Respiratory imaging

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CXR interpretation

Identification

Correct patient

Correct date & time

For assessing technical quality

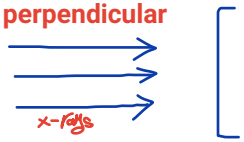
Technique: **RIPE(** rotation. inspiration. Projection, exposure)

Abnormal finding

1) Rotation

any rotation on X,Y,Z axes will affect the interpretation

perpendicular

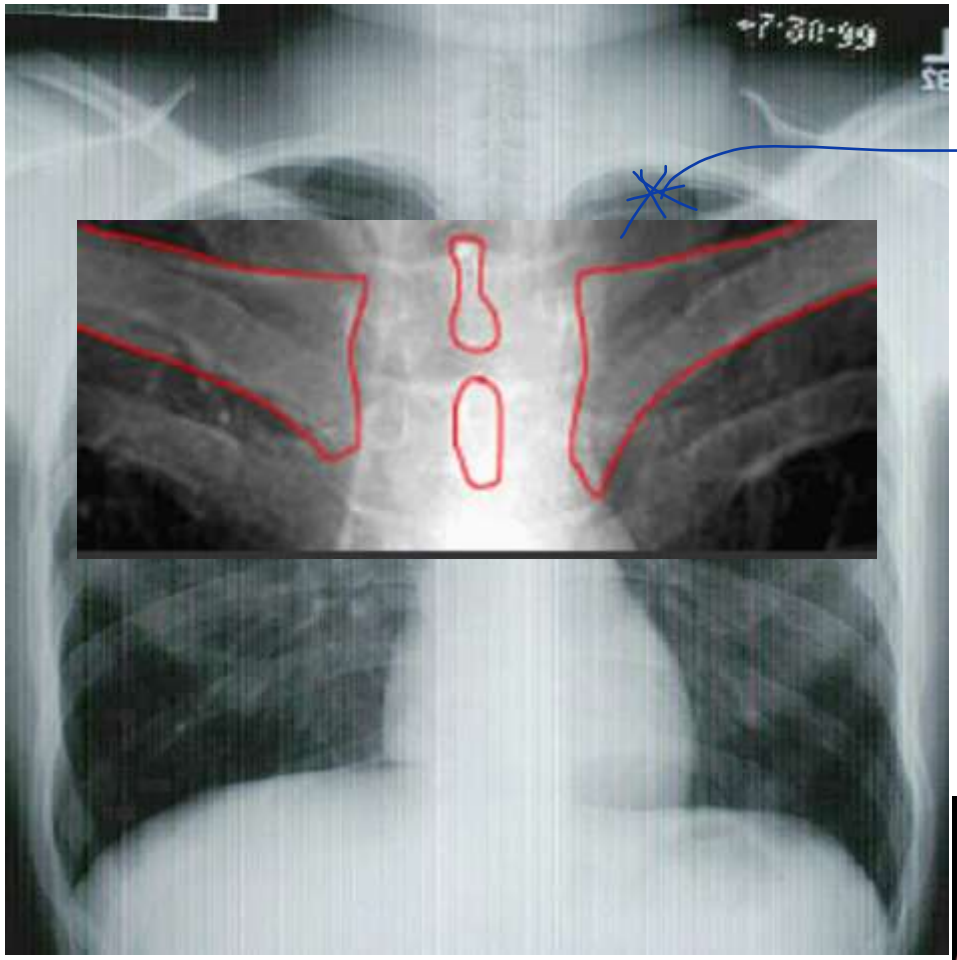


>> Is the film\patient centralized or not ?

