Respiratory imaging

Asma S Albtoosh,MD
Jordan university hospital

Edited by: Ruaa Hdeib

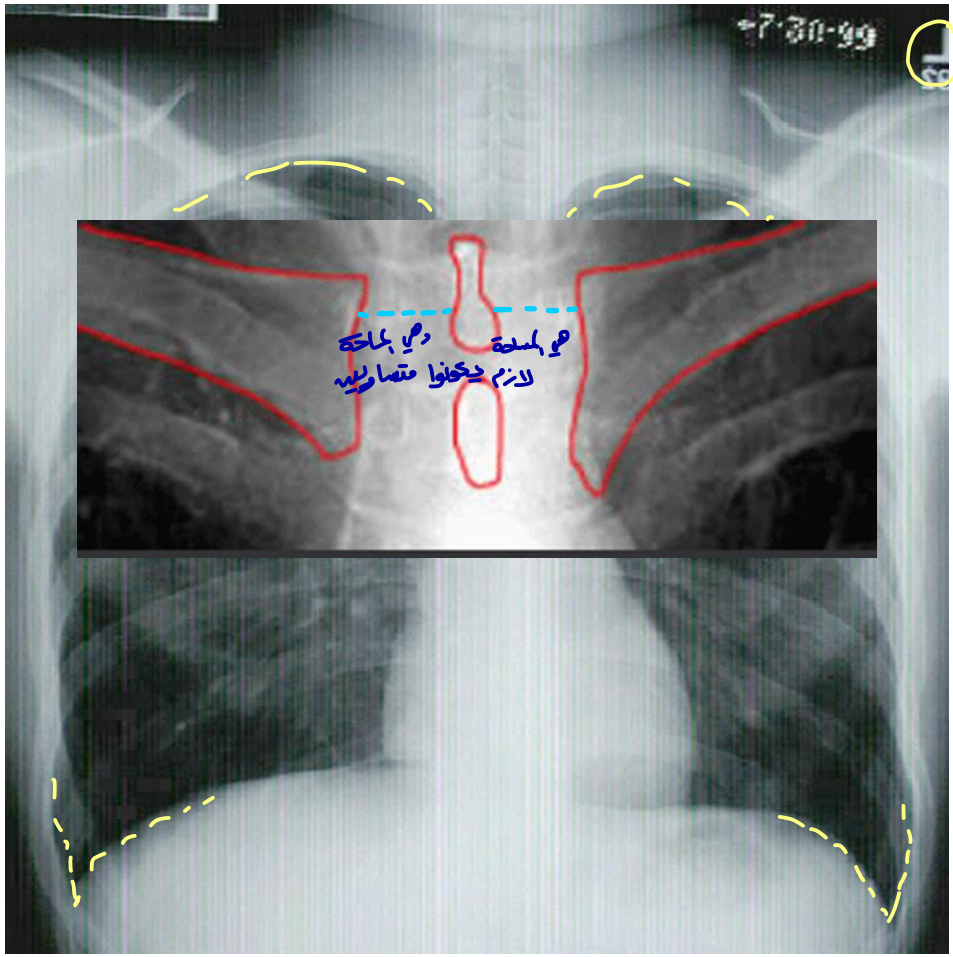
CXR interpretation

1. **Identification**
    - Correct patient
    - Correct date & time
2. **Technique: RIPE(** rotation. inspiration. Projection, exposure)
3. **Abnormal finding**

↳ the alignment of the clavicle to the spinal processes

Rotation and inspiration

Rotated or not? - not the same as trachea shifted to the right or to the left -



* the apexes of both lungs & costophrenic angles are visulized

anterior 5-7 ribs

Posterior 8 ribs

↑ hyperinflation

↓ low lung volume

not rotated, centralized film

anterior ribs → Obleique → 6

Posterior ribs → 8 → بعضهم 9 حتى

↳ Indication of good inspiration during the film taking

* if >6 or >8 → hyperinflation

* if <6 <8 → وقت الصورة كان المريض عامل expiration ↳ technical error or true volume loss

Projection

PA vs AP

scapula is outside the feild

normal size lung واقف

small lung المريض نايم

large heart تصور أول شي

cardiomegaly عكس تفكر or effusion or wide mediastinum or increase in filtrate in the base of the lung

Interpret in the clinical scenario

Exposure=Penetration

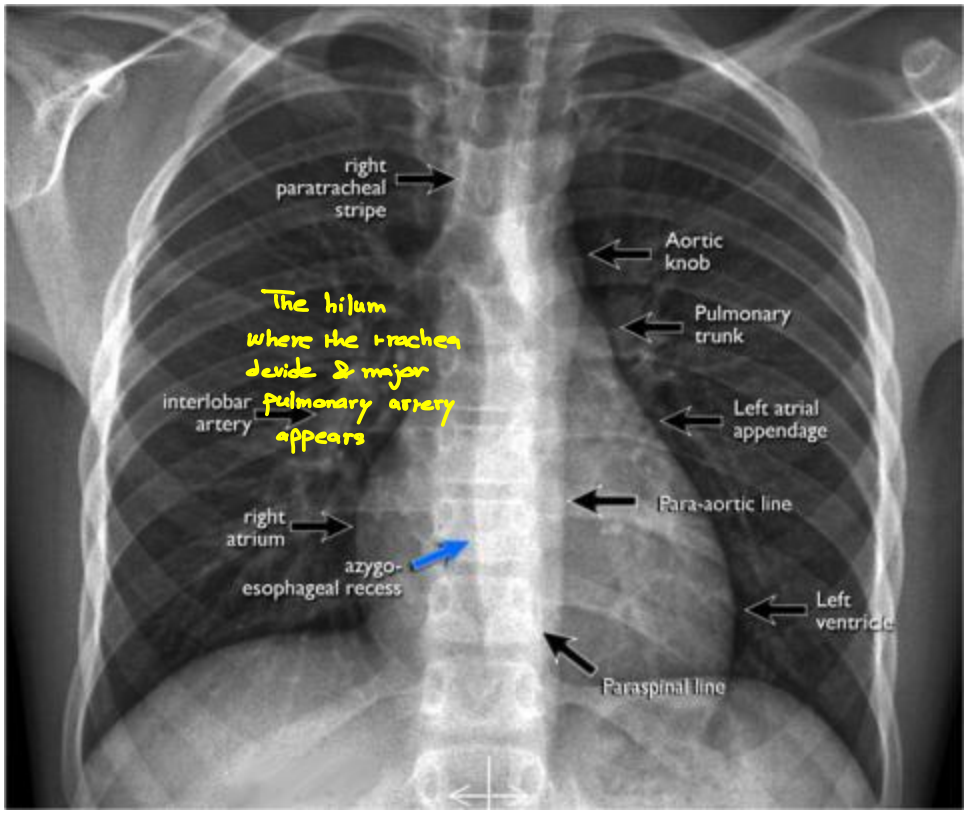
↳ Dose of radiation administered to the pt.

black lung as in emphysema

Over penetrated	Under penetrated
	
you see the spine even below the heart	you can't see the spine

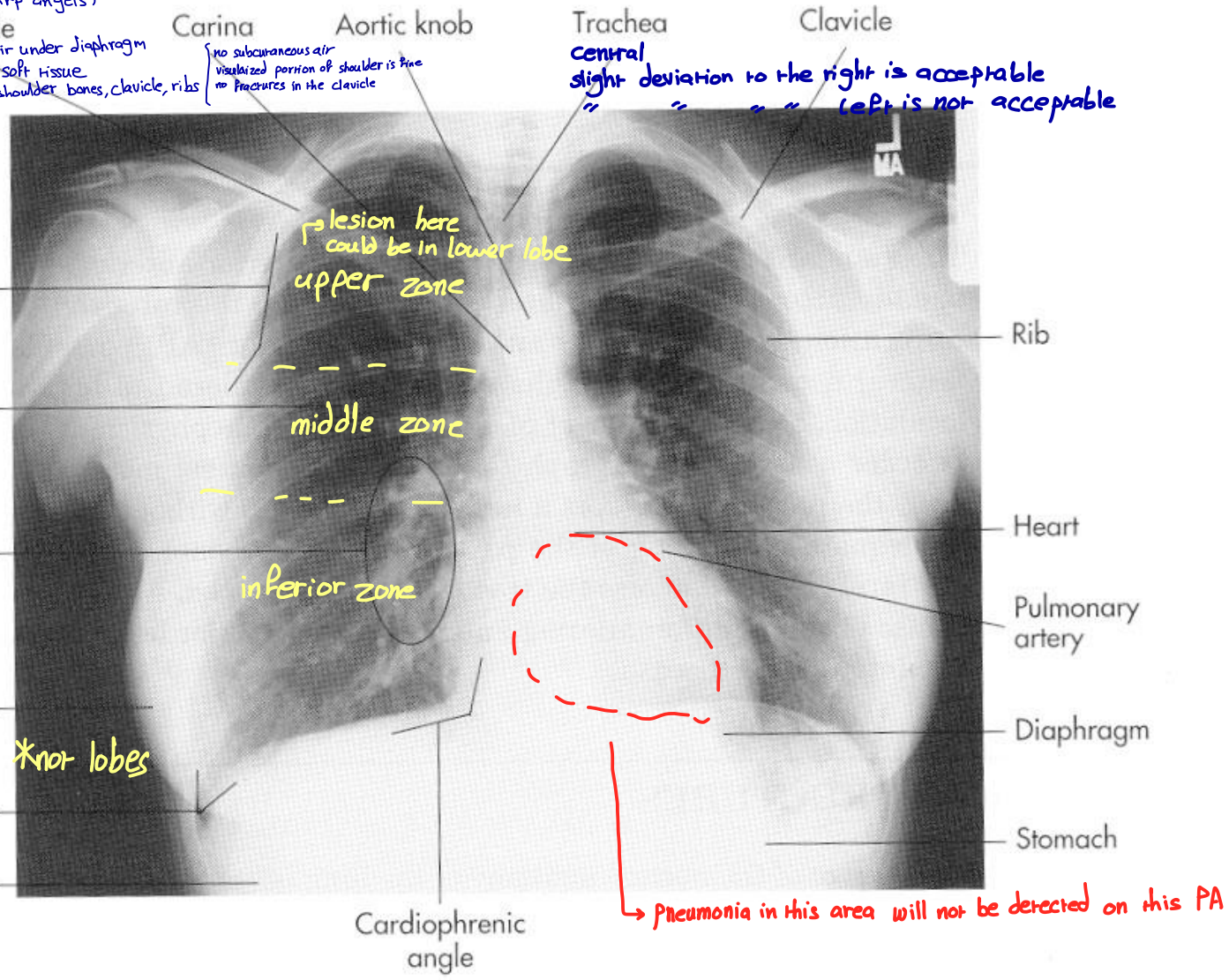
- Spine appearance behind the heart -

Normal anatomy



ABCDE :
A: airway, trachea
B: breathing, Lung
C: cardio, heart, hilum, mediastinum (wide or not)
D: diaphragm (sharp angels)
E: every thing else: ① air under diaphragm ② soft tissue ③ shoulder bones, clavicle, ribs
- no subcutaneous air
- visualized portion of shoulder is fine
- no fractures in the clavicle

AP:
you can't identify lobes
just guessing



* Focal lung lesion, it is either:
1. mass
2. nodule — rounded lesion with well defined borders; mass → ≥ 3 cm; nodule → < 3 cm (29 mm) [differs in size]
3. cavity (empty → bolus // fluid level → abscess)
4. patch (parchy opasity) → area of increased whiteness

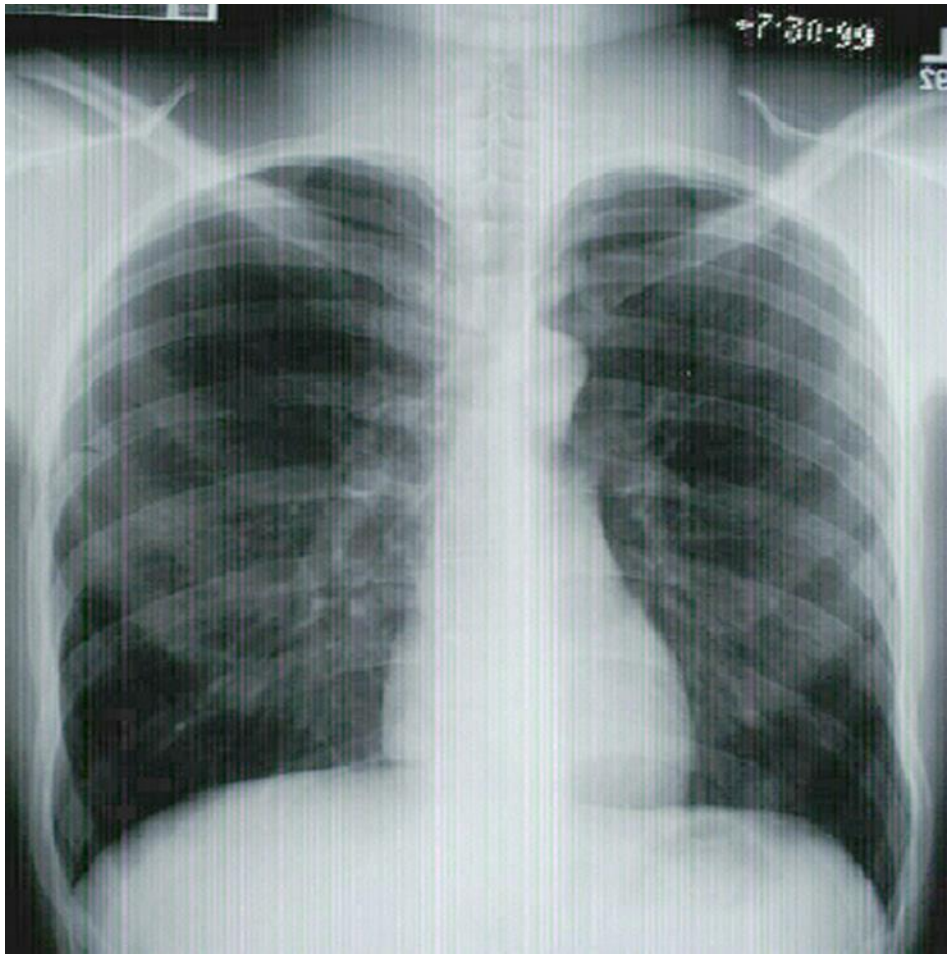
↳ mass → needs immediate action
↳ nodule → Fleischner guidlines

Fig. 3-1 Normal position of anatomical structures on a posterior or anterior chest radiograph.

* silhouette sign → شغليته إجوا فوق بعض ، فوا البوردر تبع بعضهم

if a lesion is silhouetting the right border of the heart it is most likely to be originated from the lower lobe

Zones or lobes?



Lobes

Lateral CXR

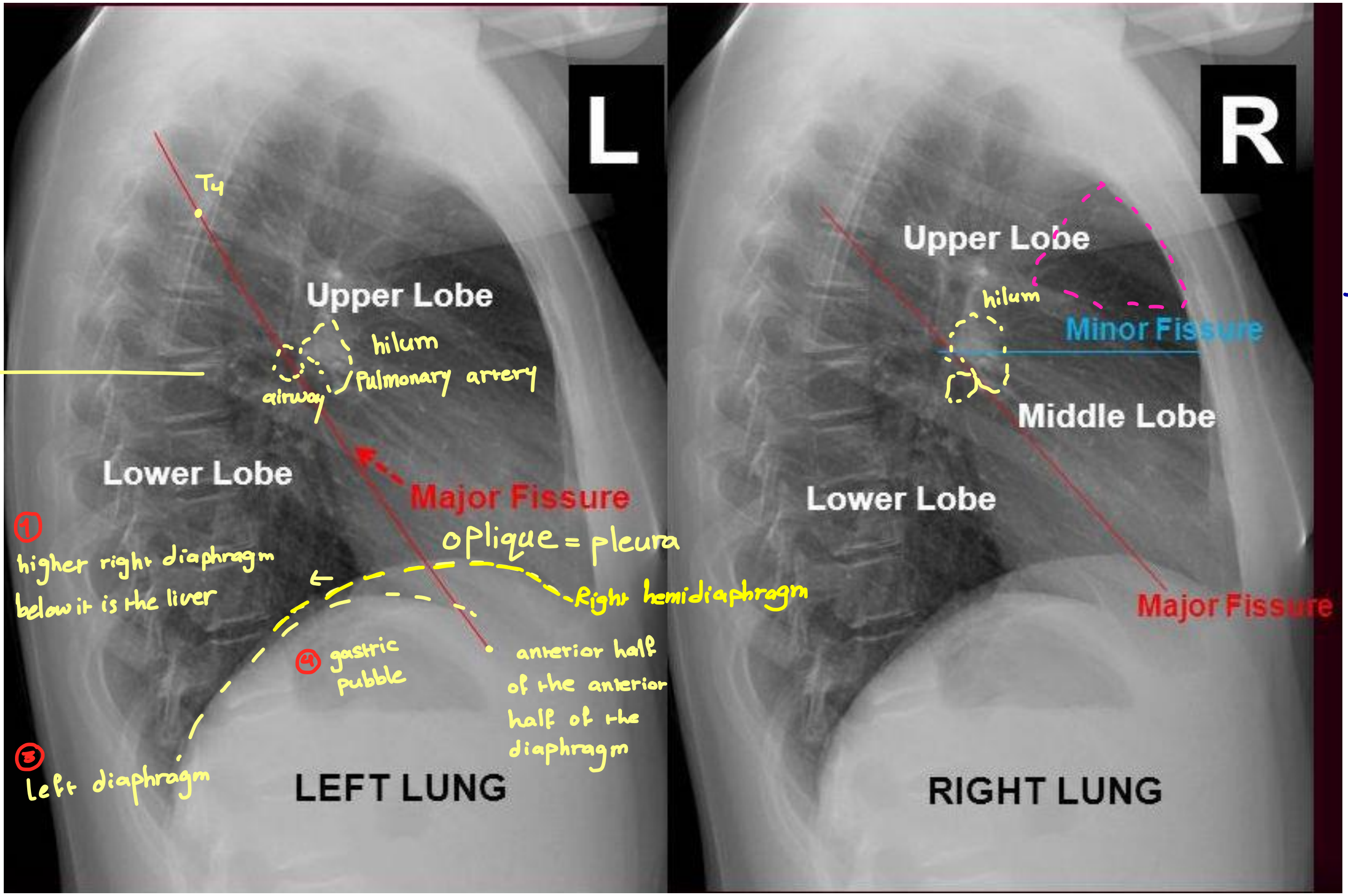
benefit: see pneumonia on the lower lobe that you missed on the frontal film
increased whiteness of the spine as you go down: indication of lower lobe lesion

بنهاية الـ
heart shadow
posteriorely

how to detect right from left diaphragm?

② * left diaphragm
اختفى البوردر تبعه
لأنه الـ heart إجا
تداخل وغطى عليه
وهو dense structure

Gastric pubble
إذا تحته فهو left
↳ this is how you detect elevated left hemidiaphragm

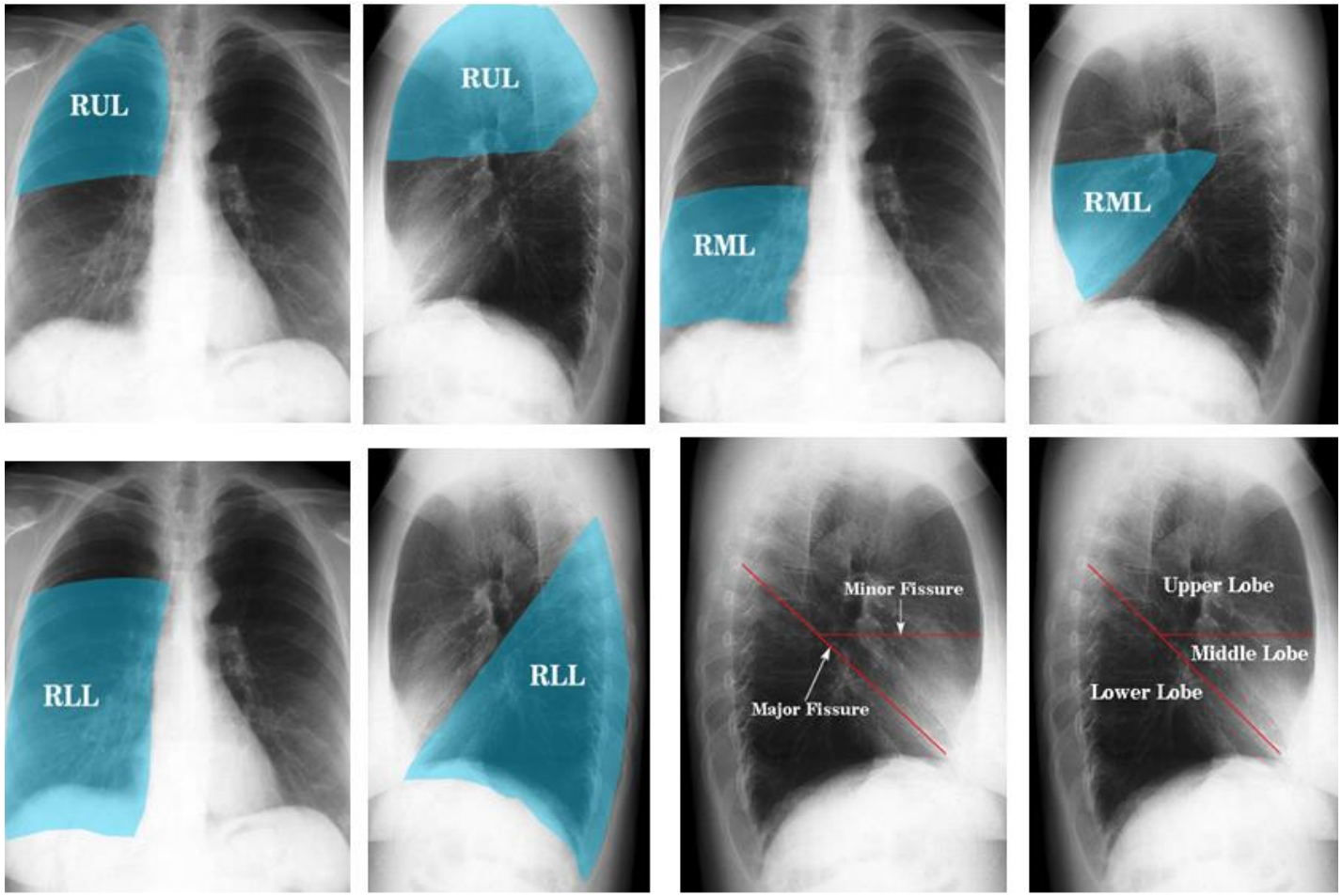


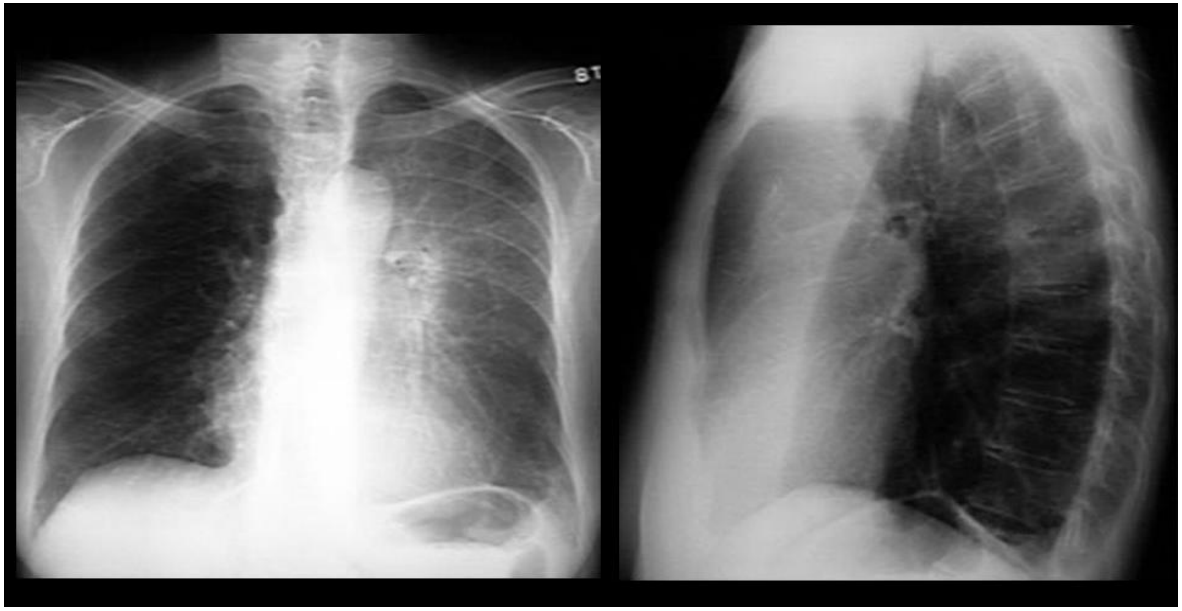
*if wide, more black retrosternal space this is sign of hyper inflation

