the long-axis measurement, the maximum short-axis diameter is measured (14 mm, horizontal arrow). The average diameter of the nodule is 15 mm. As detailed in the first recommendation, for purposes of risk estimation, the dimension of small pulmonary nodules (<10 mm) should be expressed as the average of maximal long-axis and perpendicular maximal short-axis measurements in the same plane. For larger nodules and masses (≥10 mm), long- and short-axis measurements should be recorded. Because the average diameter of this nodule is larger than 10 mm, both long- and short-axis measurements are given.

Figure 3

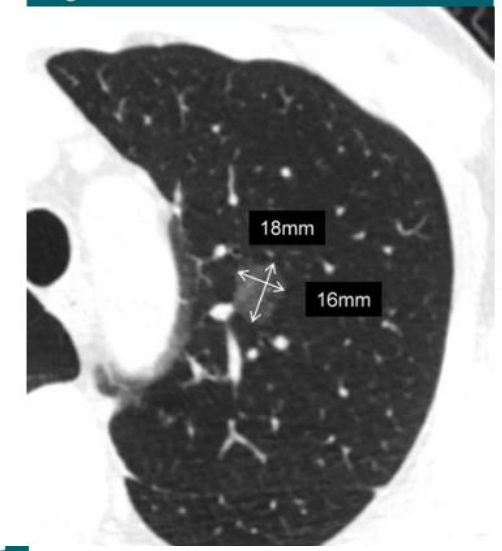

Figure 4

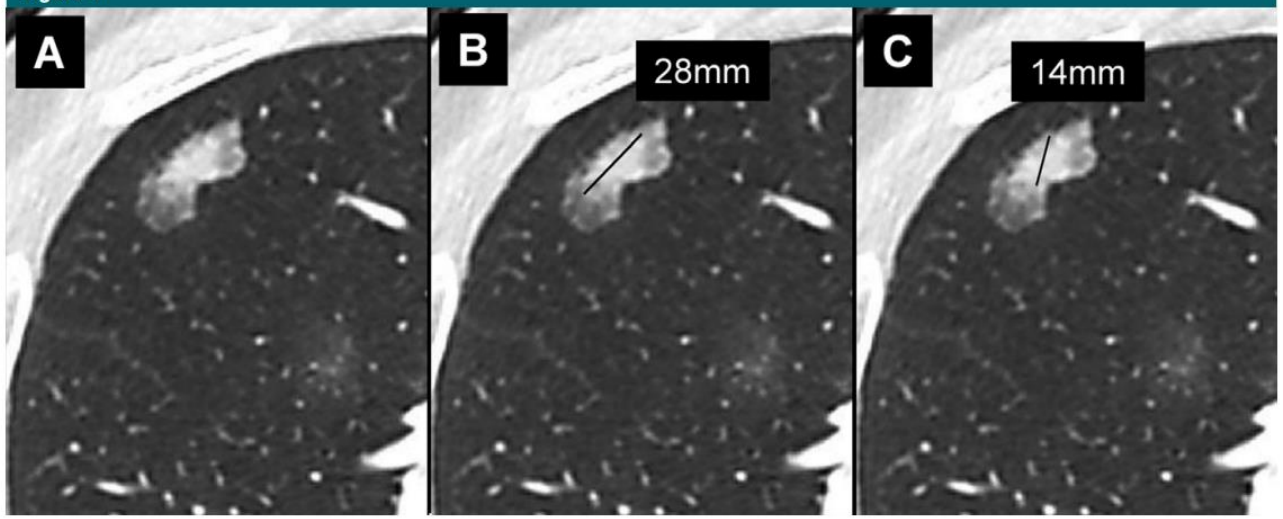

Figure 4: Transverse CT sections of a part-solid nodule in the right upper lobe. *A,* The solid component of the nodule is ill defined, resulting in variability of measurements, as performed by two radiologists. The two long-axis diameters of the solid component were, *B,* 28 mm and, *C,* 14 mm. On the basis of the clinical implications, we recommend use of the larger long-axis diameter. Only solid component measurements are shown in this figure; however, in clinical practice, nonsolid and solid components must be measured.