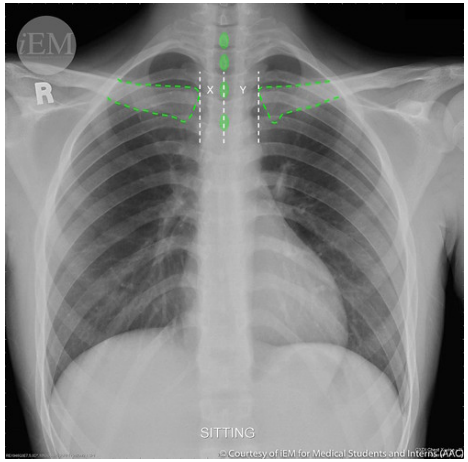
✓ By measuring the distance between the medial edges of the clavicles to the vertebral spinous processes.

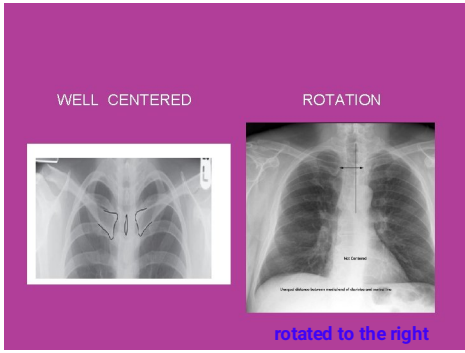
✓ They should be equal or near equal.

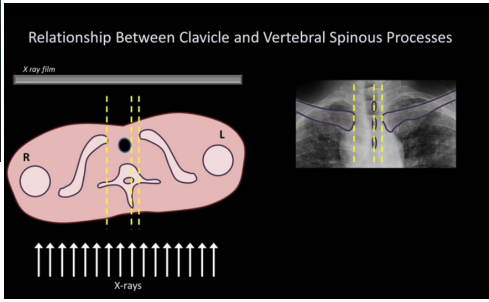
✓ Anterior structures move the same direction as rotation so the clavicle/spinous process width is increased on the side to which the patient is rotated.



important :
part of the lung apex must be above the clavicle (in well positioned x-ray)







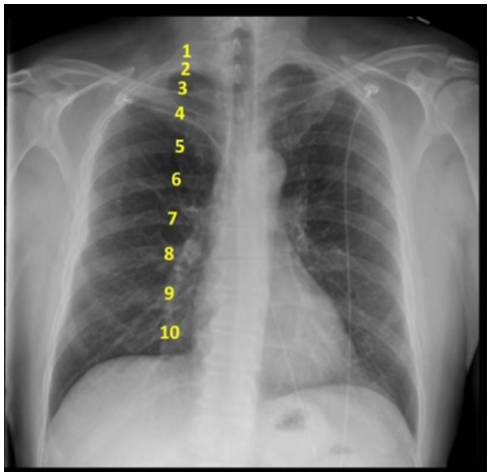
2) Inspiration

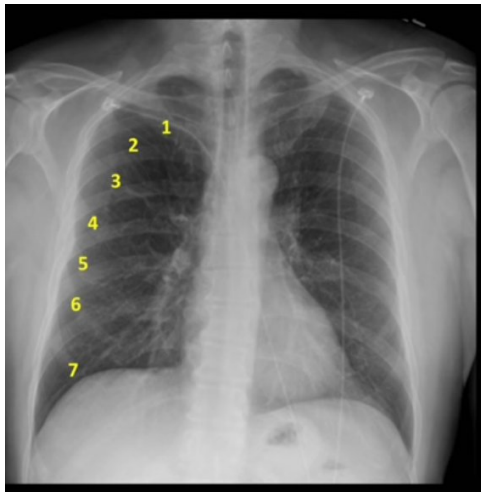
✓ Before taking the x-ray we ask the patient to take a deep breath

✓ In patient with normal lung volumes : 9-10 posterior ribs should be visible \\ 6-7 anterior ribs (harder to count) with the 7th appears to pierce the diaphragm