يضيف خط يمر بال
hilum horizontally

the upper lobe is in front of the lower lobe

*Middle lobe pneumonia → your findings will be on the anterior chest


RUL
RUL
RML
RML
RLL
RLL
Minor Fissure
Major Fissure
Upper Lobe
Middle Lobe
Lower Lobe

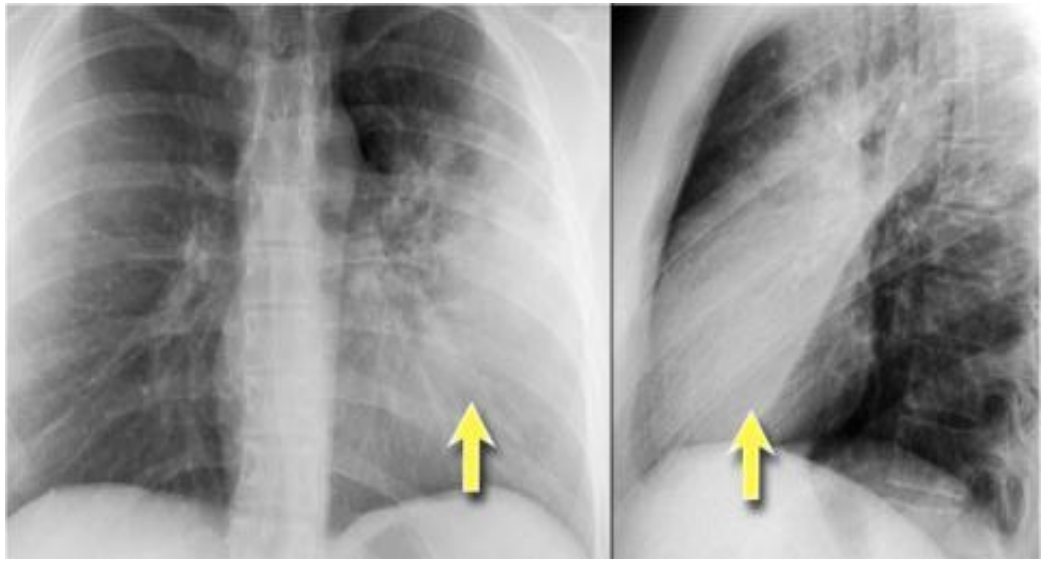


A silhouette sign

Patch silhouetting:

Right heart border
↳ Middle lobe

Left
↳ Linguola



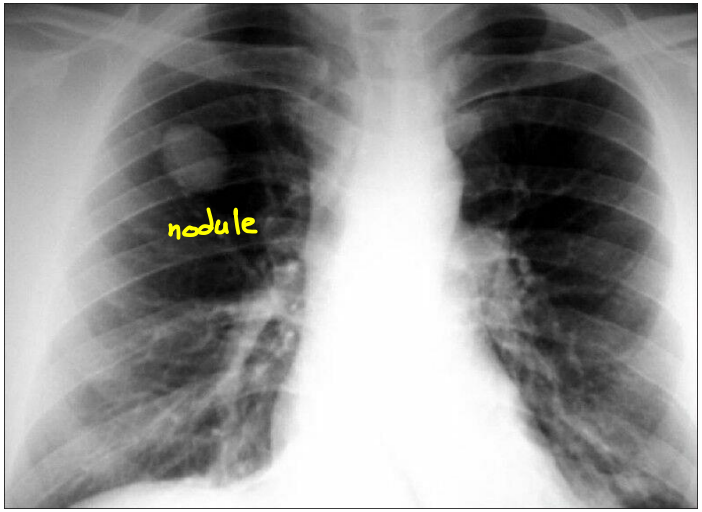
Left hemidiaphragm
↳ Lower lobe

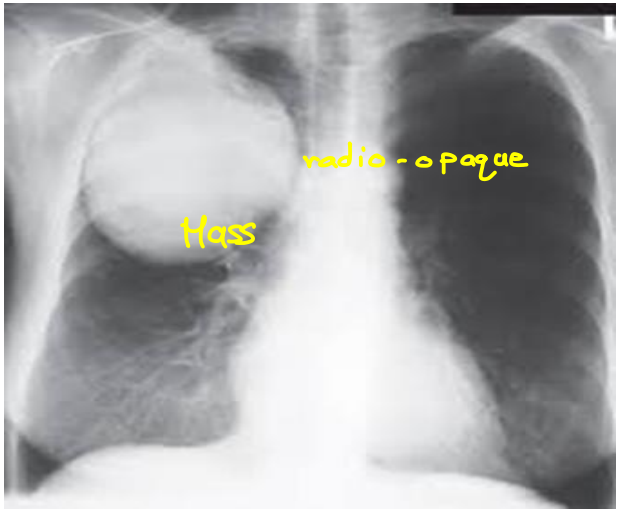
ABCDE

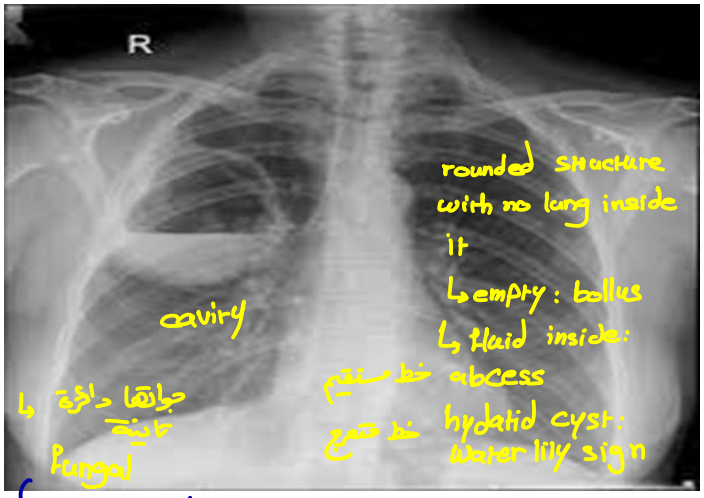
- Airway.
- Breathing.
- Cardiac, hila and mediastinum.
- Diaphragm.
- Everything else .

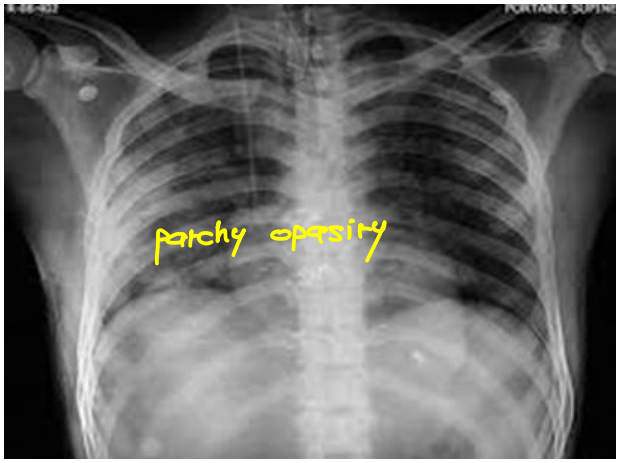
Focal lung lesions

↳ Nodule ↳ Mass ↳ cavity ↳ patchy opasity









cavity with soft tissue inside : staph.

Focal lung lesions. Cont'd

cavity with soft tissue

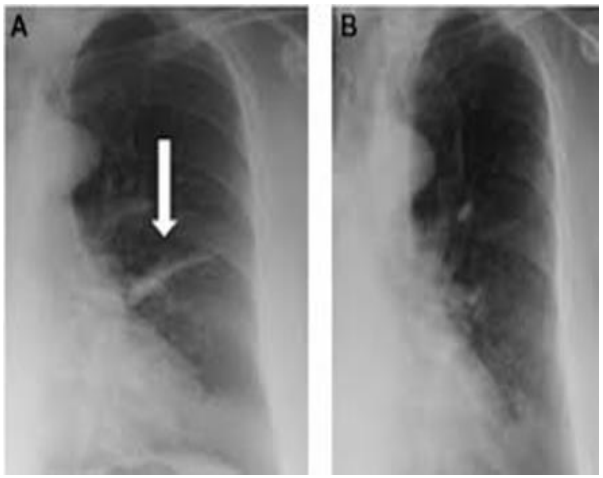
Fungal ball

patch / no air bronchogram

collapse in right

atelectasis

bolus



left hilar enlargement

Regarding the interpretation of abnormality, I'll use the ABCDE terms:

A: regarding the airway, the trachea is centralized

B: regarding the breathing, I'll comment on the lung, on the right side, I can see patchy opacity in the upper & mid zones of the right lung. There is no abnormal lesion on the left lung.

The patchy opasity has air bronchogram

The right hilum is not visulized because it's sellouting this lesion so I can't comment on the right hilum.

The left hilum seems to be ok.

C: The cardiothoracic shadow is fine

D: The right hemidiaphragm is slightely elevated compared to the left hemidiaphragm which is normal.

Right costophrenic angle is sharp, left costophrenic angle is hard to be visulized maybe it's bluntted

E: Everything else: There is no subcutaneous air, no joint destruction, no air under diaphragm

Diagnosis: patchy opasity + air bronchogram = Consolidation

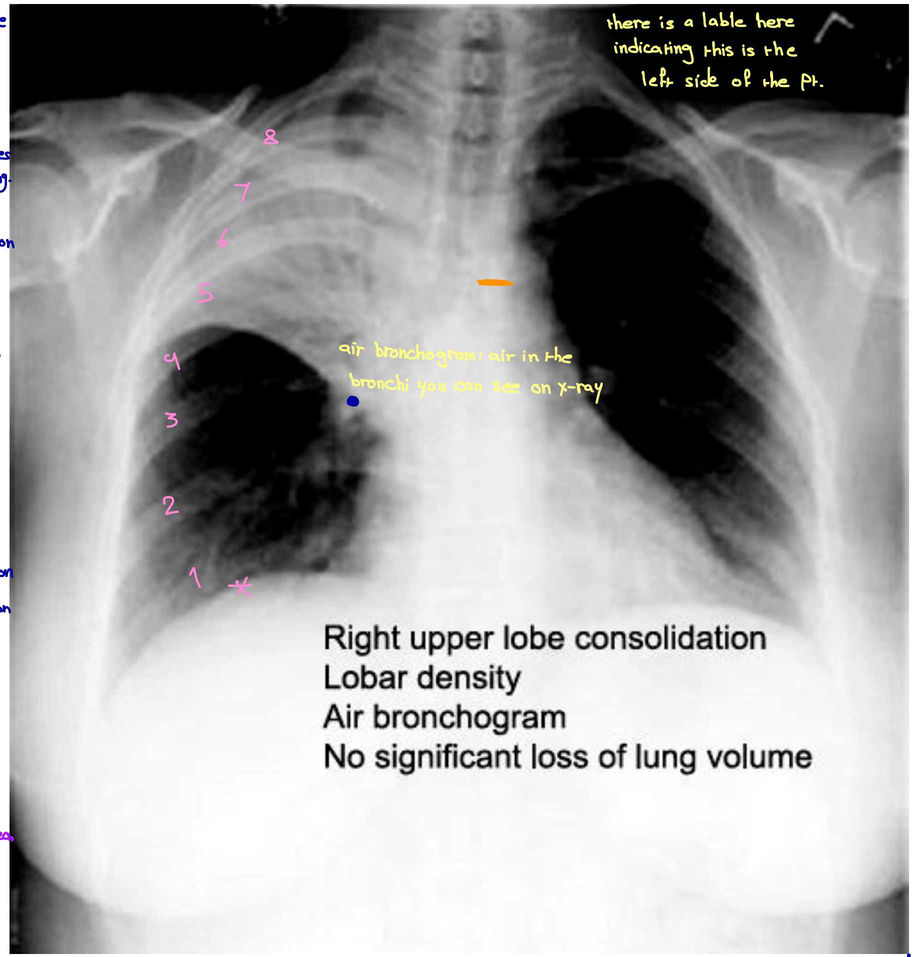
so this patchy opasity with air bronchogram → likly consolidation and consolidation is equal to Pneumonia.

Pneumonia respects the lung anatomy: no tracheal deviation, no loss of lung volume

عهاد المريض بعطيه antibiotic وبروحه وبعدها بعيدله ال X-ray

ما في داعي تعمل CT

↳ If there is no air bronchogram: closed bronchi (mass for example) ⇒ this is called collapse (with: shifting in the trachea, loss of volume)



Comment:

This is a frontal x-ray unlabeled, no pt. name or date or time when the x-ray was performed.

Regarding the technique, the film seems not to be rotated because the spinus process in the center is equally distant from the medial end of both clavicels.

Regarding inspiration, I'll count the posterior ribs, so I'll start from here * so I have 8 ribs posteriorly. I can visulize the apex on the right side and the apex on the left as well as the area of costophrenic angles → which indicates there is good inspiration.

Regarding projection, the film seems to be done in PA projection because the heart size is not enlarged.

Regarding exposure, I can visulize the spine to here — then I think the spine disappear, so I think the film is adequetly penetrated

↳ When commenting on the diaphragm → you have to comment on the angles [bluntted or sharp]

↳ bluntted = closed costophrenic angle مسكرينه فيهم fluid أو إشي

↳ btw the parietal & visceral pleura (meniscal sign)

Diffuse lung lesions

> 3

reticular, nodular, reticulonodular

Lung fibrosis

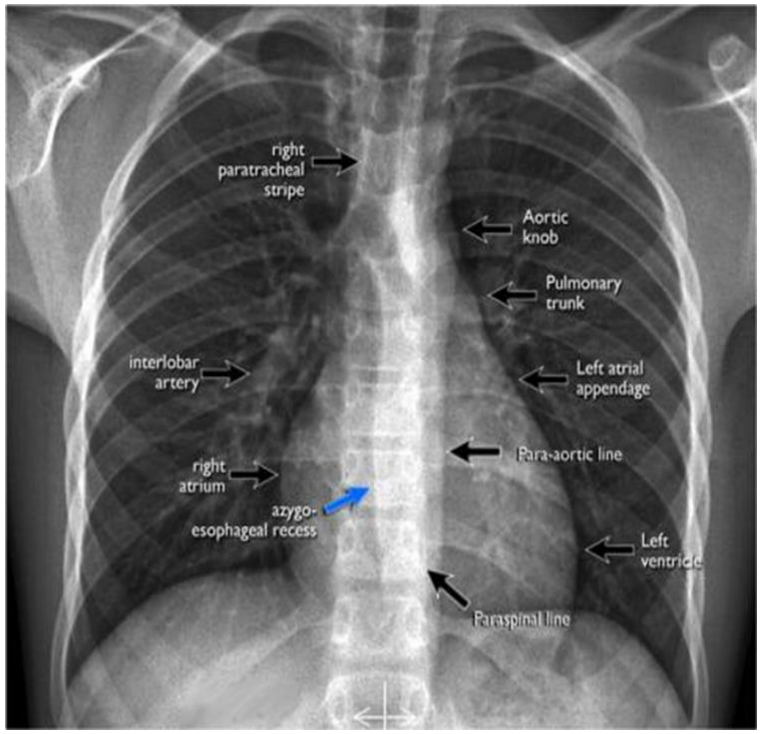
reticular

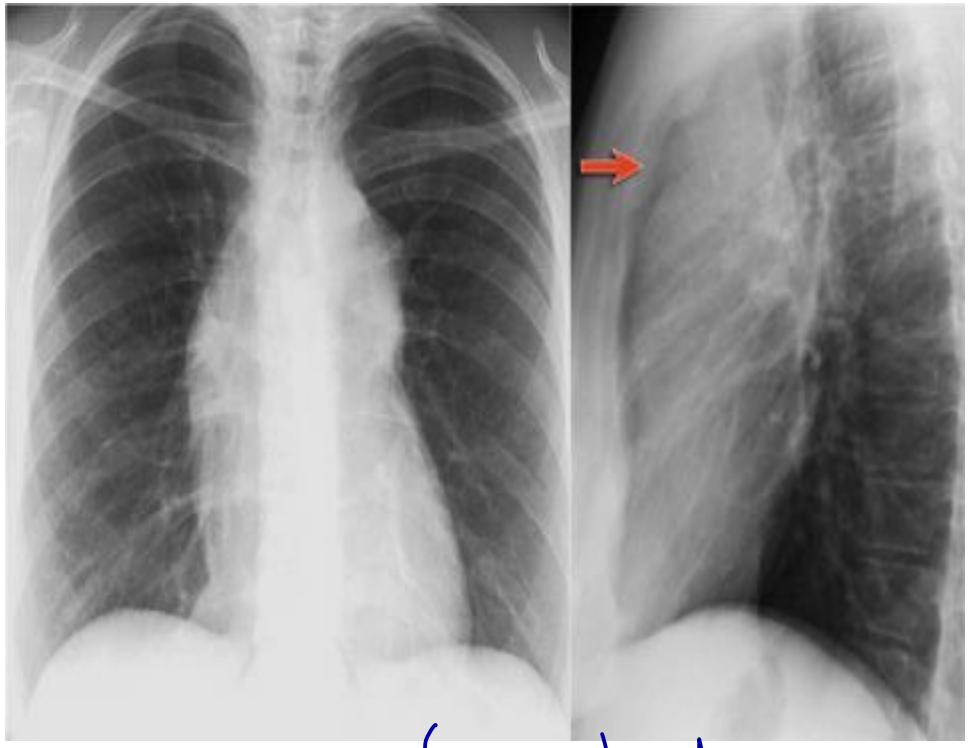
diffuse nodular opasities

nodular opasities

↳ Miliary TB

Mediastinum



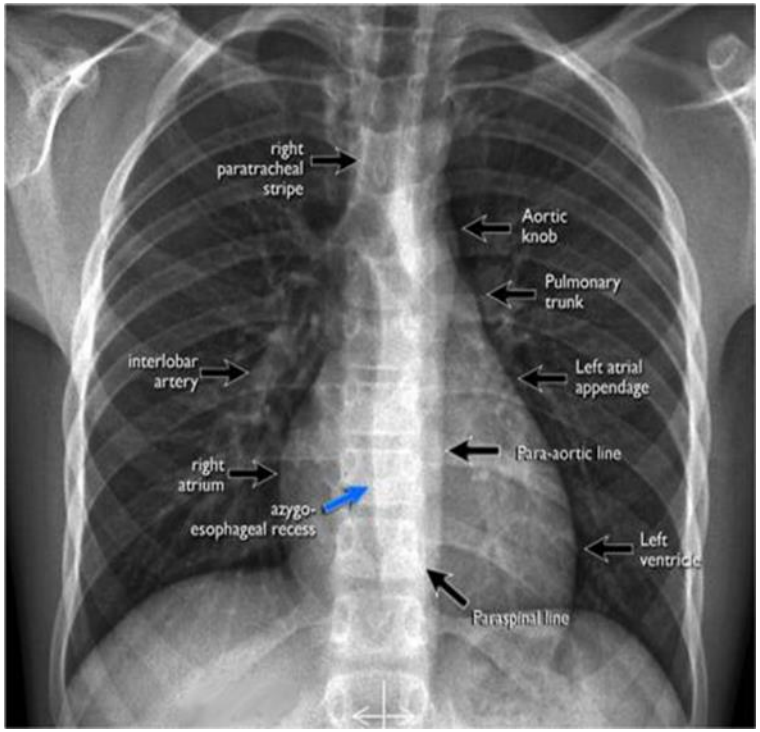


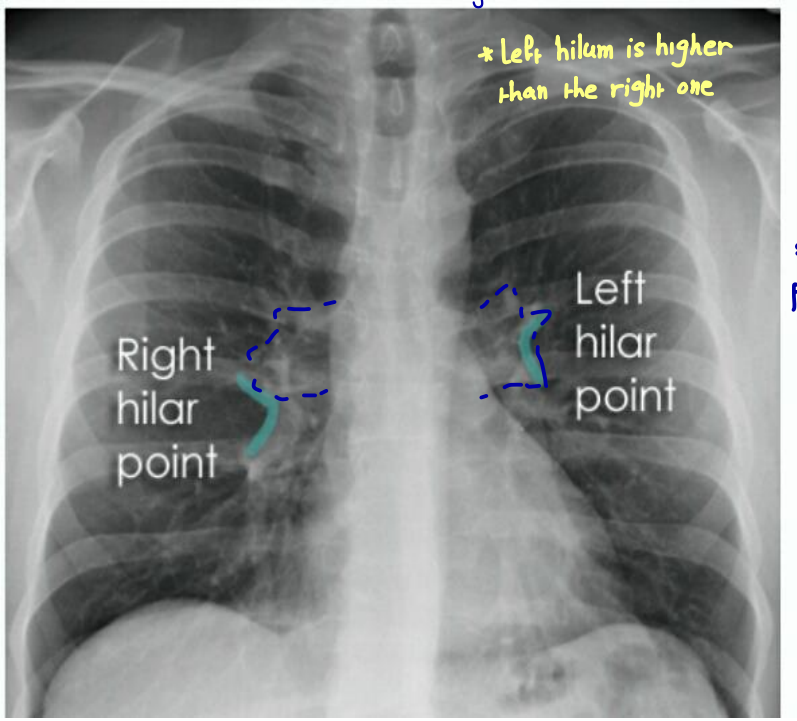
↳ enlarged mediastinum

What we look for : Lymphadenopathy , Pulmonary HTN

Hilum

↳ Left hilum نازل اكتر
↳ mass does collapse
↳ hilar enlargement : unilateral or bilateral
pulmonary HTN
LN enlargement · lymphadenopathy , infectious causes: TB
malignant causes: lymphoma
granulomatous diseases sarcoidosis





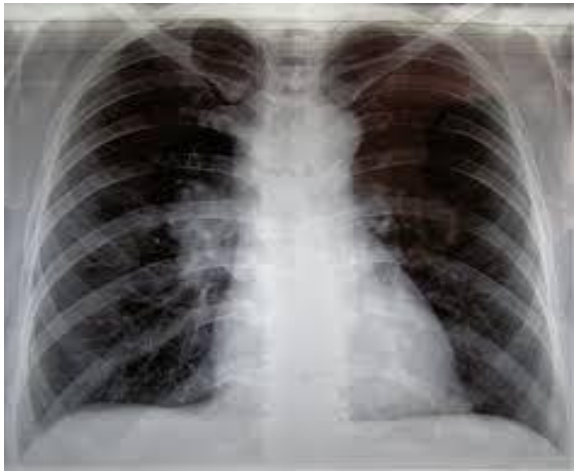
size
shape
Position

▶ Causes of bilateral hilar enlargement: 1. generalized lymphadenopathy: sarcoid , TB , Lymphoma 2. due to vascular structure → pulmonary hypertension 3. airways → mass (unilateral hilar enlargement is malignancy until proven otherwise)