Figure 6

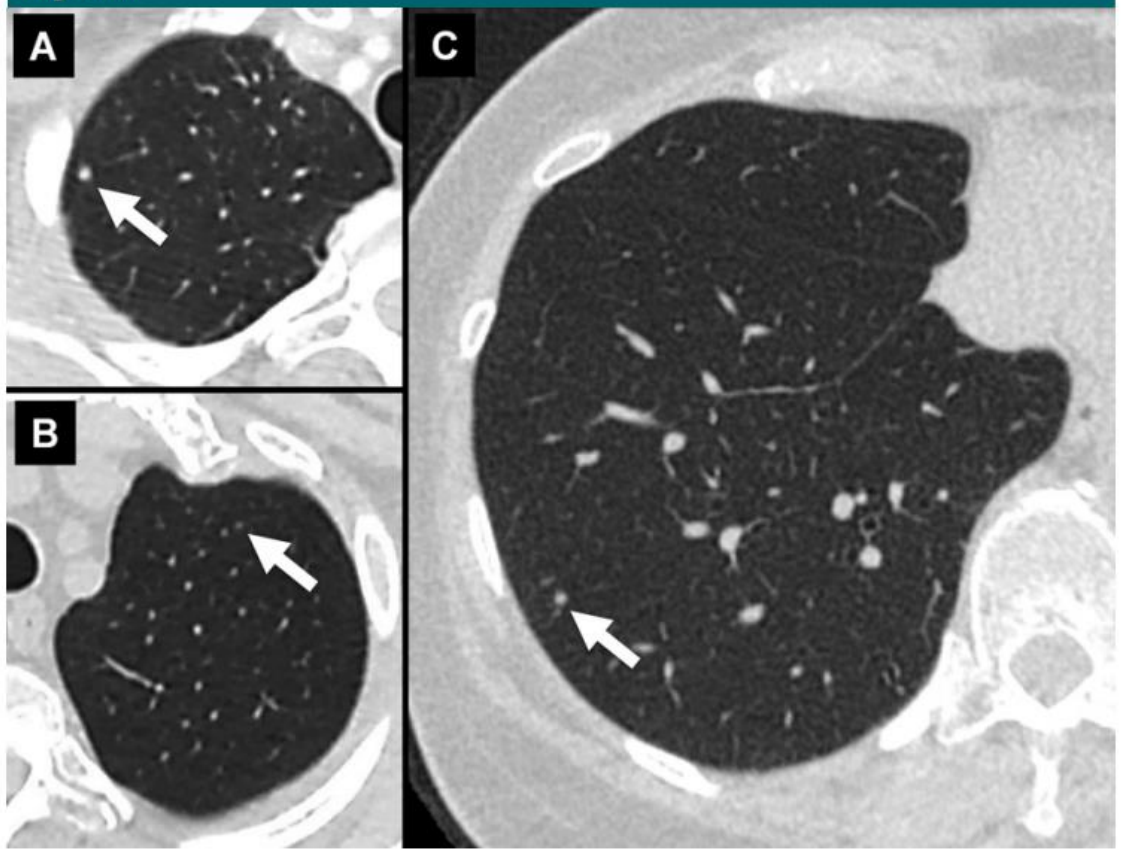

Figure 6: Transverse CT sections through nodules 3 mm or smaller (arrow) in the, *A,* right upper lobe, *B,* left upper lobe, and, *C,* right lower lobe. Such small nodules should not be measured, given inherent accuracy limitations and variability in determining whether the lesion is a solid, part-solid, or ground-glass nodule.

of attenuation changes over time, is required before use of these techniques can be recommended for clinical lung nodule management.

CT Section Thickness

Several authors have studied the relationship between the accuracy of nodule measurement and CT section thickness (31,45–47). They consistently found that variability decreased with decreasing section thickness (31,45,46) and that the thinnest sections (usually 1 mm) provided the most consistent results (47). The studies also found that the effect of section thickness on variability was particularly pronounced for nodules smaller than 10 mm and for spiculated rather than smooth nodules (31). This can be explained by the increased partial volume averaging effect for small nodules when thicker sections are used, whereas the same effect is less severe with larger nodules. From a practical perspective, these findings support the use of contiguous thin (≤1.5 mm) sections for the purpose

Man mäter inte förändringar som är **≤ 3mm**. Dessa kallas **småknodulära** förändringar.

Progress definieras som en skillnad av åtminstone **2 mm**.

Lungcancer ur radiologens perspektiv

- Det finns riktlinjer och rekommendationer som strukturerar upp arbetet och underlättar.
- Ingen stor utmaning i typiska och tyvärr ofta långt gångna fall.
- Riktig utmaning och tidskrävande när inte så är fallet men det är där vi alla gör störst nytta.
- Den stora utmaningen är att ha lungcancer i åtanke i vårt mycket heterogena patientunderlag.
- Ödmjuk, hellre fälla än fria.

Radiologen är en del av ett Team

Tack för uppmärksamheten.

Rapadalen, Sareks Nationalpark