✓ So here we wanna check the inspiration of the patient by counting the ribs

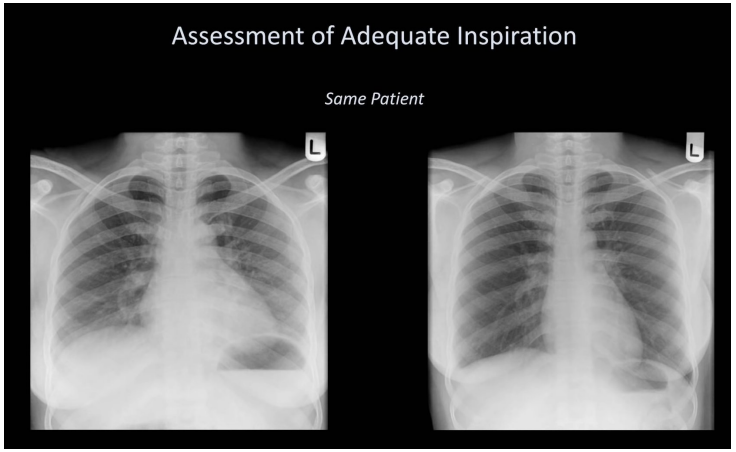
✓ NOTE : We prefer doing an "exhalation" X-ray in pneumothorax and air-trapping conditions

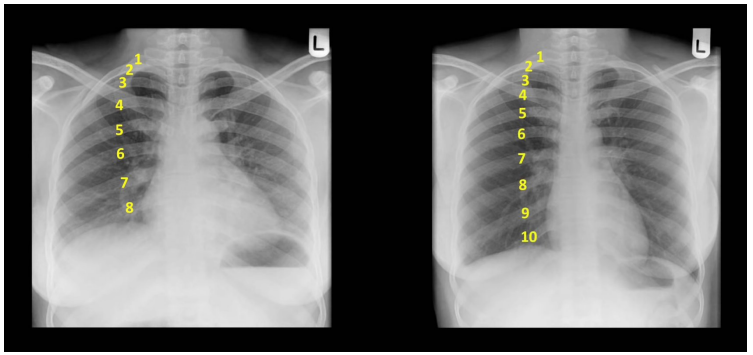




✓ If the ribs are less than what's supposed , then it's either we are dealing with an interstitial lung disease where lung volumes are reduced or the patient didn't take full inspiration

✓ If MORE >> this is hyperinflation (example : COPD)





1) Count the ribs
2) make sure u can identify the apices and the Costophrenic angles

3) Projection

AKA : portable x-ray

useful in ICU patients who can't stand

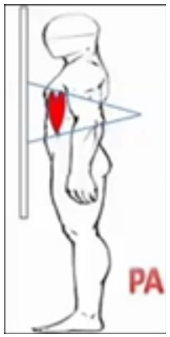
PA → is superior

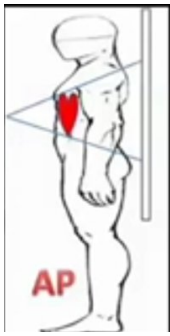
VS

AP

The standard x-ray film that we usually order

problem: False cardiomegaly
** always avoid commenting on the heart size in an AP x-ray





	PA view	AP view
Clavicle	Over lung fields	Above lungs apex
Scapulae	Away from lung fields	Over lung fields
Ribs	Posterior ribs distinct	Anterior ribs distinct
Heart		Relatively enlarged