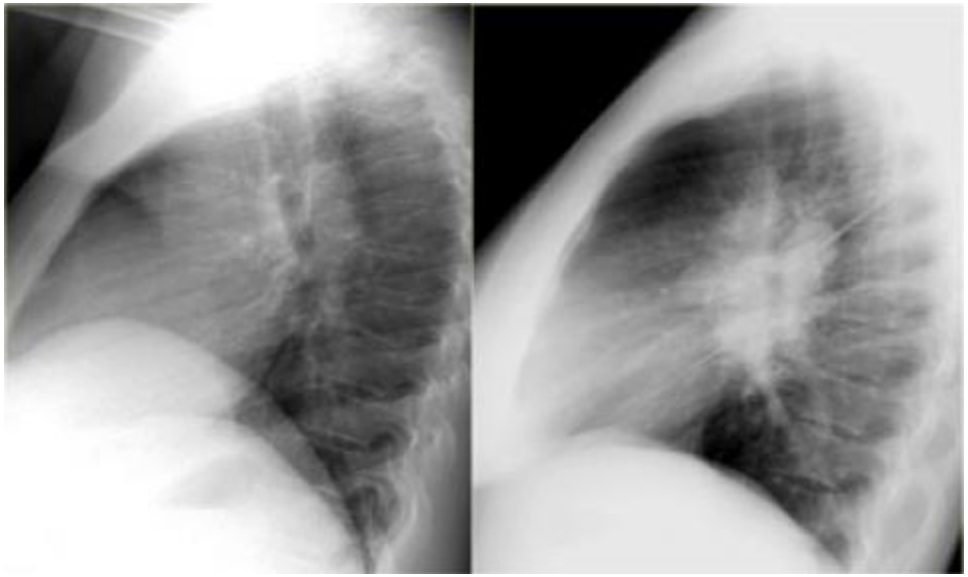
hilar : the area where you can see projection related to the anterior third of the heart shadow
① 2 pulmonary arteries & vein
② Right & left main bronchus
③ Lymph nodes

شو بطلع منها ؟

unilateral hilar enlargement



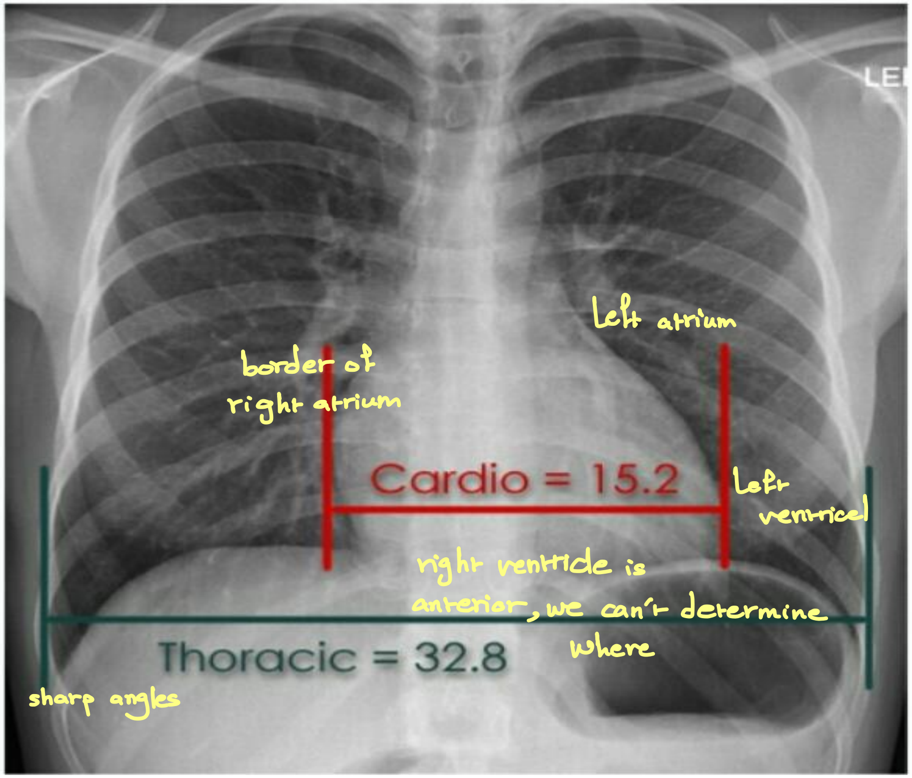
Bilateral hilar enlargement



Donut sign

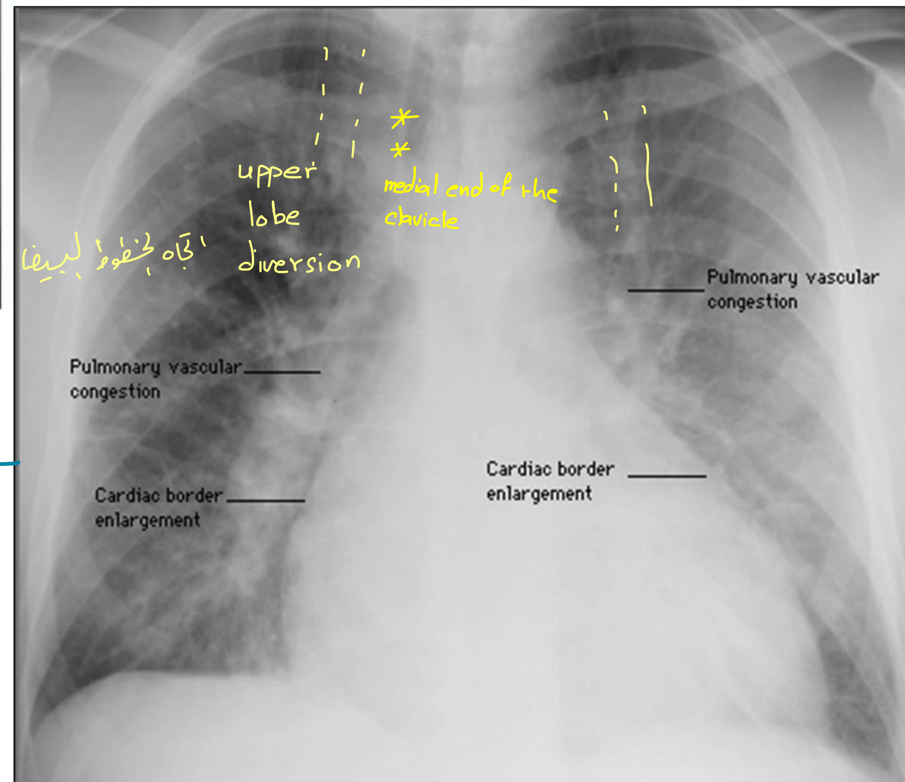
Lymph nodes around the airway

Cardiothoracic shadow



↳ make sure it's in PA projection

ratio of cardiac shadow to the inner chest → should be < 50 % → more than this indicates cardiomegaly



typical picture of heart failure, where you can see cardiomegaly and increased markings (blood vessels & lymphatics الي بمشوا فيه السكان) = pulmonary vascular congestion
Also, there is bilateral pleural effusion.
the film is rotated to the right. There is technical issue the whole apex is not visualized

Comment:

This is a frontal x-ray, unlabeled, no pt. name or date or time when the x-ray was performed.

Regarding the technique, the film seems not to be rotated because the spinus process in the center is equally distant from the medial end of both clavicels.

Regarding inspiration, I'll count the posterior ribs, so I'll start from here * so I have 8 ribs [7 ribs anteriorly] posteriorly. I can visulize the apex on the right side and the apex on the left. The area where I should see the left costophrenic angle is visulalized (looks blunted) The right costophrenic angle is sharp & visualized.

Regarding projection, the film seems to be done in PA projection because the heart size is not enlarged.

Regarding exposure, I can visulize the spine, so I think it's adequetly penetrated

ABCDE terms:

A: regarding the airway, the trachea is deviated to the left (which is not acceptable)

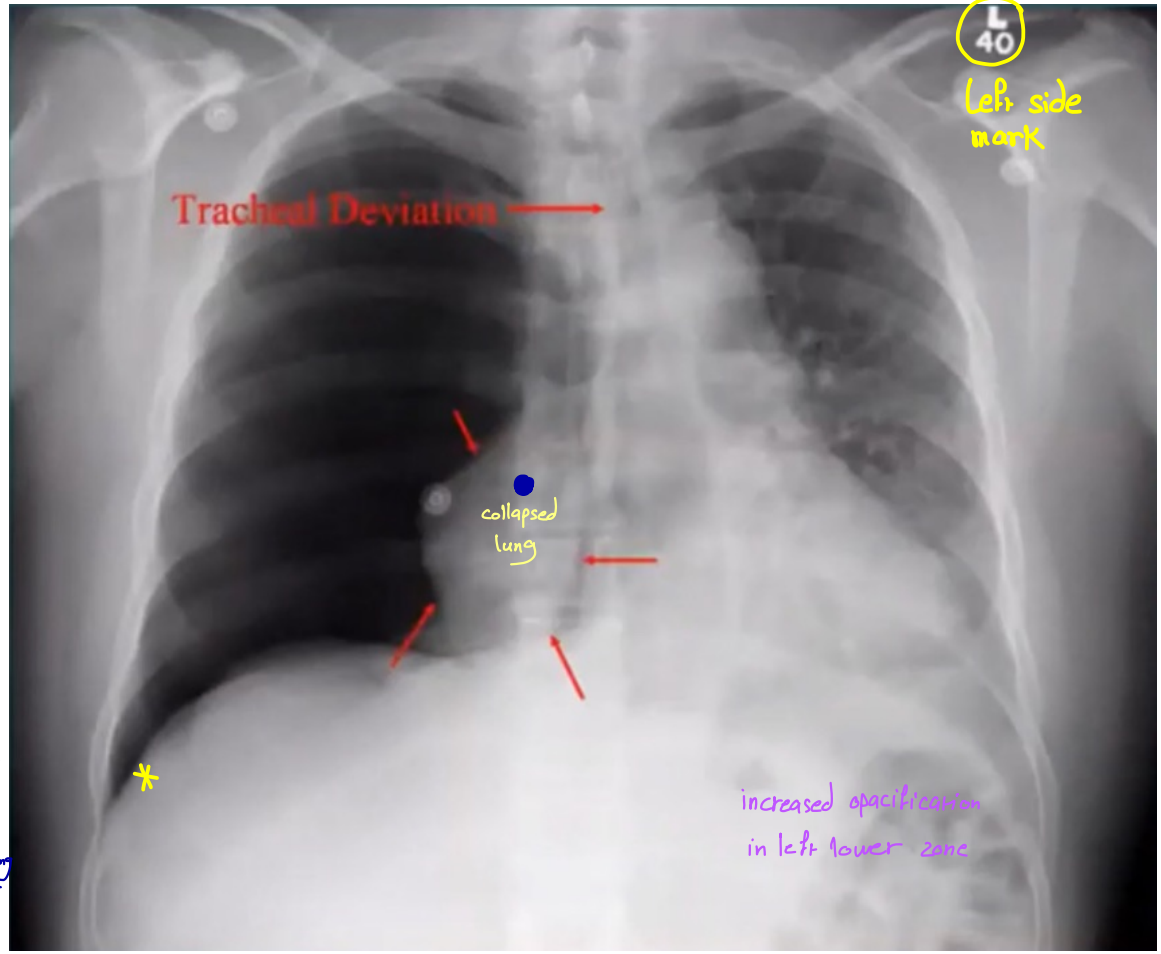
B: regarding the breathing, I'll comment on the lung, on the right side, I can see patchy opacity in the middle & lower zones of the right lung located medialy & on the top of costophrenic angle, it's sellouting the right heart border (guessing it's on the middle lobe)
There is visualized vascular markings on the left side but they are absent on the right side
The right hilum is not visulized because it's sellouting this ● lesion so I can't comment on the right hilum. Also the left hilum can't be commented on. Same for the mediastinum.

C: I can't comment on the cardiothoracic shadow because the patchy opasity is sellouting the right border of the heart.

D: The right hemidiaphragm is slightely elevated compared to the left hemidiaphragm which is normal).
Right costophrenic angle is sharp, left costophrenic angle is hard to be visulized maybe it's blunted

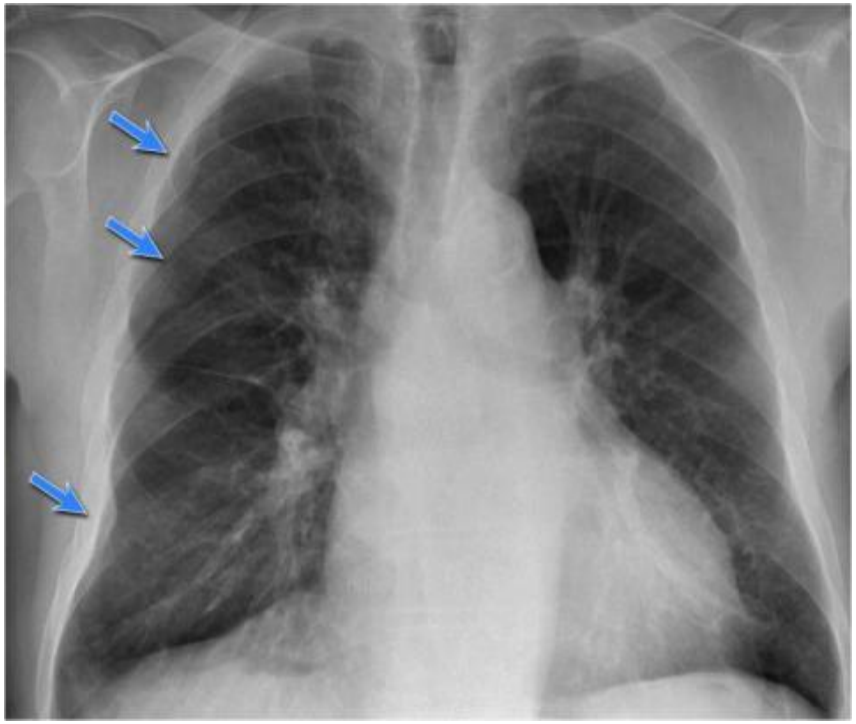
E: Everything else: There is no subcutaneous air, no joint destruction, no air under diaphragm, no air bronchograms

Diagnosis: pneumothorax, there is air in the right pleural space.



cressent sign

air under diaphragm
↳ perforated viscous
↳ stomach
↳ intestine



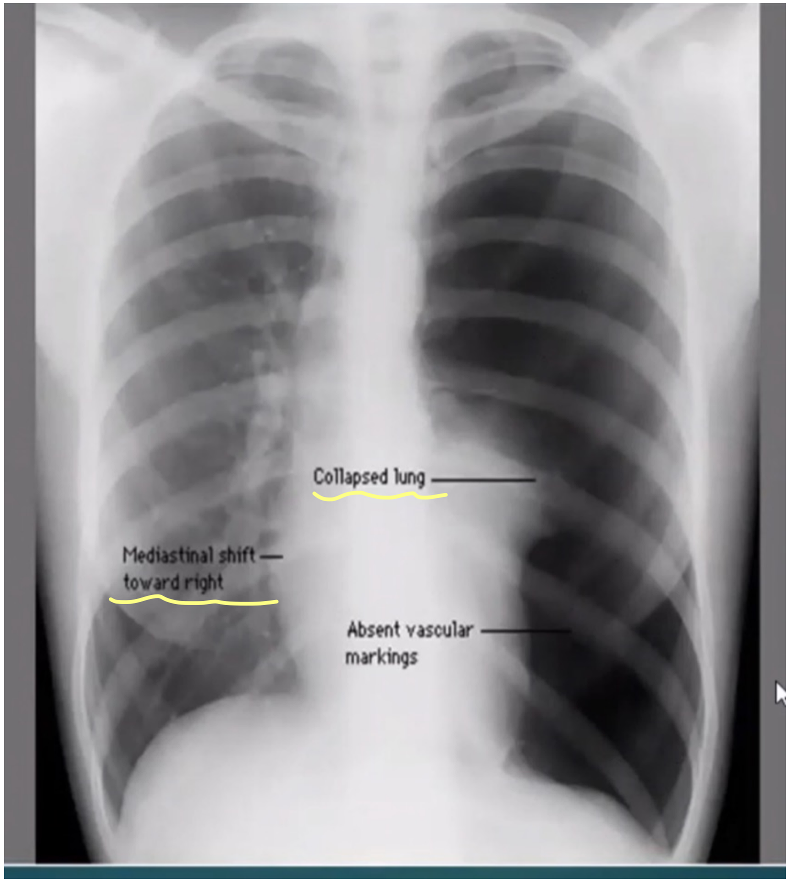
healed ribs fractures

شكلهم متعرج

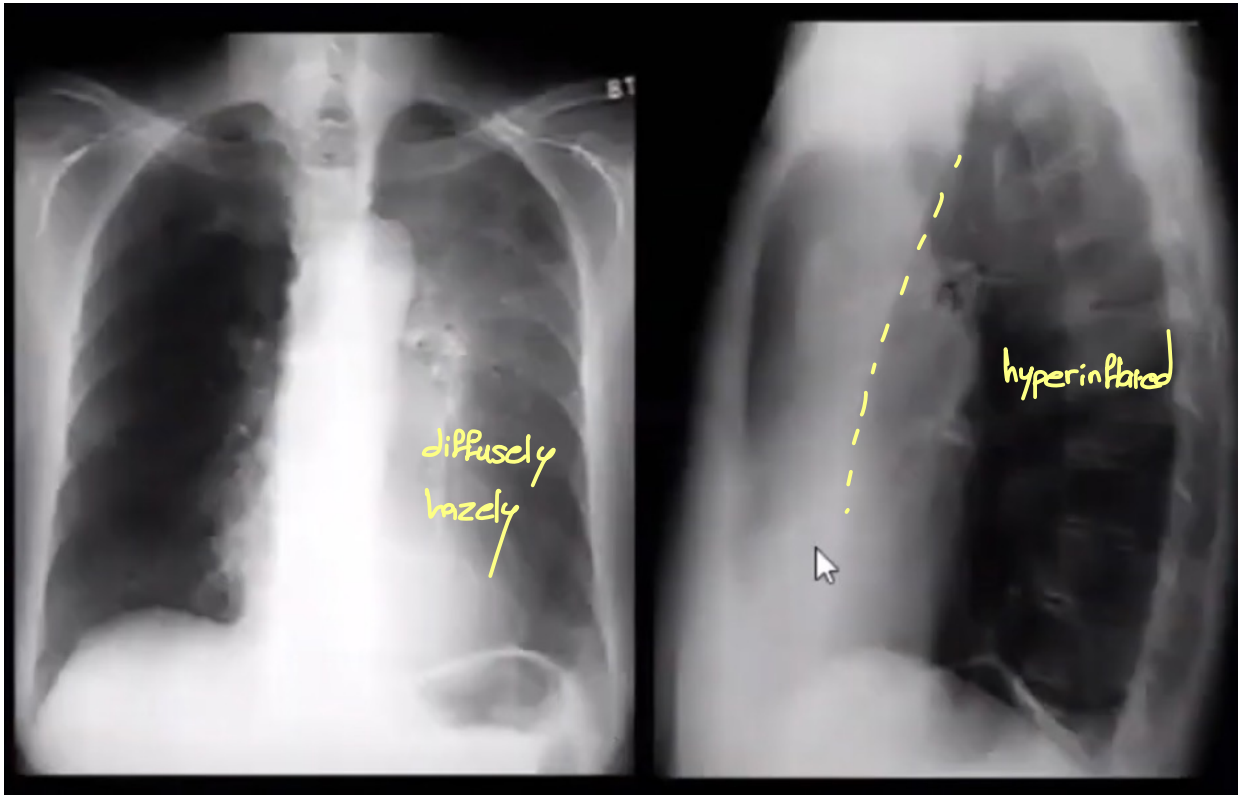
Left sided pneumothorax

Left side of the lung is bigger than the right

لأنه مجمعة هواء ، الطبيعي تكون اليمين أكبر من اليسار



Exercise



This is left upper lobe collapse

* Large left hilum → indication for left lung mass

Comment:
This is a frontal x-ray, unlabeled, no pt. name or date or time when the x-ray was performed.

Regarding the technique, the film seems not to be rotated because the spinus process in the center is equally distant from the medial end of both claviacls.

Regarding inspiration, I'll count the posterior ribs, so I'll start from here * so I have 8 ribs posteriorly. I can visulize the apex on the right side and the apex on the left. I can't visulize the costophrenic angles → which indicates there is technigual issue [6 ribs anteriorly]

Regarding projection, the film seems to be done in PA projection because the heart size is not enlarged.

Regarding exposure, I can visulize the spine to here — then I think the spine disappear, so I think the film is adequetly penetrated

Regarding the interpretation of abnormality, I'll use the ABCDE terms:

A: regarding the airway, the trachea is centralized (slightly deviated to the right)

B. regarding the breathing, I'll comment on the lung, on the right side, I can see patchy opacity in the upper & mid zones of the right lung. There is no abnormal lesion on the left lung. (with prominent lung markings)

The patchy opasity has air bronchogram (the opasity is not pulling the trachea, not reducing the lung volume so this suggestive of pneumonia consolidation)

The right hilum is not visulized because it's sellouring this ● lesion so I can't comment on the right hilum.

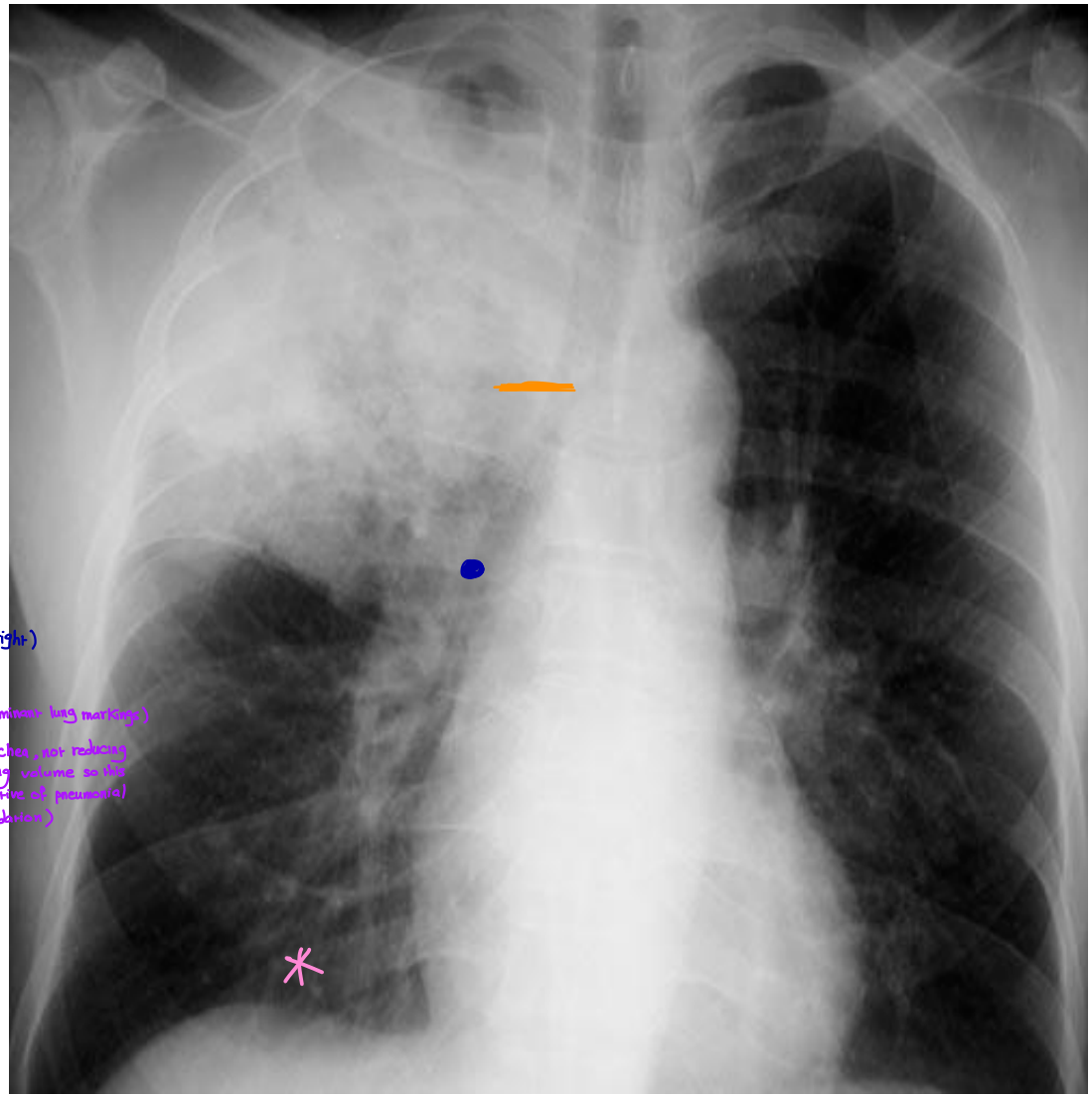
The left hilum seems to be ok.

C: The cardiothoracic shadow is fine (not enlarged)

D: The right hemidiaphragm is slightrely elevated compared to the left hemidiaphragm which is normal. → 2 cm

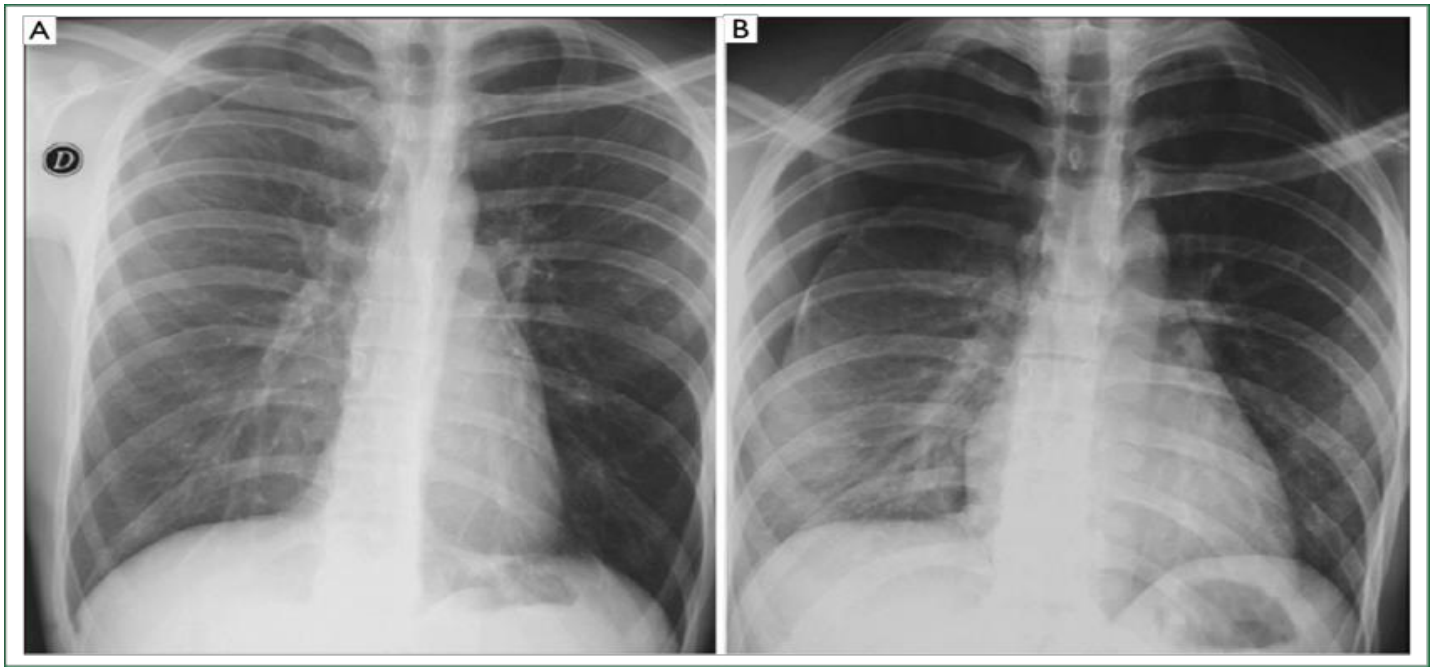
E. Everything else: There is no subcutaneous air, no joint destruction, no destructive lesions, no fractures
I can't comment wheather there is air under diaphragm or not bcs it's not visualized on the left side, but on the right side there is no air under diaphragm

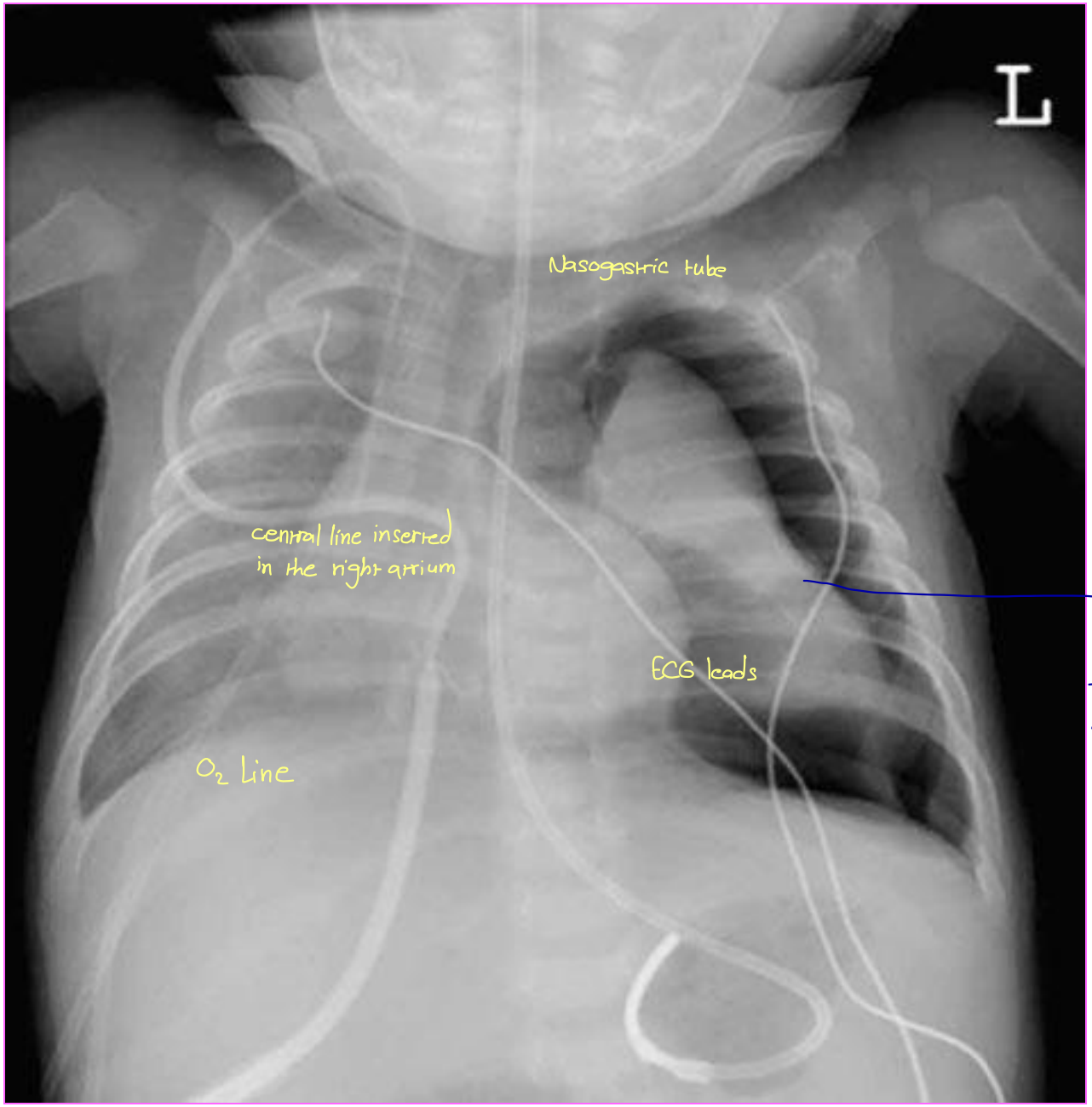
Diagnosis: right lobar pneumonia



→ Pneumothorax

Large intercostal spaces





*heart looks like boots shaped, so this pt. mostly have congineral heart disease

The whole spine is visualized = over exposed

Mostly there is fluid

Loss of lung markings on the left side

→ Patchy opasity with no air broncho-gram that is kidney shaped, in the left upper & mid zones

* collapsed left lung with pneumothorax

Indicative for perforated viscous or post-operative

there is air under diaphragm bilateraly

* there is patchy opasity in the left lower zone sellouting the left heart border & it's homogeneous in density with no air bronchogram, and having this concave upper border = meniscal sign

↳ left side pleural effusion

meniscal sign = free floating fluid
بتتحرك بسهولة

→ Pregnant lady sign

↳ there is fluid btw the parietal & visceral pleura بس مسكر مه خوه ومسكر مه تحت

Fibrin deposition لـ بسبب ال

Empyema ← pocket متل وعاء

↳ infected pleural space which needs urgent draining with chest tube insertion.

* patchy opasity in the right upper zone with no air bronchogram

* loss of lung volume on the right side

* right upper lobe collapse

lung بتنفتح tube الـ بتسحب

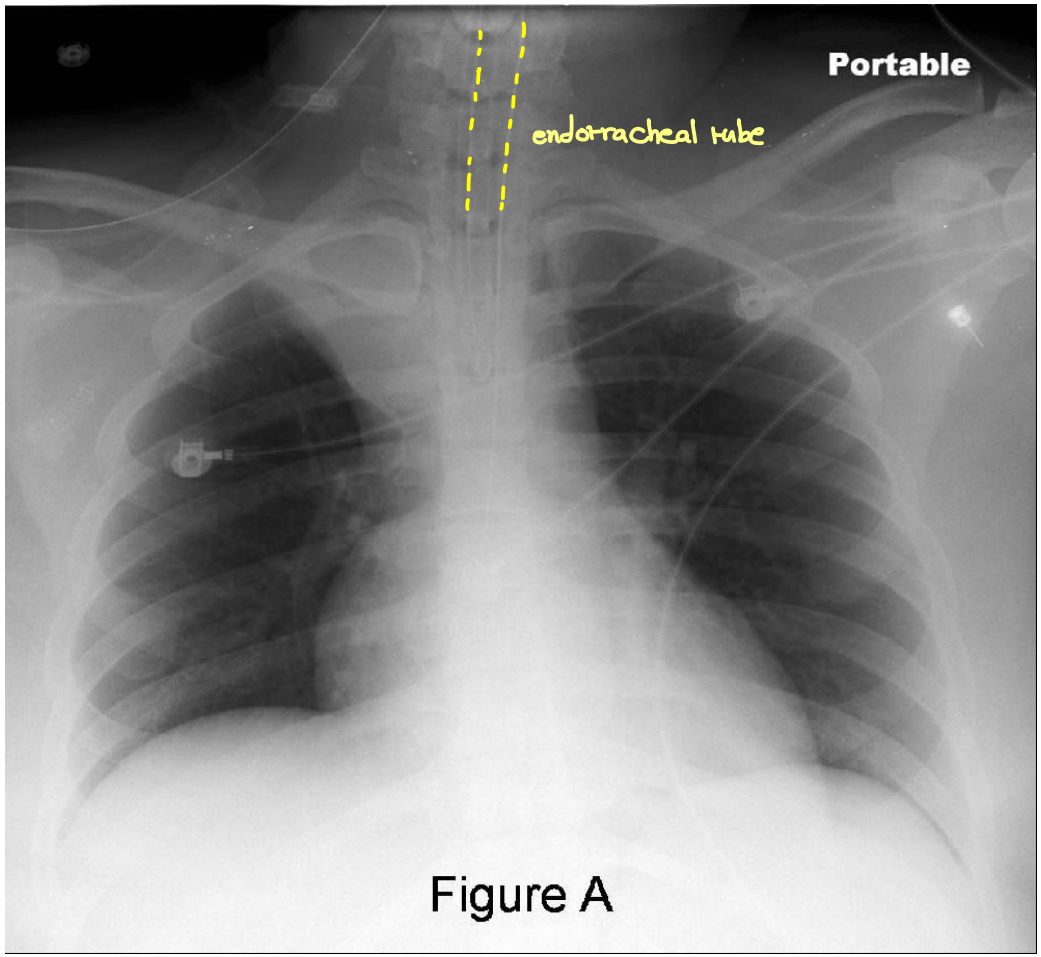


Figure A

Typical picture for pt.
With lung fibrosis where
you see diffuse reticular
lines

Lung volume أقل شوي

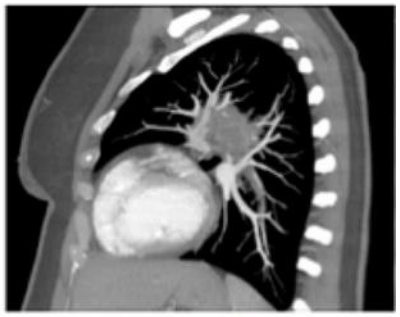
heart shadow كبير مو كتير

Chest CT interpretation

Terms…
axial, coronal, sagittal

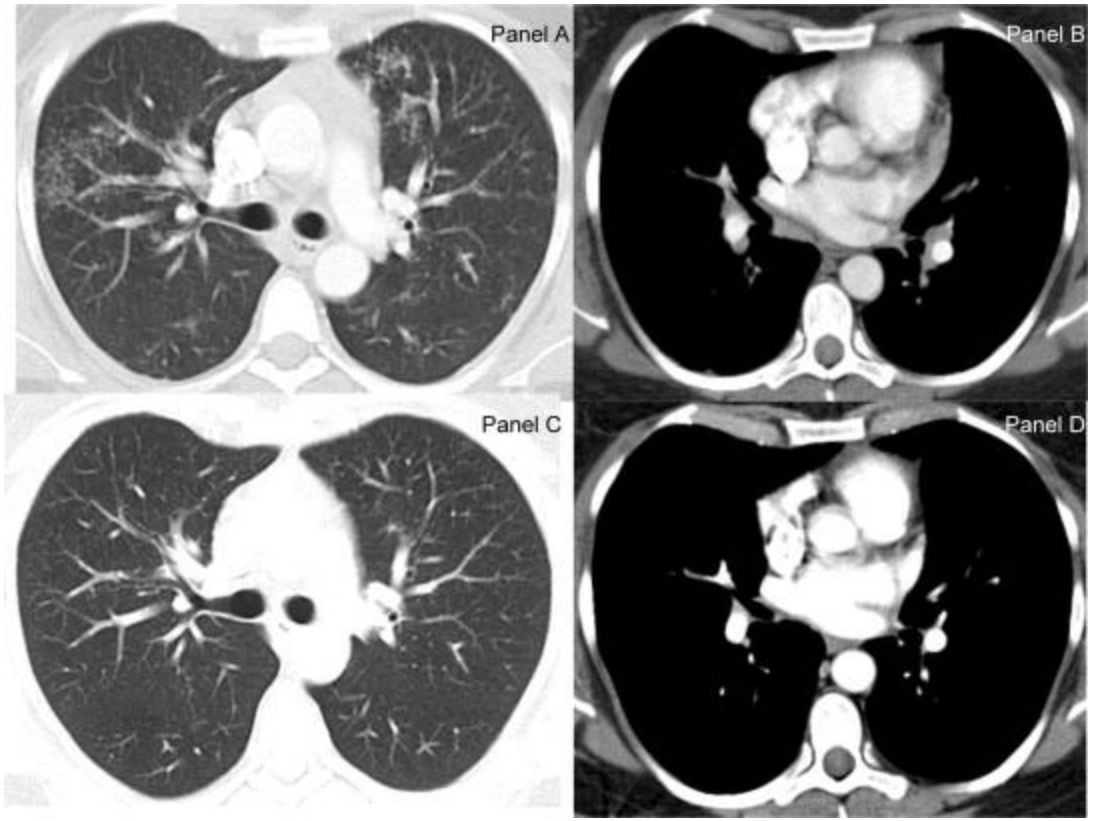
Axial view
Top to bottom

Coronal view
Front to back

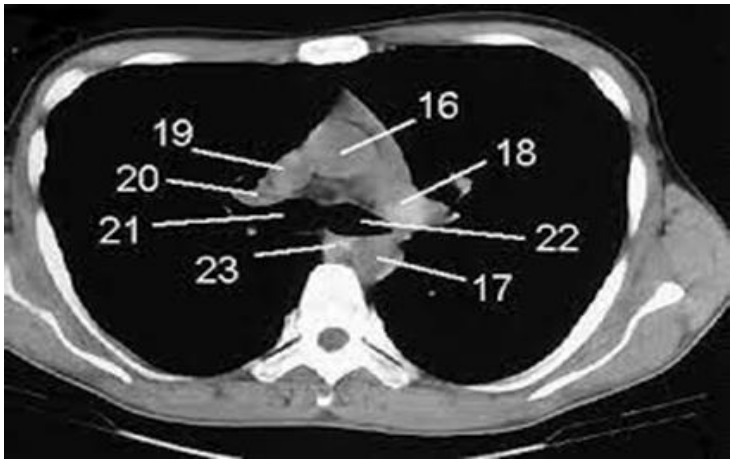


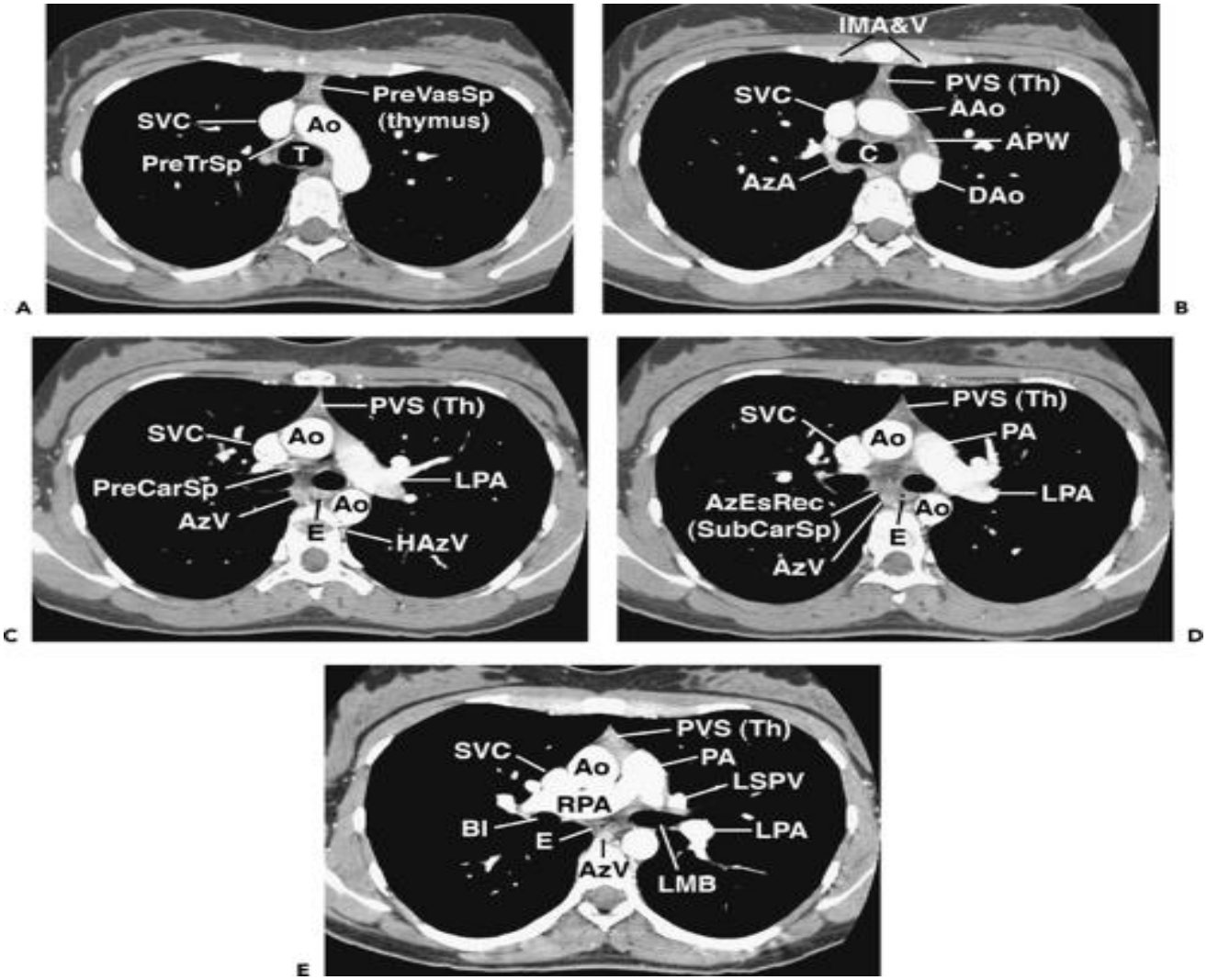
Sagittal view
Side to side

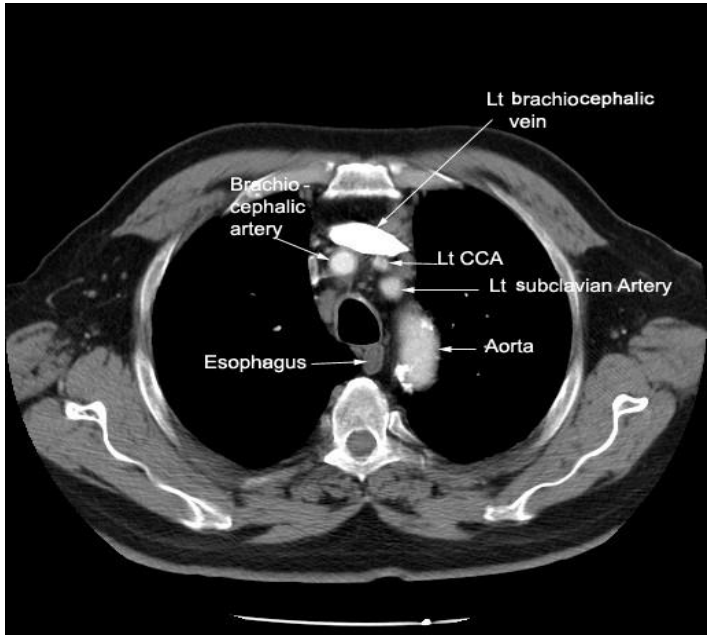
Terms …
Mediastinal and lung window

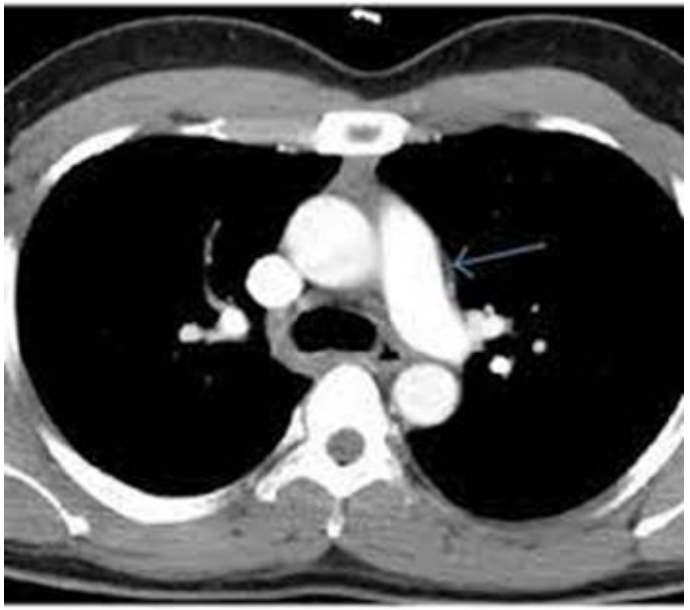


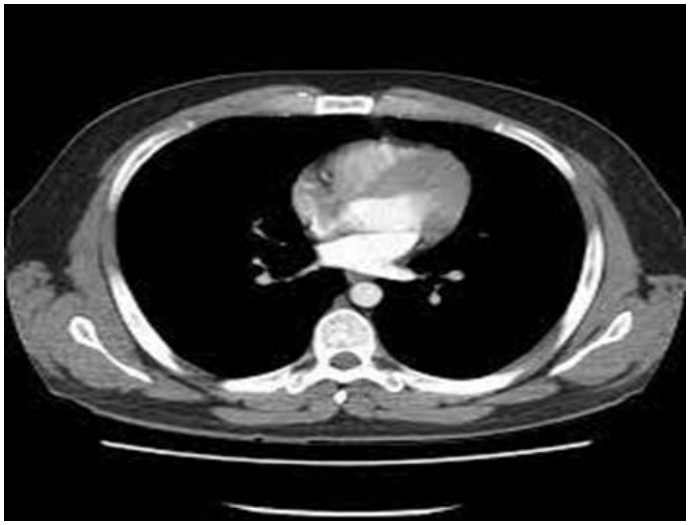
Ct chest with contrast

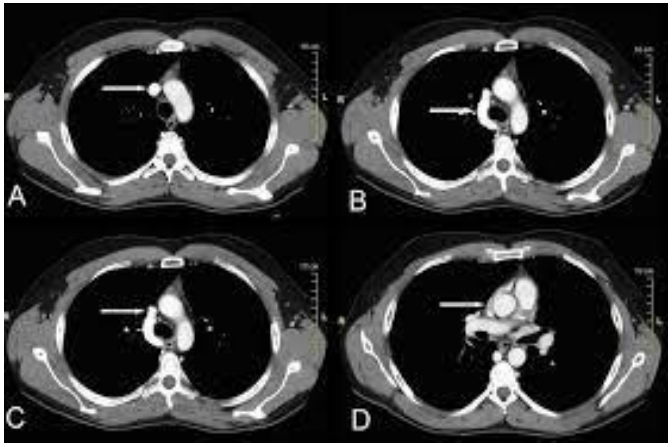


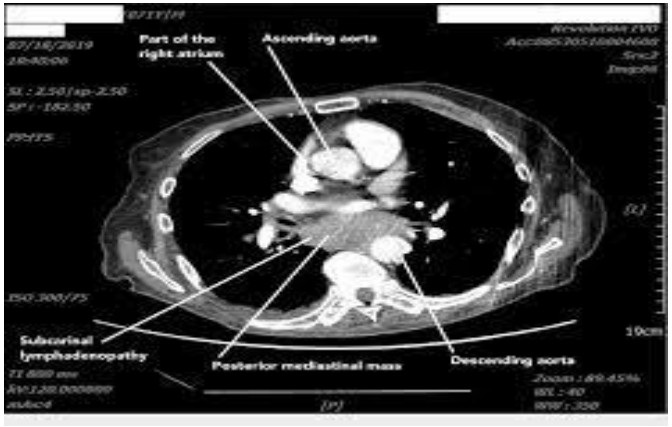

A
SVC
Ao
PreVasSp
(thymus)
PreTrSp
T
B
IMA&V
SVC
PVS (Th)
AAo
APW
C
AzA
DAo
C
PVS (Th)
SVC
Ao
LPA
PreCarSp
Ao
AzV
E
HAzV
D
SVC
PVS (Th)
Ao
PA
LPA
AzEsRec
(SubCarSp)
Ao
E
AzV
E
PVS (Th)
SVC
Ao
PA
LSPV
RPA
BI
E
LPA
AzV
LMB

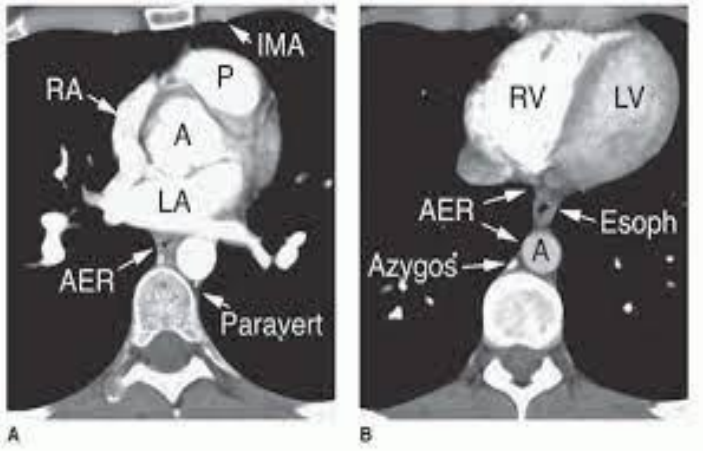

Lt brachiocephalic vein
Brachio - cephalic artery
Lt CCA
Lt subclavian Artery
Aorta
Esophagus



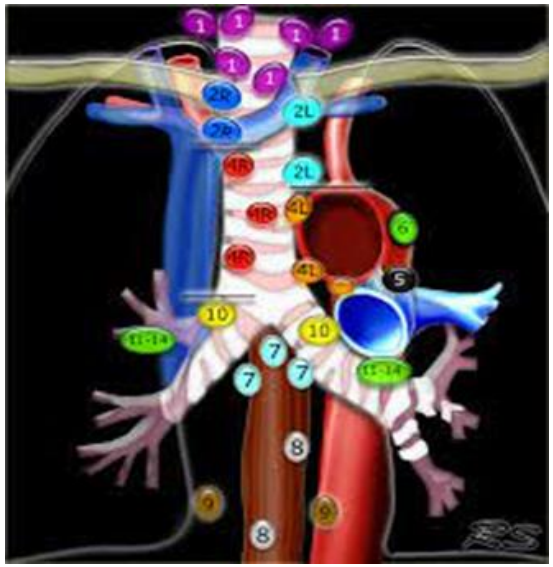


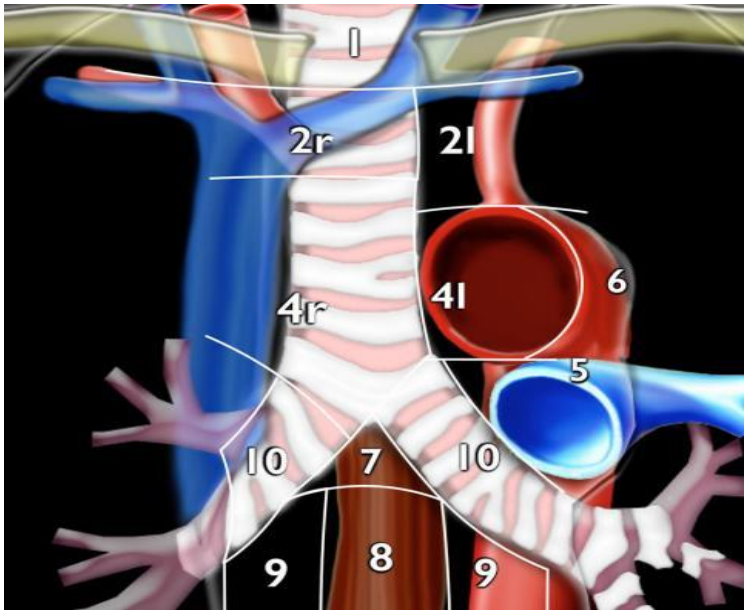

A
B
C
D

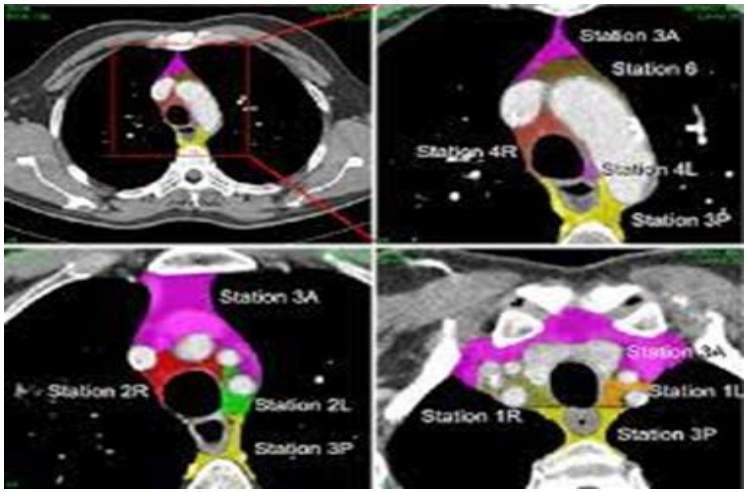

Part of the right atrium
Ascending aorta
Subcarinal lymphadenopathy
Posterior mediastinal mass
Descending aorta
10cm

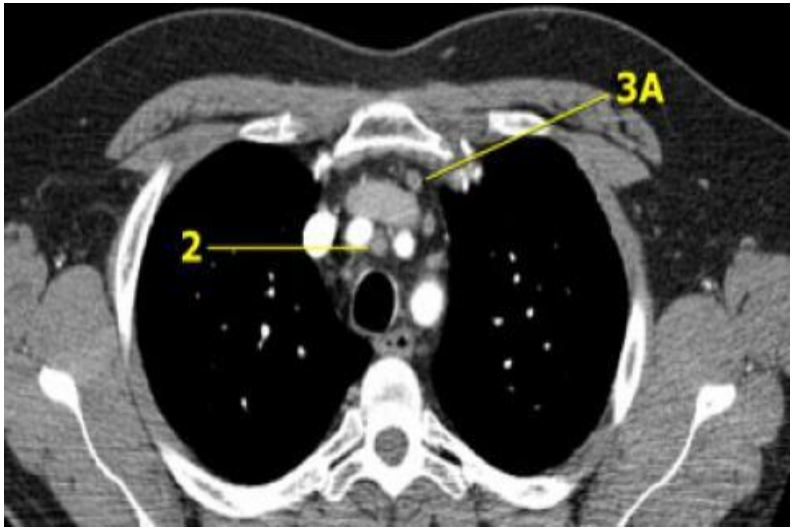

IMA
P
RA
A
LA
AER
Paravert
A
RV
LV
AER
Esoph
Azygos
A
B

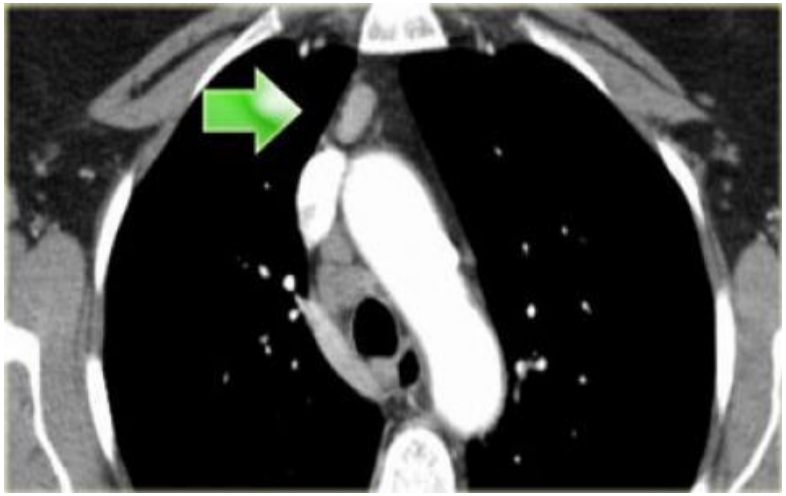
IASLC lymph node map.

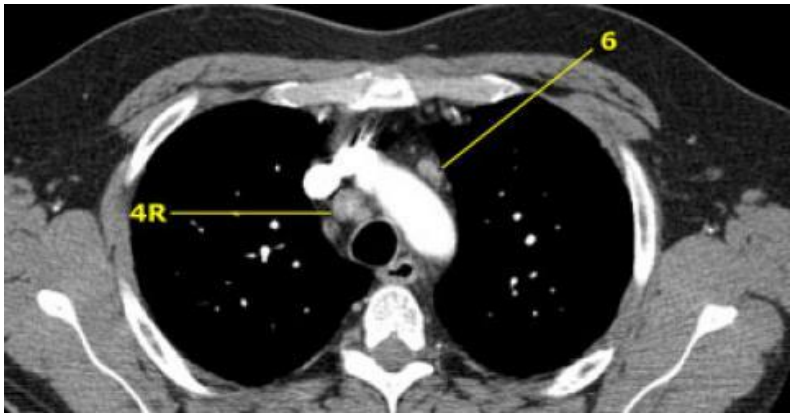


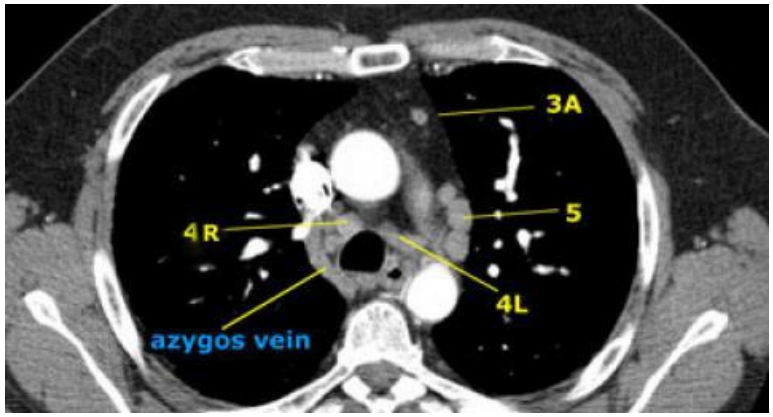


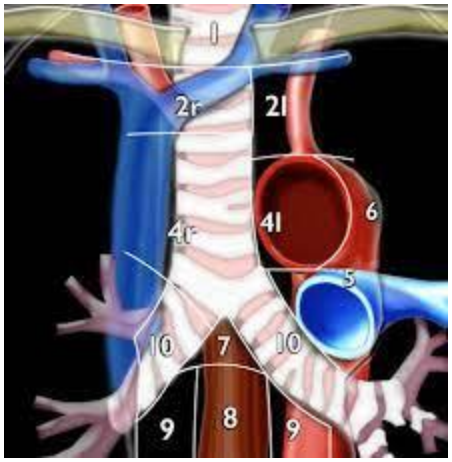


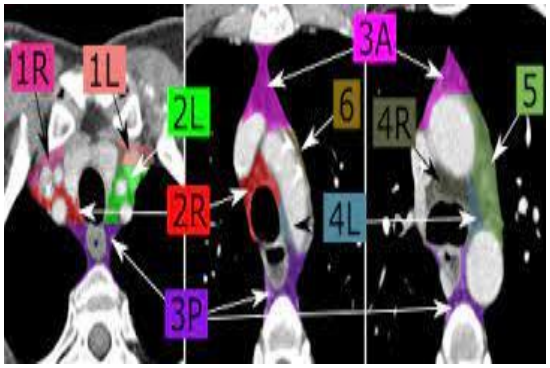

3A
2

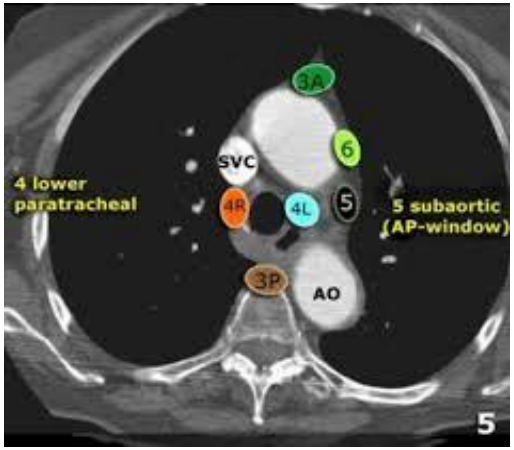


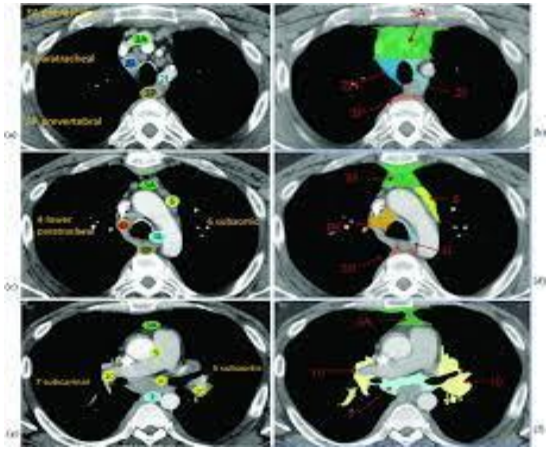

6
4R

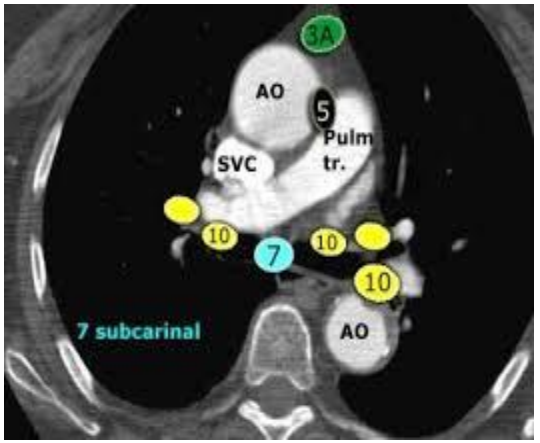

3A
4R
5
4L
azygos vein


1
2r
2l
4r
4l
6
5
10
7
10
9
8
9

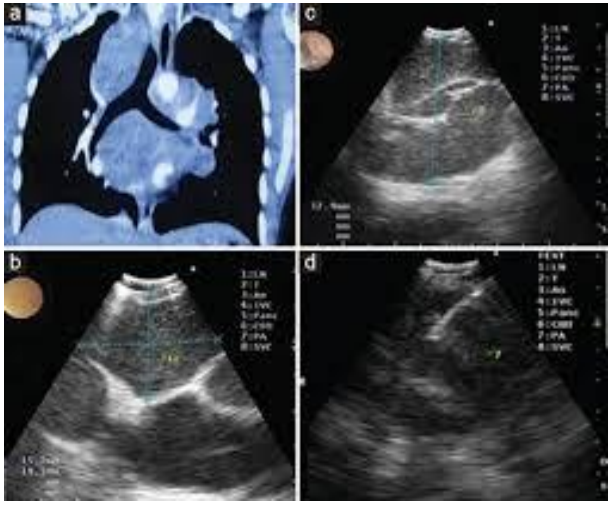

1R
1L
2L
2R
3P
3A
6
4R
4L
5

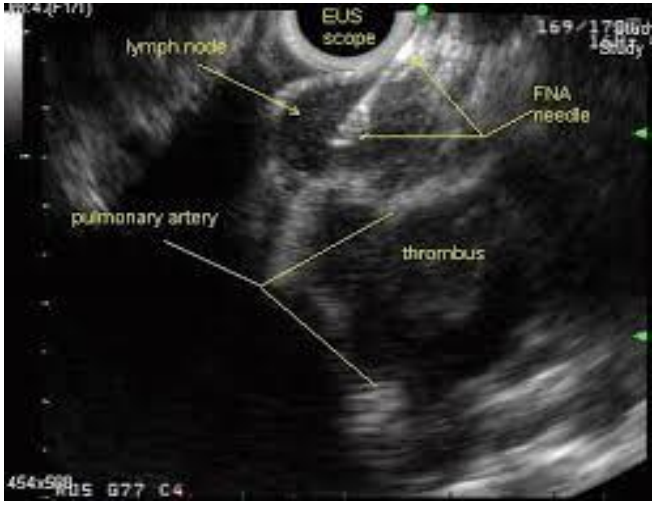

3A
6
SVC
4 lower
paratracheal
4R
4L
5
5 subaortic
(AP-window)
3P
AO
5

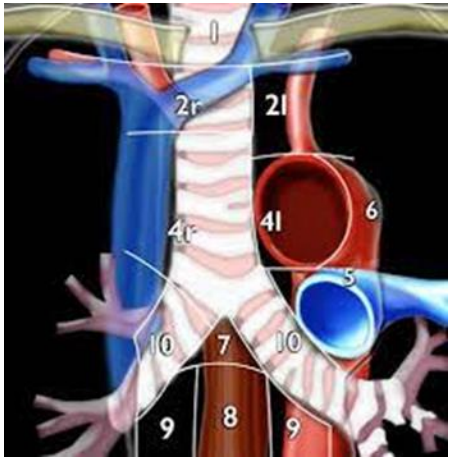


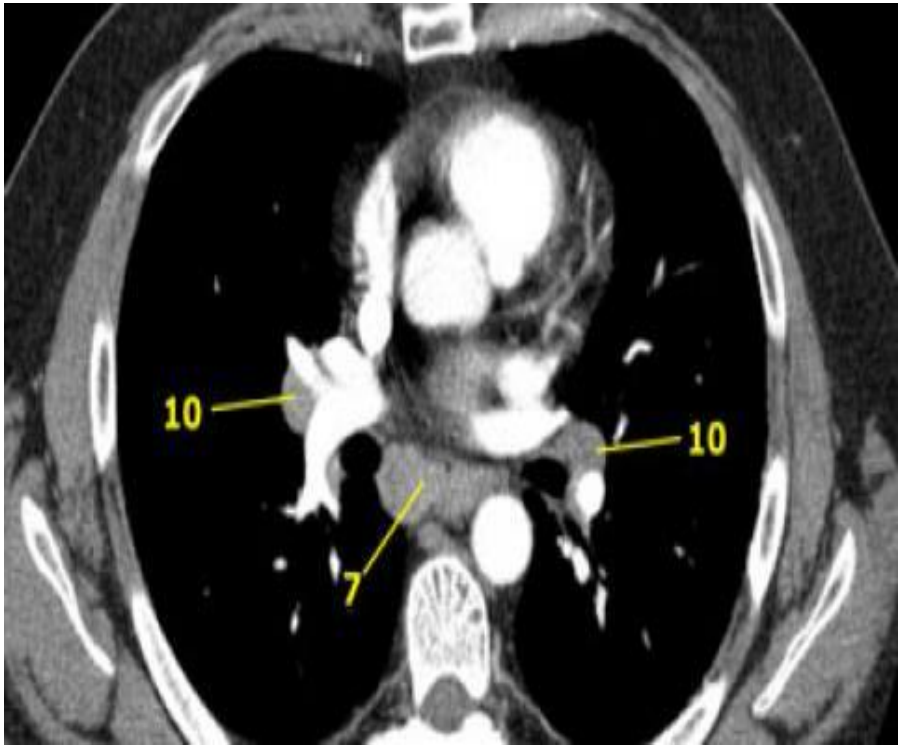

3A
AO
5
Pulm
tr.
SVC
10
7
10
10
7 subcarinal
AO

EBUS

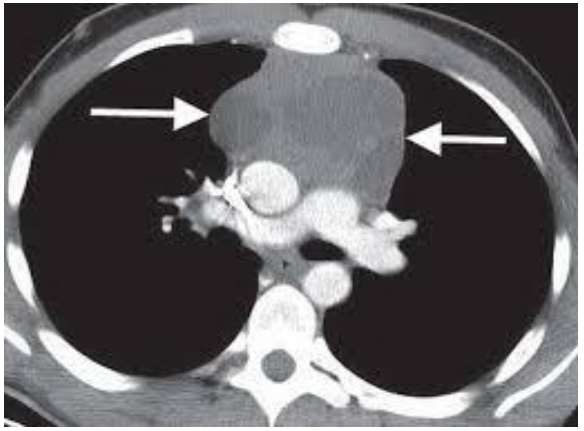

a
c
b
d

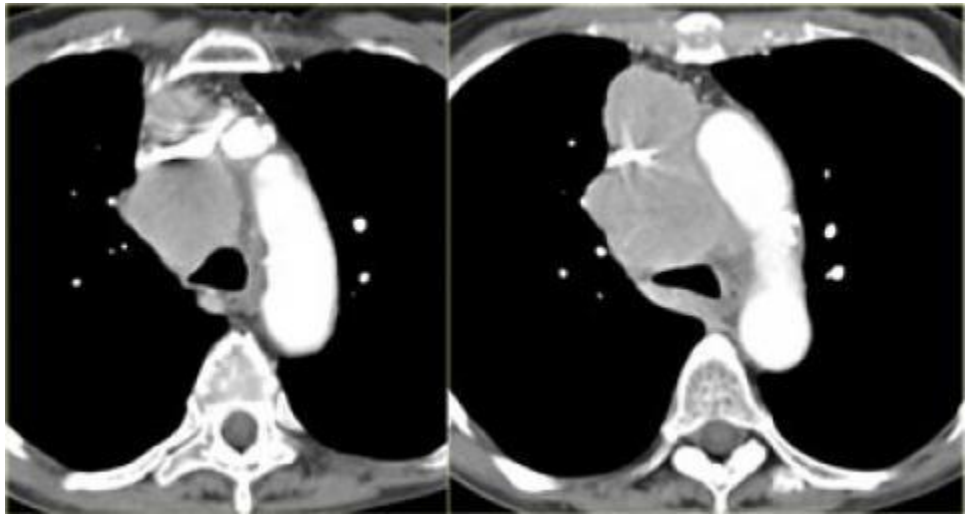

EUS
scope
lymph node
FNA
needle
pulmonary artery
thrombus

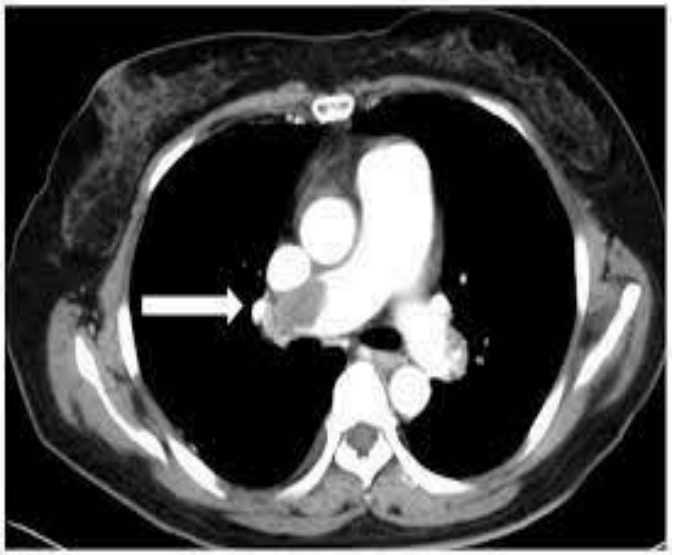

1
2r
2l
4l
6
5
10
7
10
9
8
9

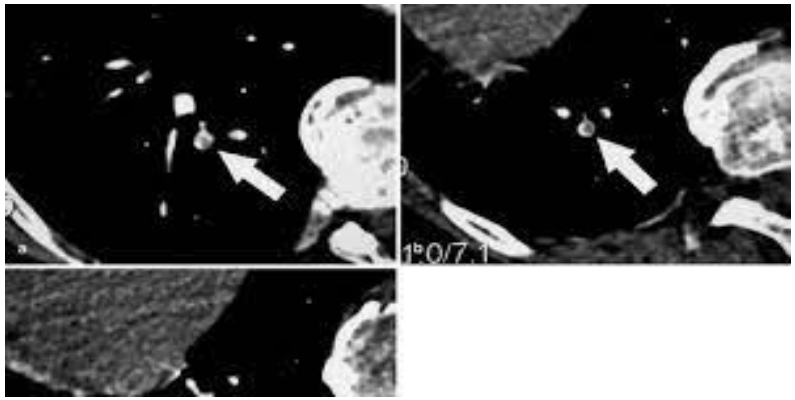

10
10
7


H-SP-CR







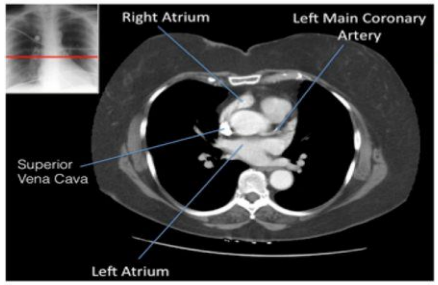


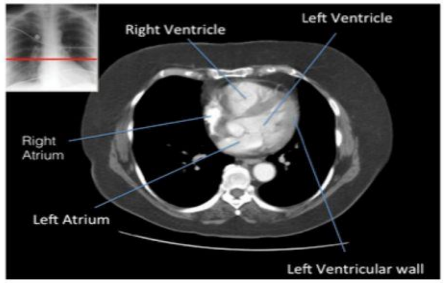
8t66

Atria Region

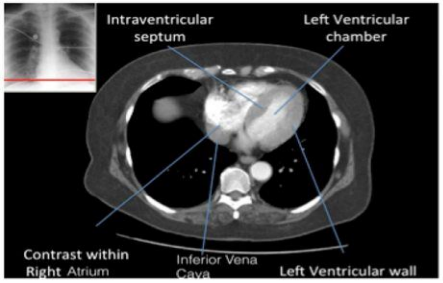
Located within this region are the

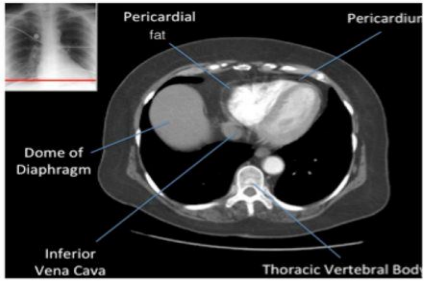
- *Atria*
- *Coronary Arteries*
- *The superficial aspects of the Ventricles*





Ventricular Region

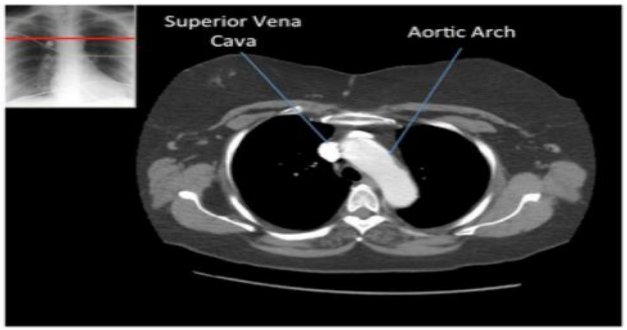




Located within this region are the

- *Ventricles*
- *Interventricular Septum*
- *Pericardium*
- *Pericardial Sac*
- *Dome of Diaphragm*

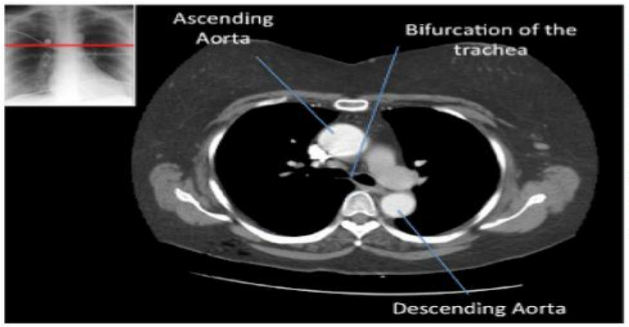
Aortic Arch Region



Located within this region are:

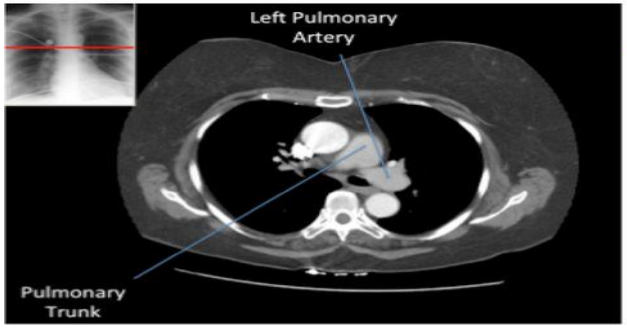
- *Superior Vena Cava*
- *Aortic Arch*

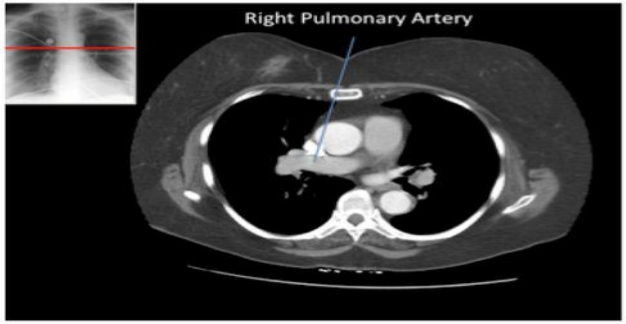
Carina and Pulmonary Vessel Region



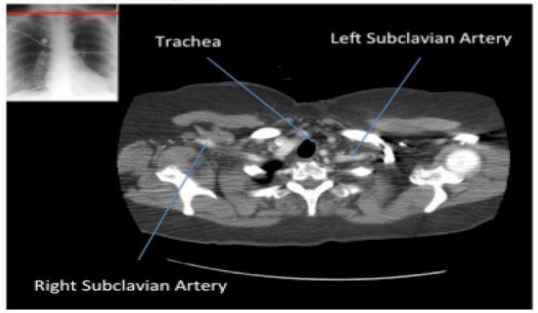
Located within this region are the:

- *Ascending and Descending Aorta*
- *Bifurcation of the trachea*
- *Aortic Arch*
- *Pulmonary Arteries*
- *Pulmonary Trunk*



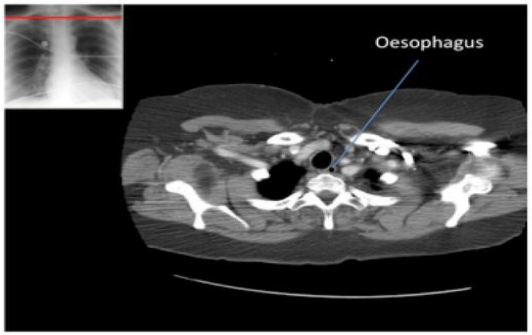


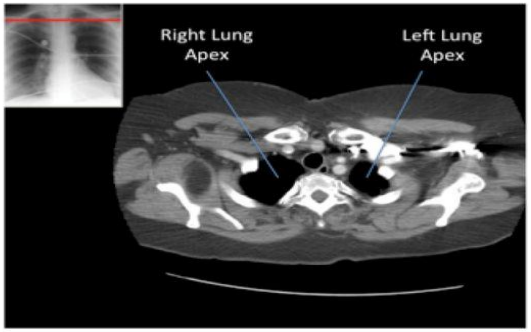
Great Vessels Region

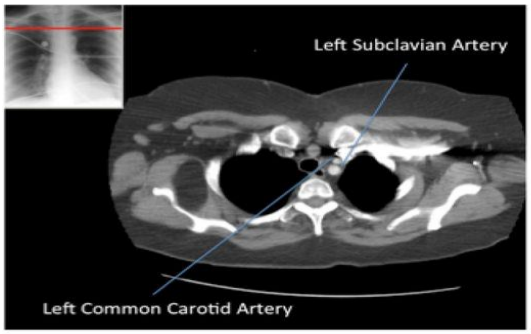


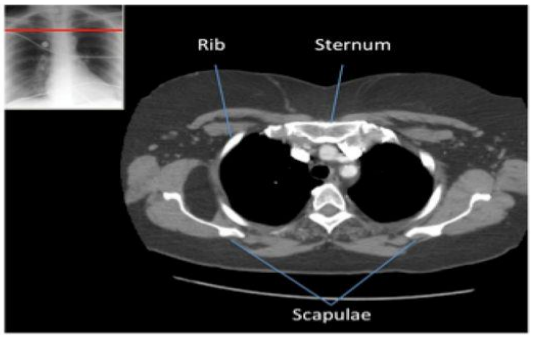
Located within this region are the:

-trachea
-oesophagus
-subclavian vessels
-carotid vessels
-lung apices
-Boney structures



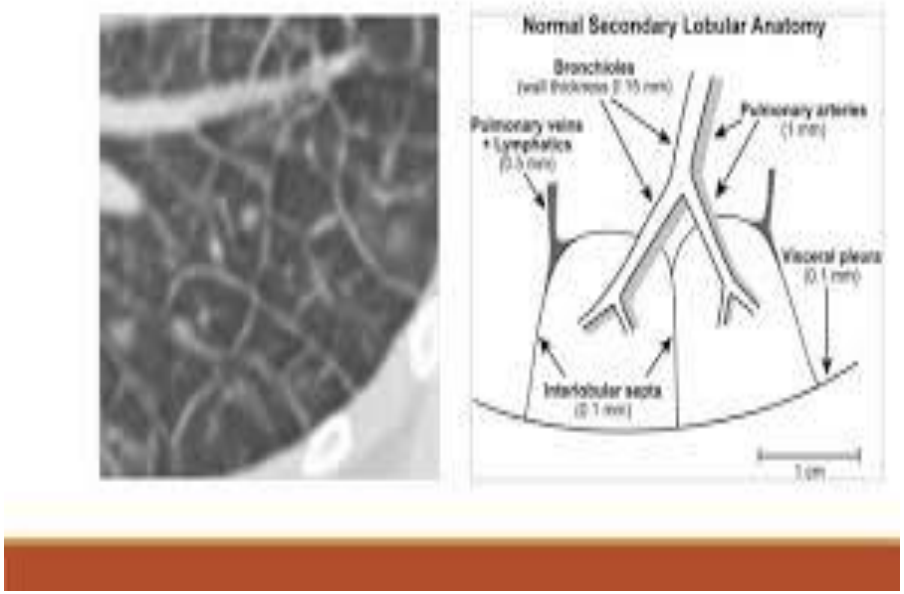






HRCT chest

Secondary pulmonary lobule



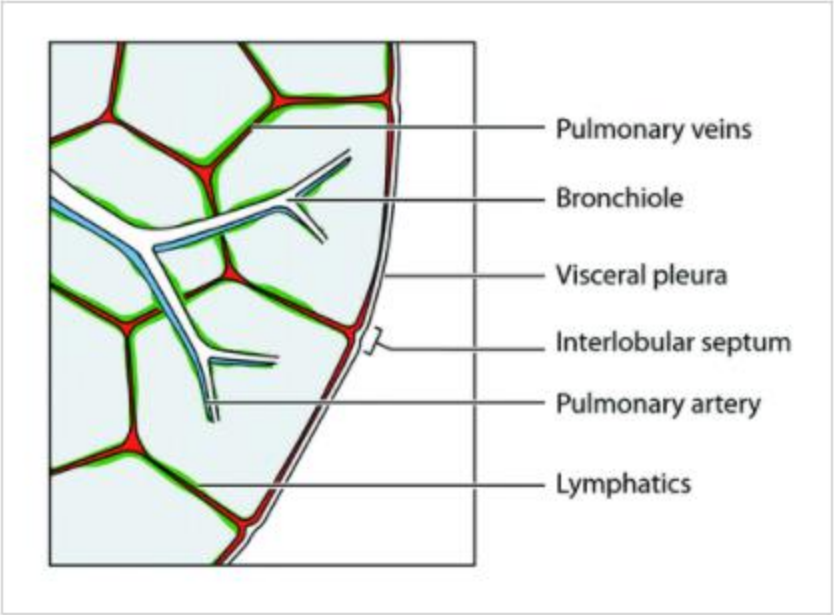
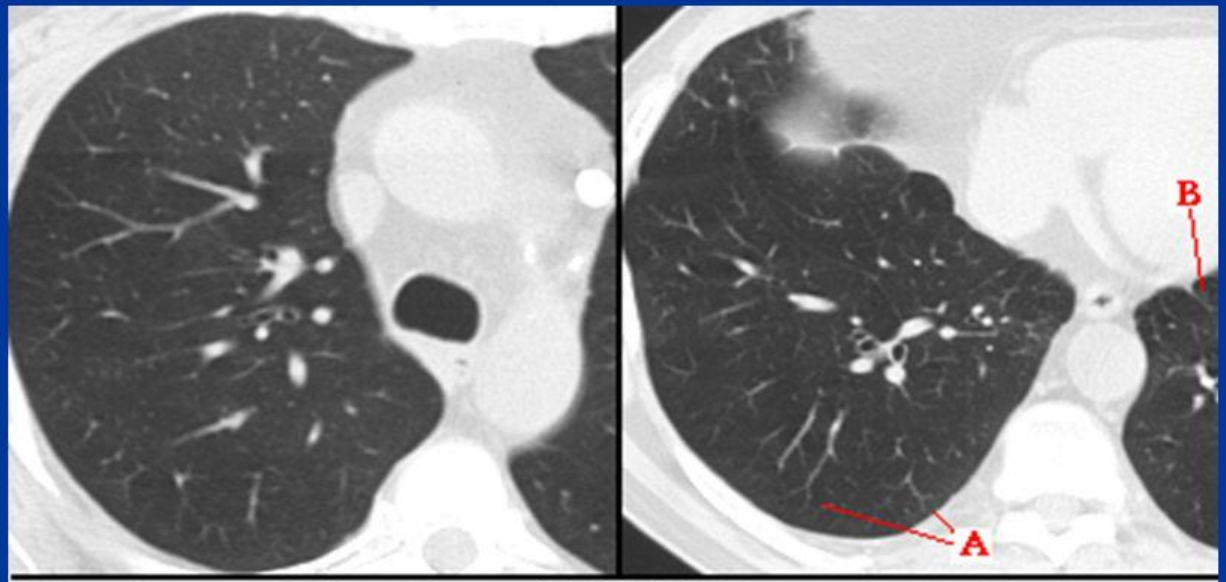


Fig. 1. —Line drawing of a secondary pulmonary lobule. Borders of lobule are interlobular septa. At center of each lobule is a bronchiole and a pulmonary artery (*blue*). Pulmonary vein (*red*) run in interlobular septa. Lymphatics (*green*) are found in interlobular septa and in central or axial interstitium that surrounds bronchovascular bundles.

Normal HRCT

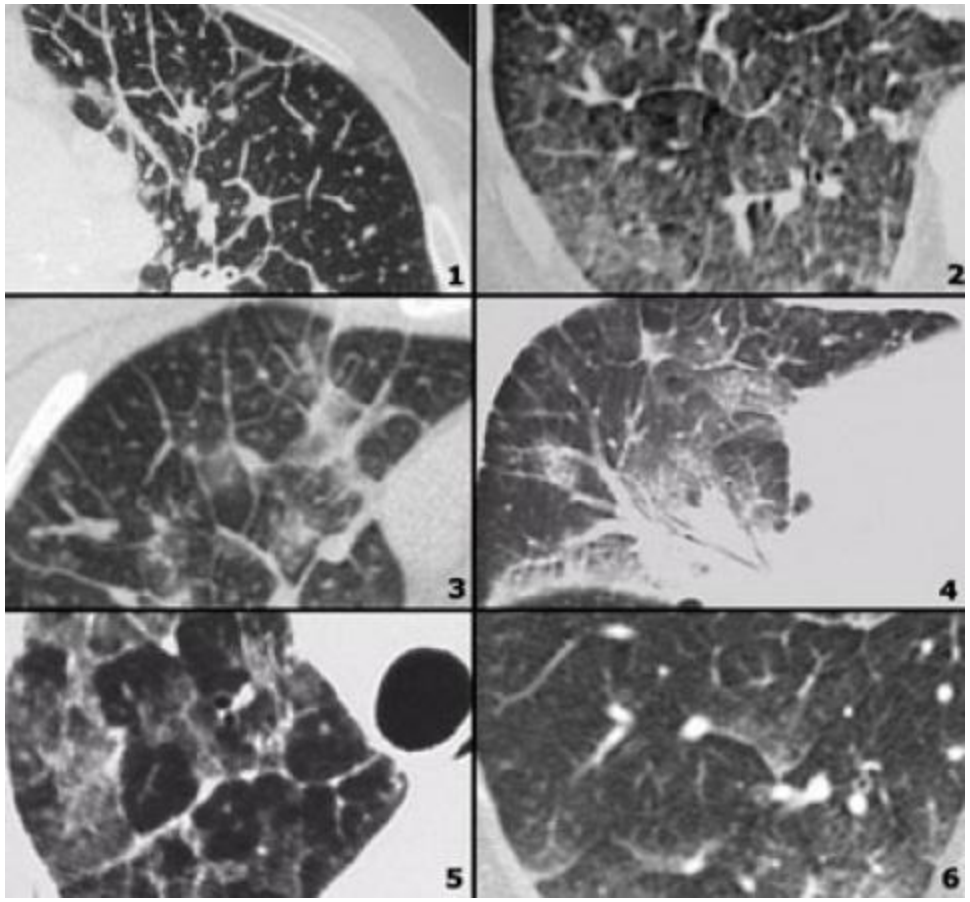


Normal upper (left) and lower (right) HRCT scans obtained in the prone position. The center of a pulmonary lobule is defined by the presence of a distal pulmonary artery (A). The faint outline of a distal interlobular septum is noted in the lower lobes (B). A subpleural clear space is normally present in the nondependent lung.

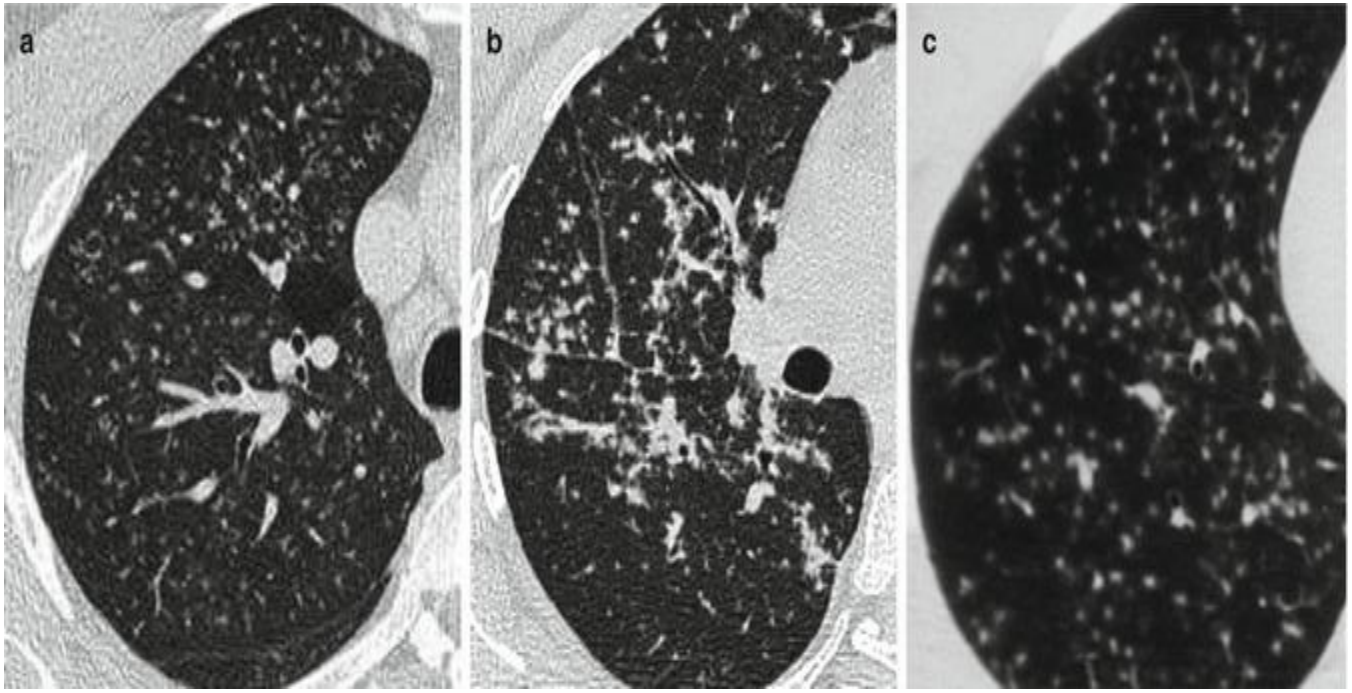
HRCT-Patterns

- Nodular pattern.
- Reticular pattern .
- Increased density (Consolidation, GGO).
- Decreased density (cystic pattern)

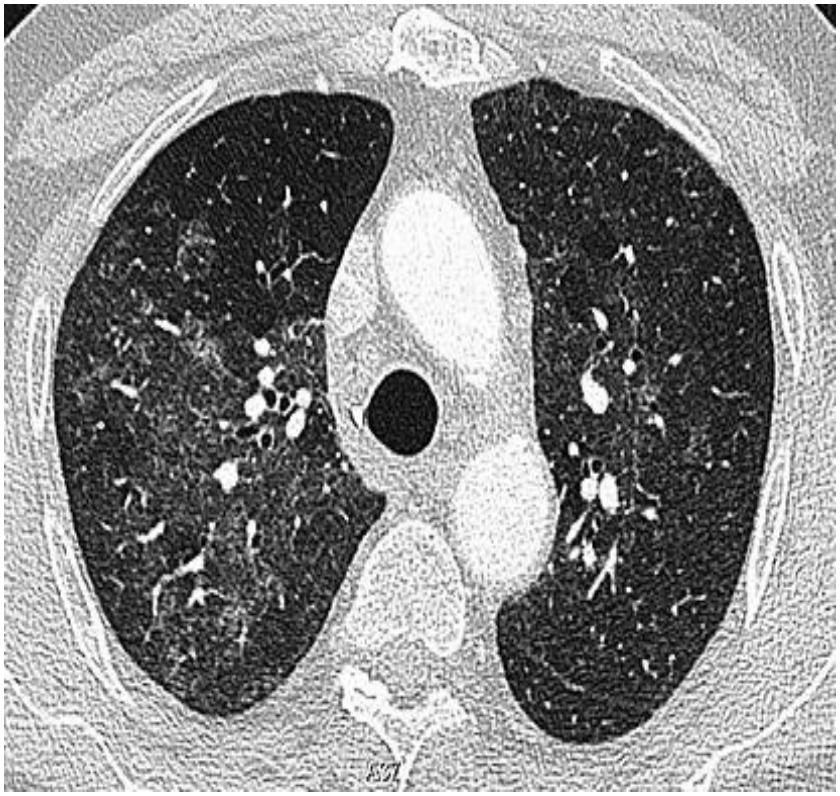
Reticular pattern

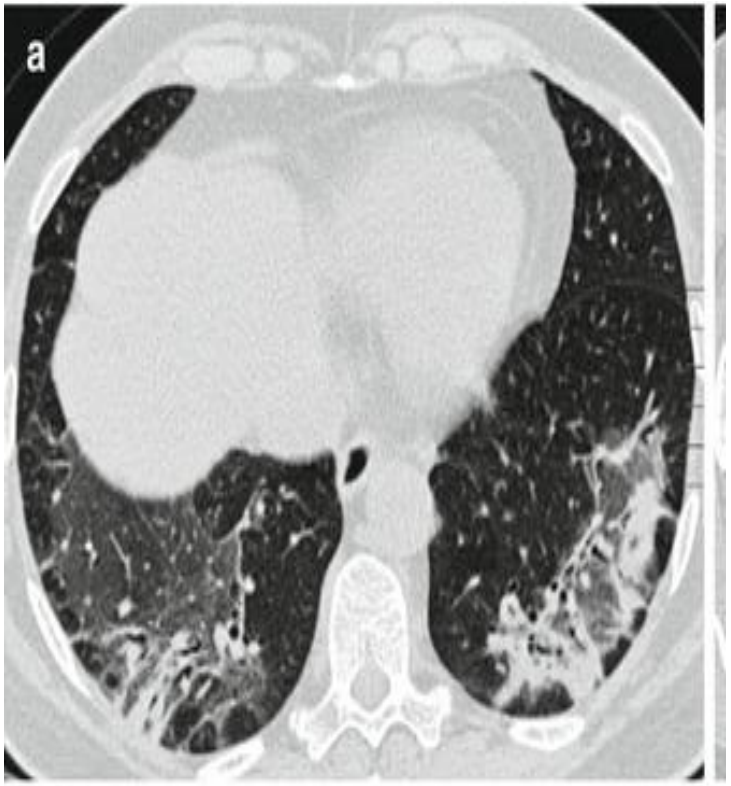


Nodular pattern

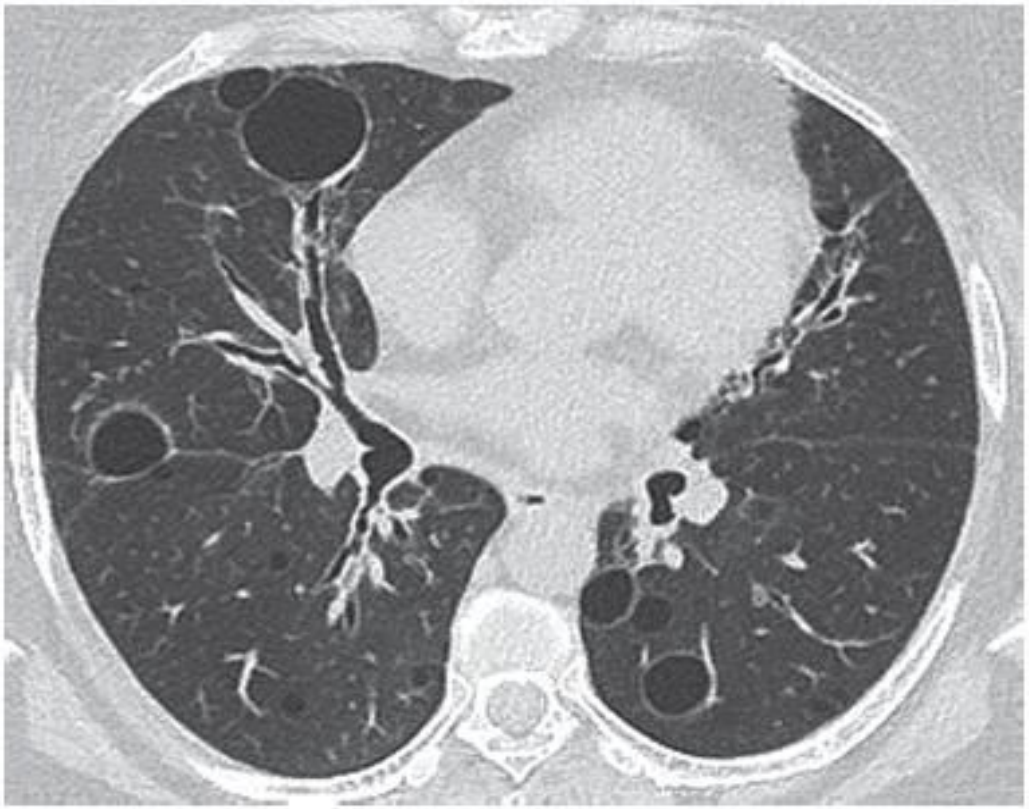


Ground glass opacity, Consolidation /Increased density





Cystic pattern /decreased density



Mosaic attenuation

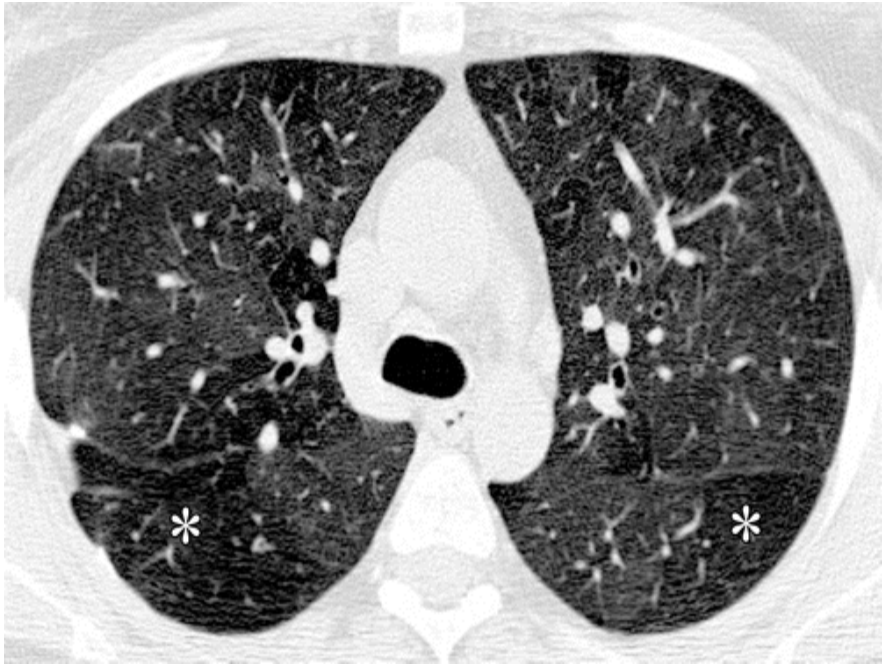
- is a descriptive term used in describing a patchwork of regions of differing pulmonary attenuation on CT imaging.
- Causes:

Obstructive small airways disease: air-trapping in lung areas with obstructive small airways disease, and reduced perfusion in these pathological areas secondary to vasoconstriction

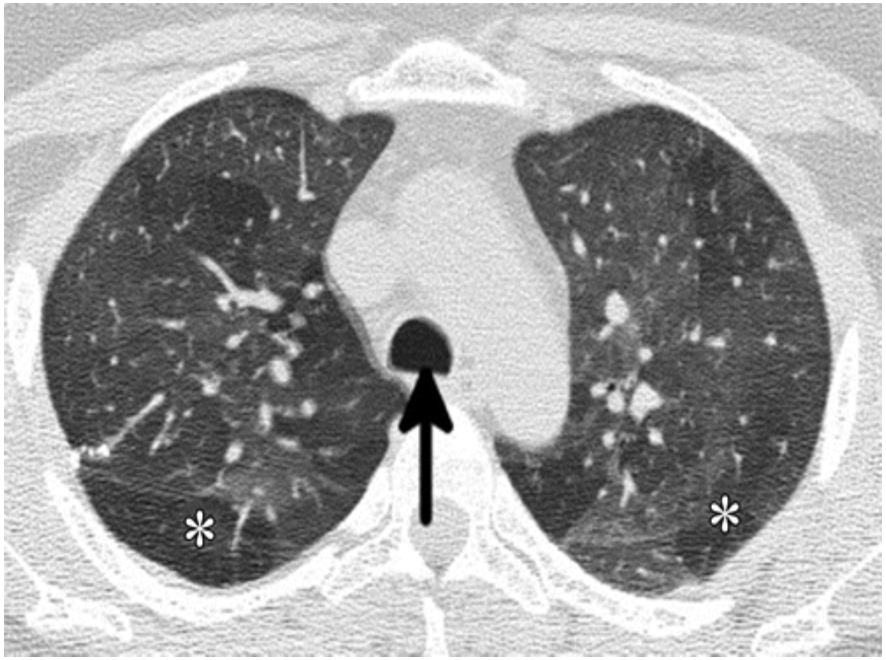
Occlusive vascular disease: low attenuation regions are abnormal and reflect relative oligemia

Mosaic attenuation

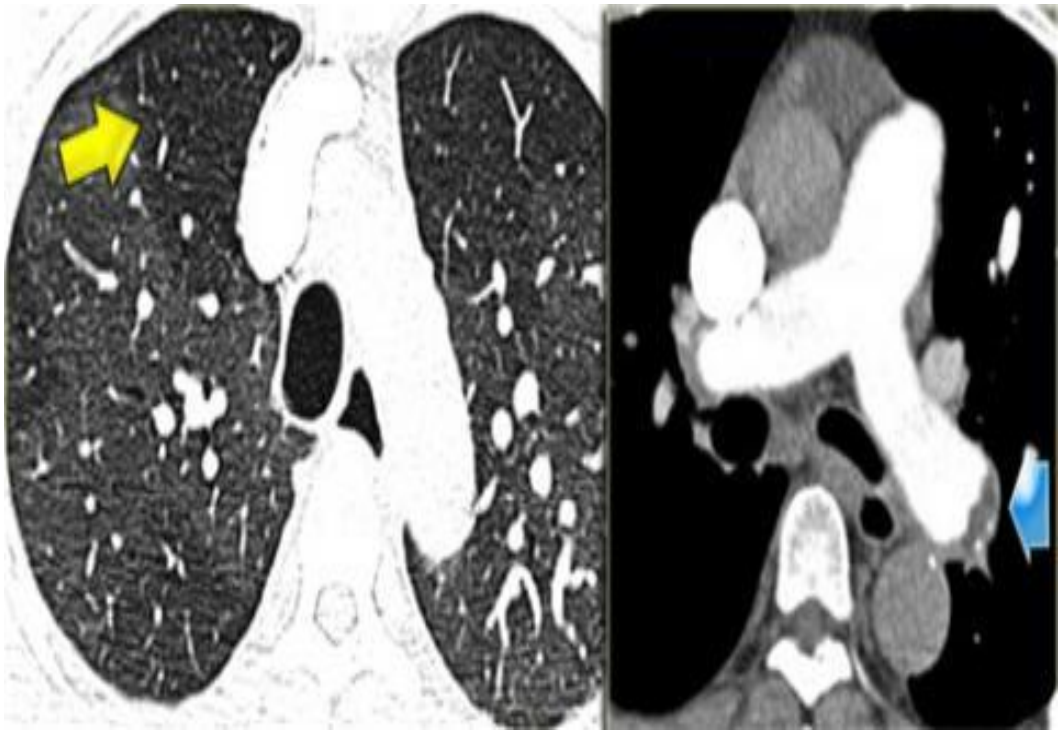
Inspiration

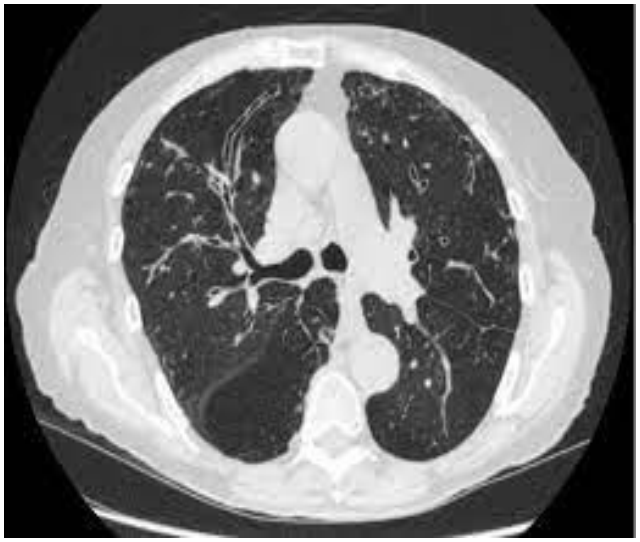


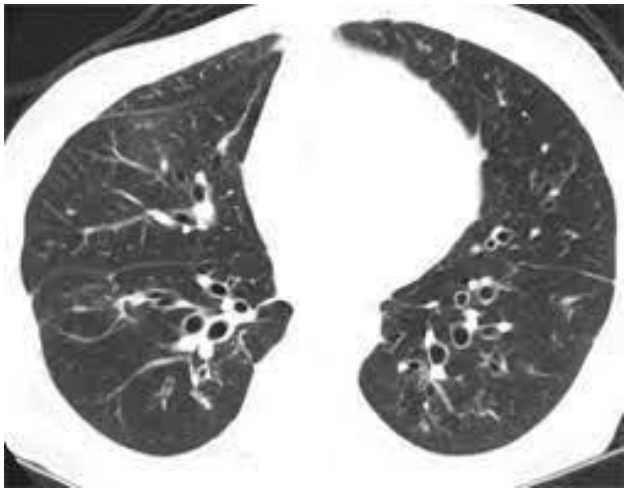
Expiration

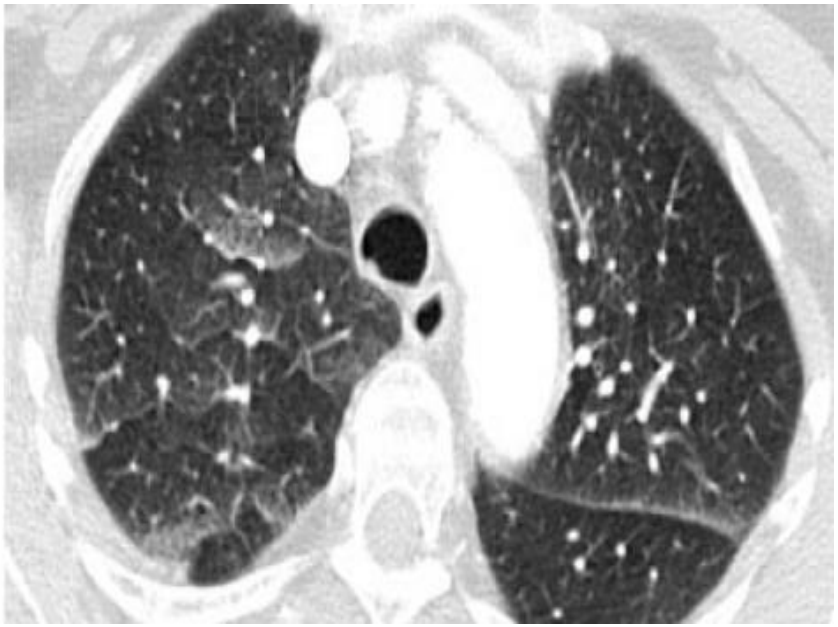


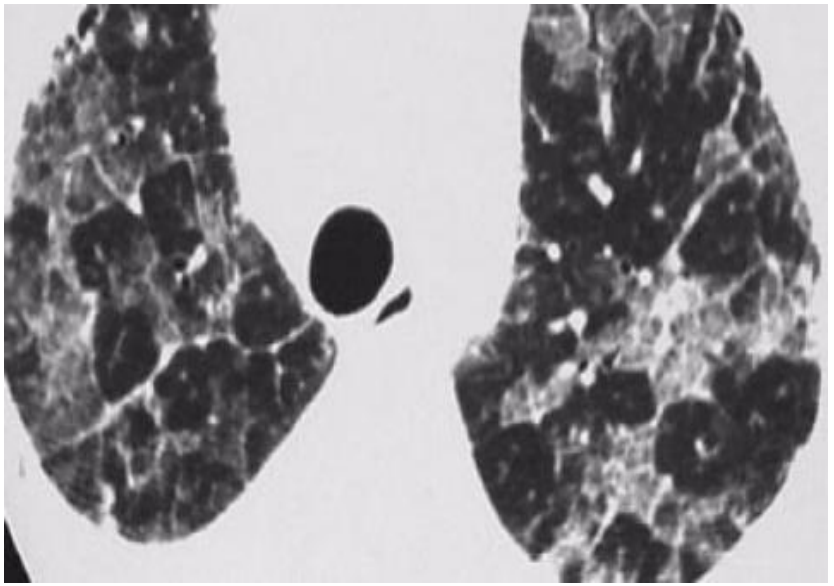
Mosaic attenuation

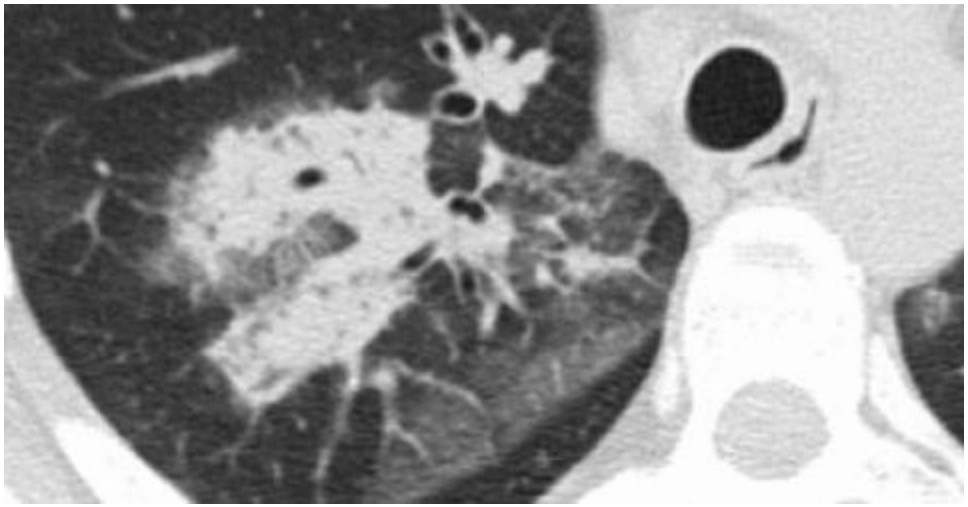




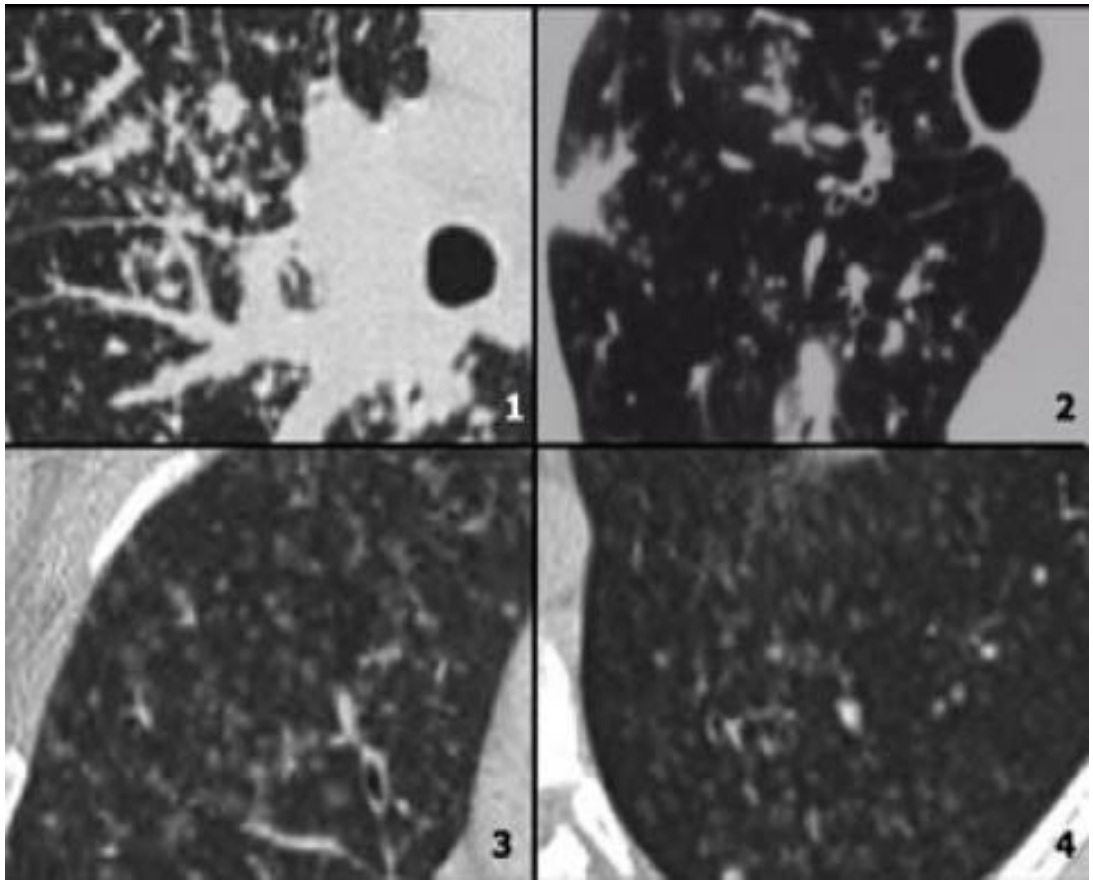








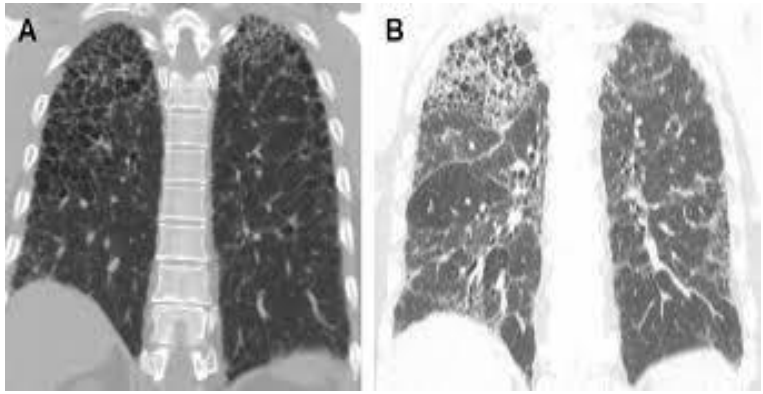
2 tree in bud



Lymphangitis carcinomatosis

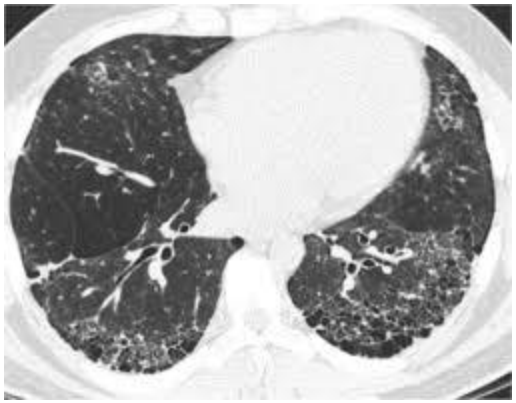
Asbestosis

Hypersensitivity pneumonitis



Congestive heart failure

Honeycombing
IPF

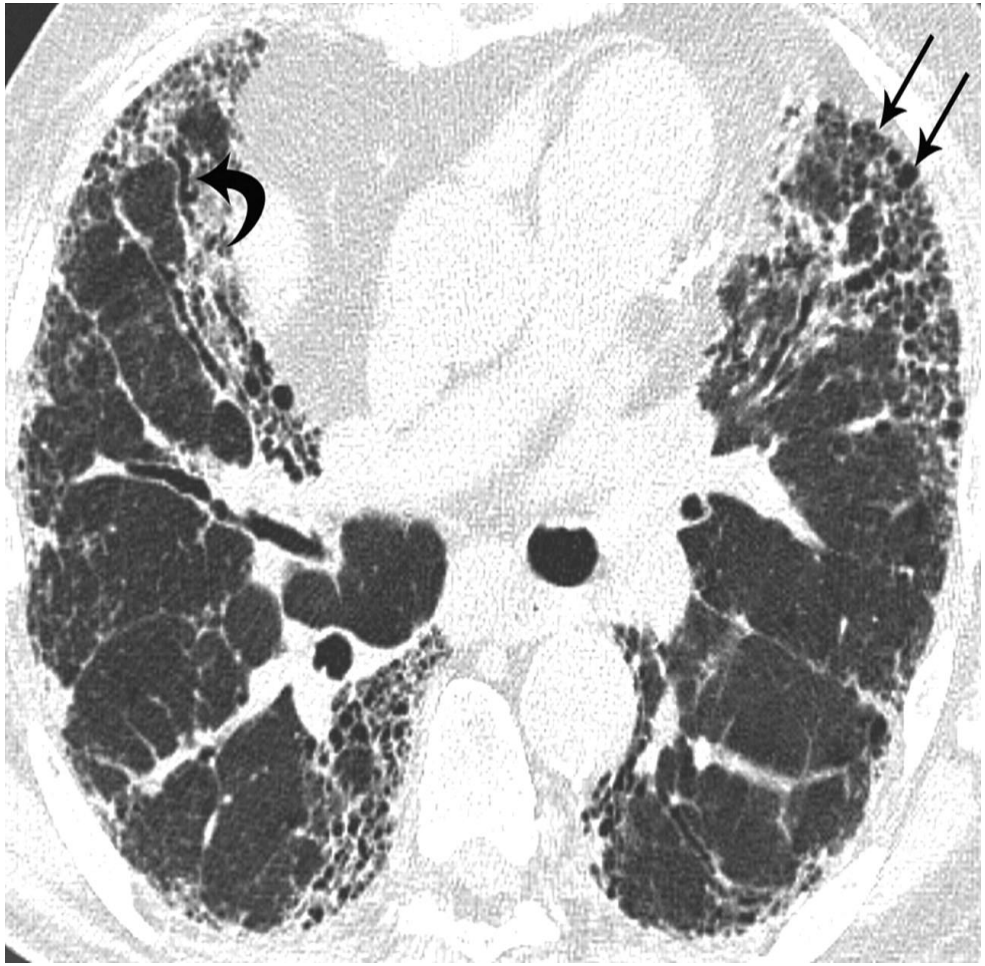


NSIP(nonspecific interstitial pneumonia)
GGO

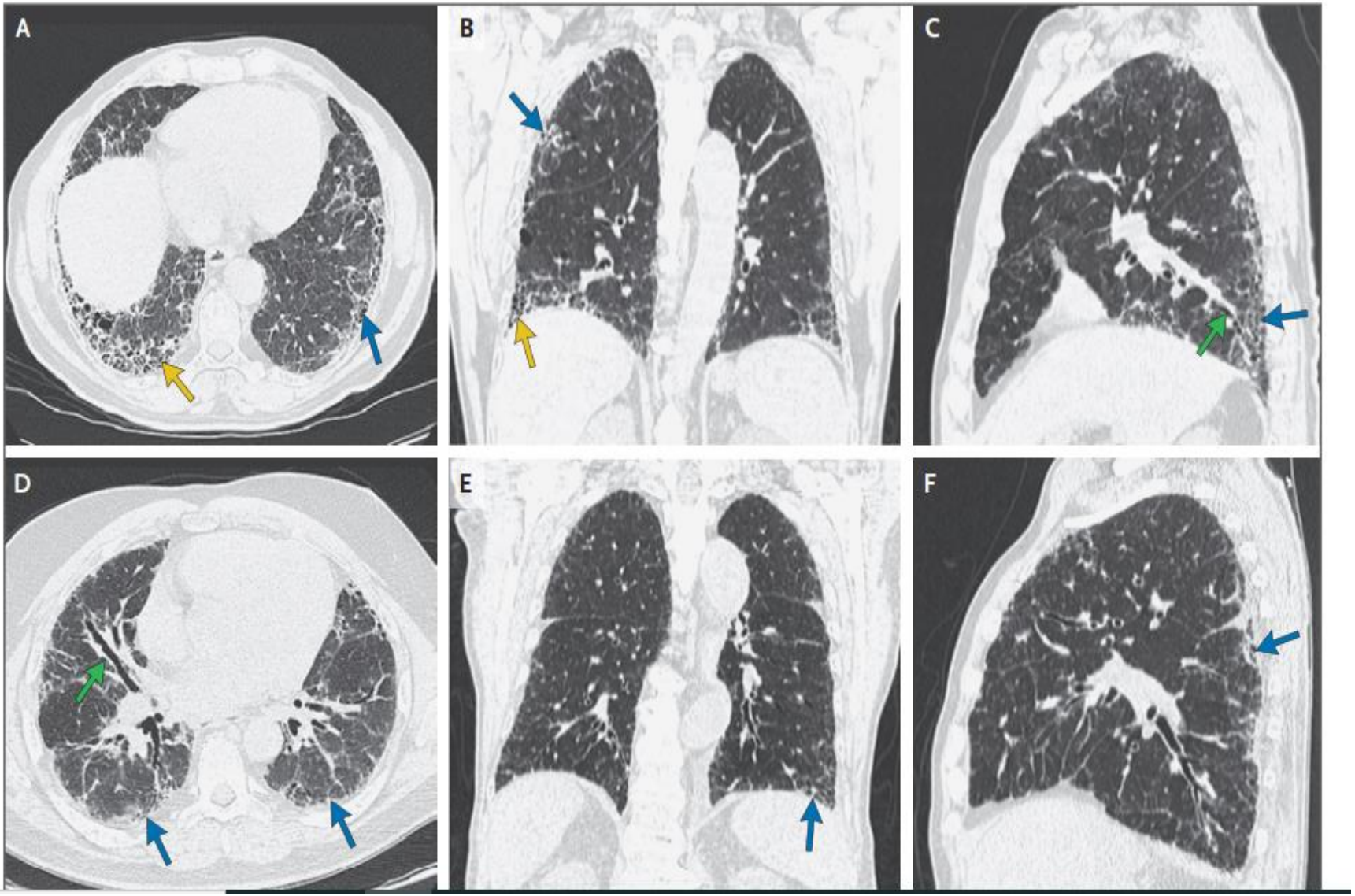
Diagnosis ?

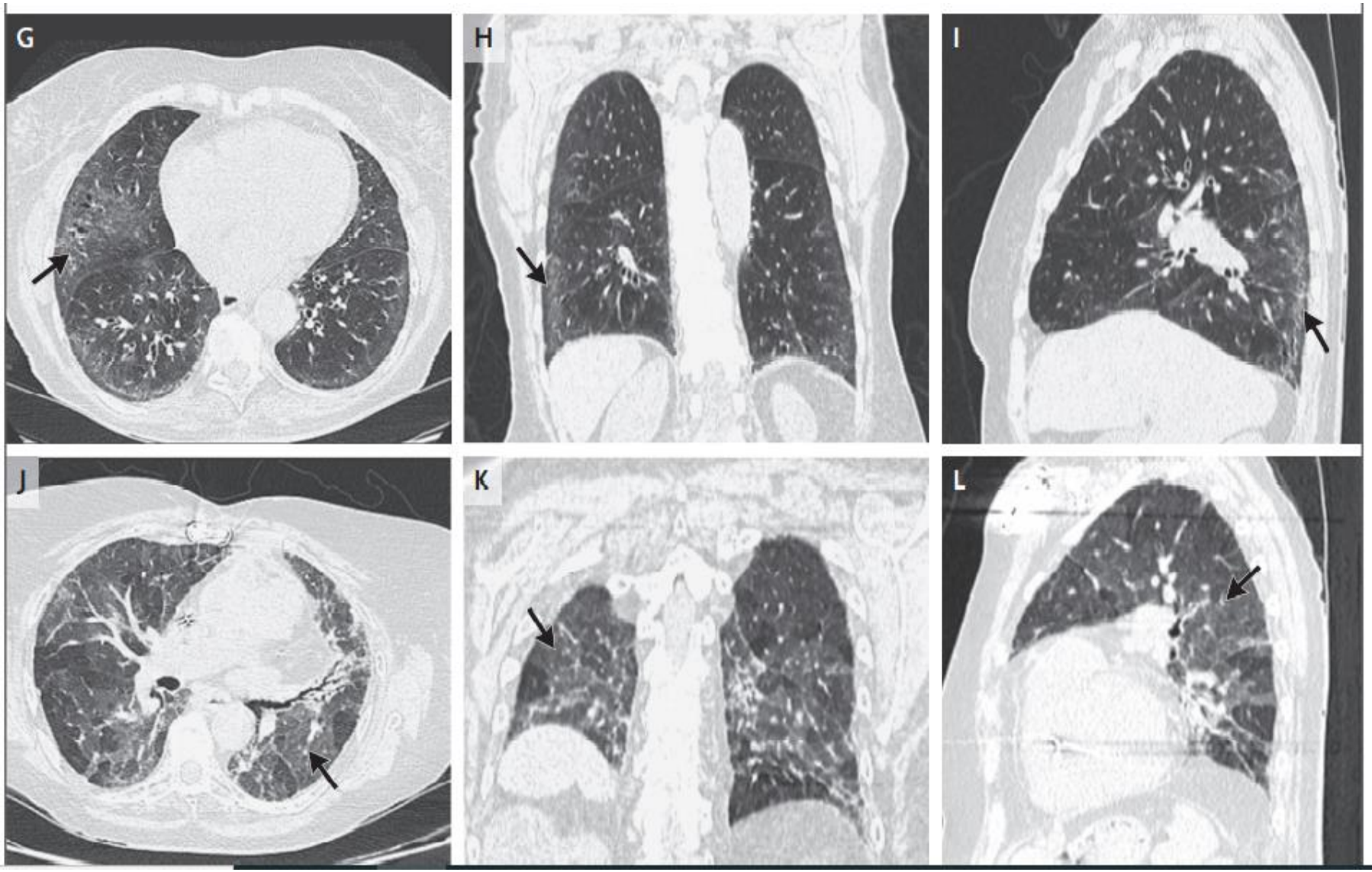
Drug induced
Radiation induced

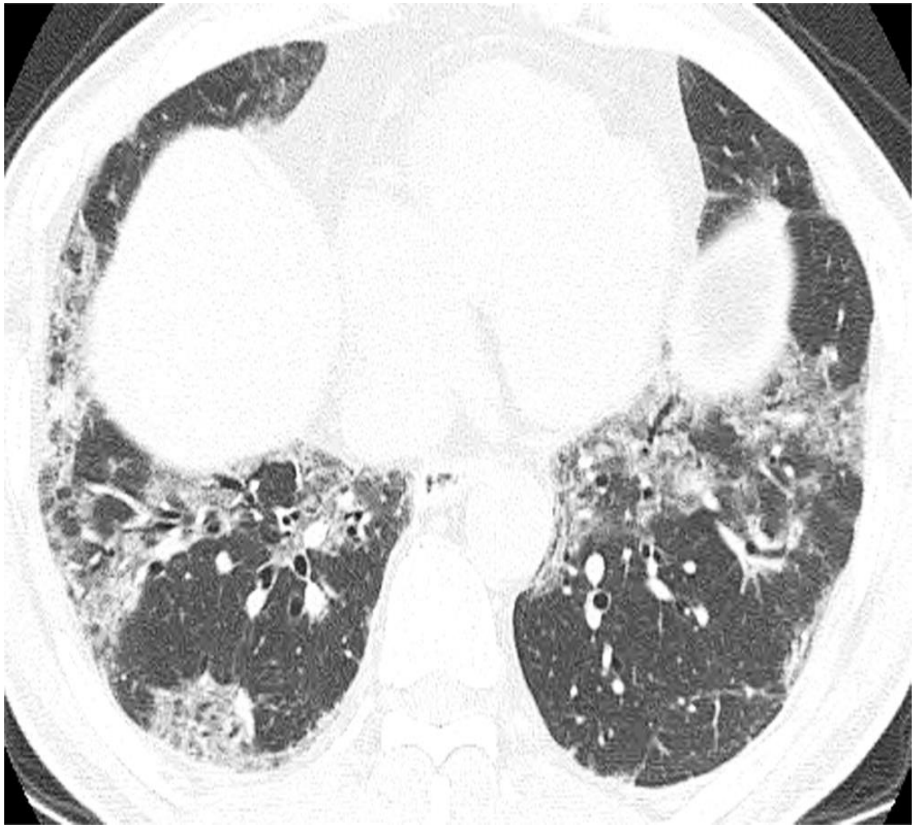
HRCT OF IPF

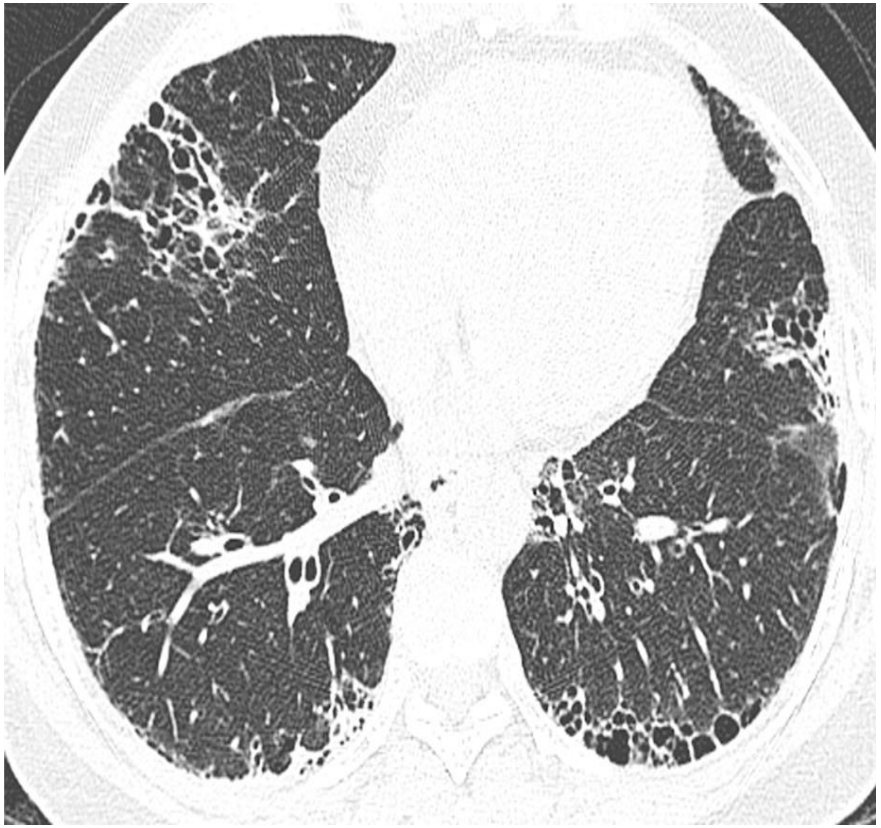


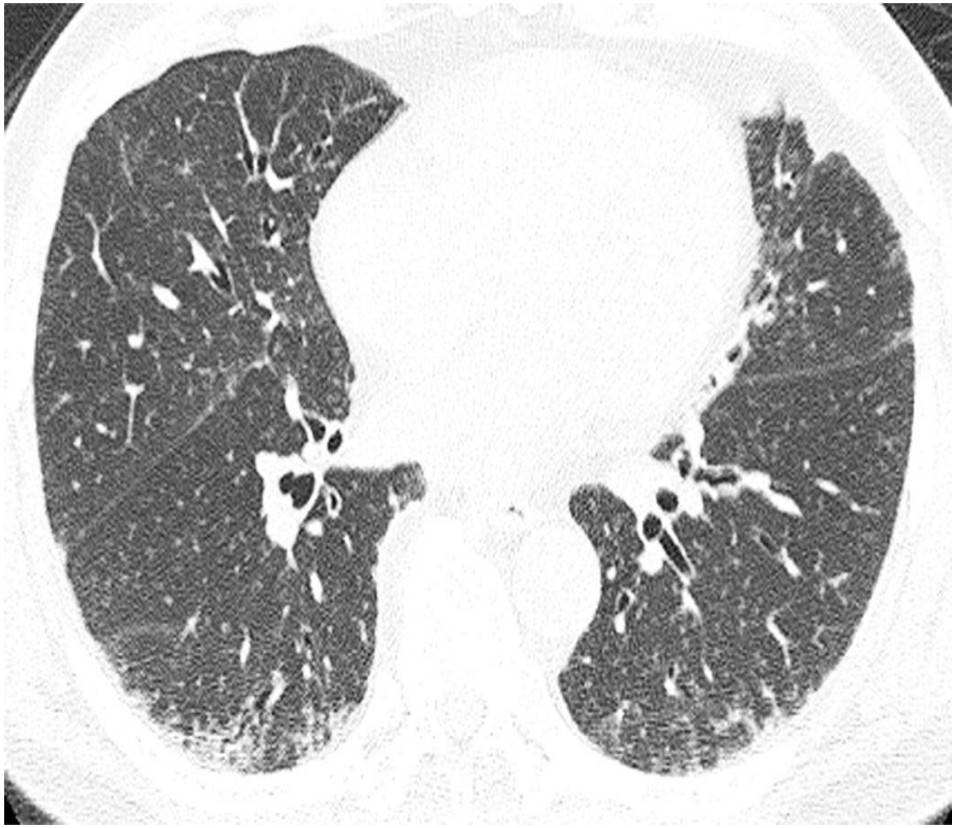

Signet
ring sign
Honeycombing
Traction
bronchiectasis
Lungcysts
Centrilobular
emphysema


A
B
C
D
E
F


G
H
I
J
K
L







High resolution computed tomography patterns and UIP diagnosis

UIP	Probable UIP	Indeterminate for UIP	Alternative diagnosis
▪ Subpleural and basal predominant; distribution is often heterogeneous* ▪ Honeycombing with or without peripheral traction bronchiectasis or bronchiolectasis¶	▪ Subpleural and basal predominant; distribution is often heterogeneous ▪ Reticular pattern with peripheral traction bronchiectasis or bronchiolectasis ▪ May have mild GGO	▪ Subpleural and basal predominant ▪ Subtle reticulation; may have mild GGO or distortion ("early UIP pattern") ▪ CT features and/or distribution of lung fibrosis that do not suggest any specific etiology ("truly indeterminate for UIP")	▪ Findings suggestive of another diagnosis, including: • CT features: ○ Cysts ○ Marked mosaic attenuation ○ Predominant GGO ○ Profuse micronodules ○ Centrilobular nodules ○ Nodules ○ Consolidation • Predominant distribution: ○ Peribronchovascular ○ Perilymphatic ○ Upper or mid-lung • Other: ○ Pleural plaques (consider asbestosis) ○ Dilated esophagus (consider CTD) ○ Distal clavicular erosions (consider RA) ○ Extensive lymph node enlargement (consider other etiologies) ○ Pleural effusions, pleural thickening (consider CTD/drugs)

UIP: usual interstitial pneumonia; GGO: ground-glass opacities; CT: computed tomography; CTD: connective tissue disease; RA: rheumatoid arthritis.
* Variants of distribution: occasionally diffuse, may be asymmetrical.
¶ Superimposed CT features: mild GGO, reticular pattern, pulmonary ossification.

Thank you