4) Exposure=Penetration

>> Dose of radiation administered

Over penetrated

alot of radiation has been used

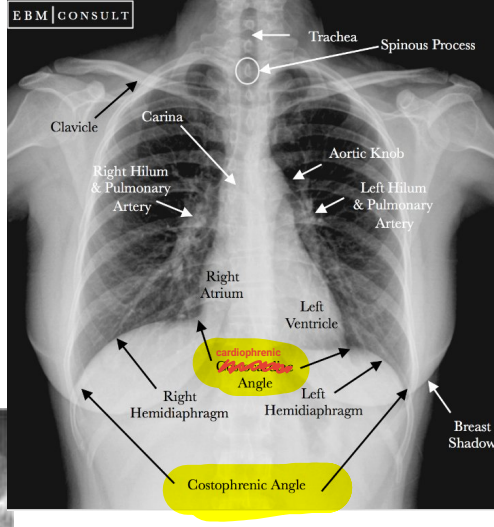
Under penetrated

less radiation has been given

problem : false effusion

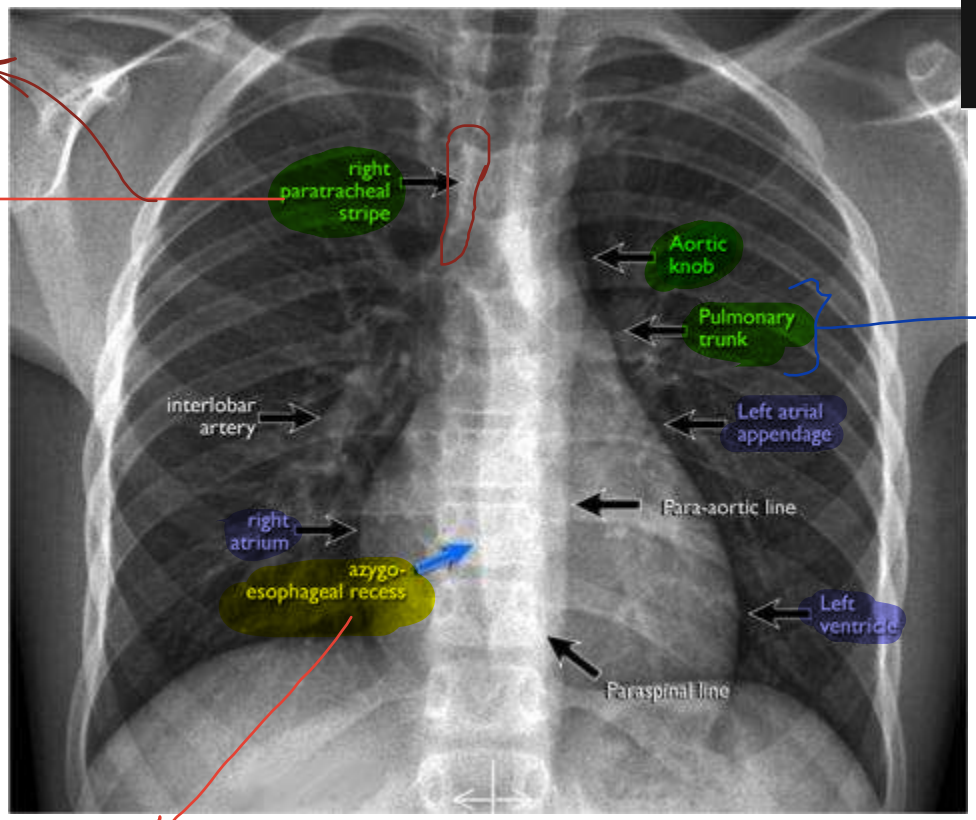
✓ The clue is the spines of the vertebral column , if you can see it clearly all the way >> over-exposed
✓ In adequate exposure >> u can see the spines up to The 1st third of the heart , after this they disappear

Normal anatomy



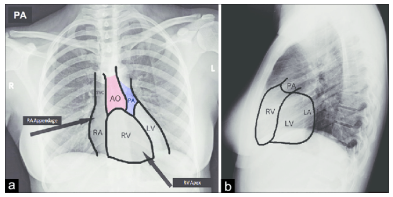
it's the CT border of the mediastinum

Right paratracheal stripe : the x-ray reflection of the border of the mediastinum
Normally it's soft tissue of (2-3mm)
>> if more than that >> widening of the mediastinum

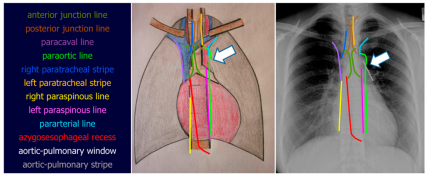


hilar area

Rt ventricle >> most anterior >> you see it on lateral view



Where azygos vein runs , if it not a straight line it may indicate the presence of a hernia



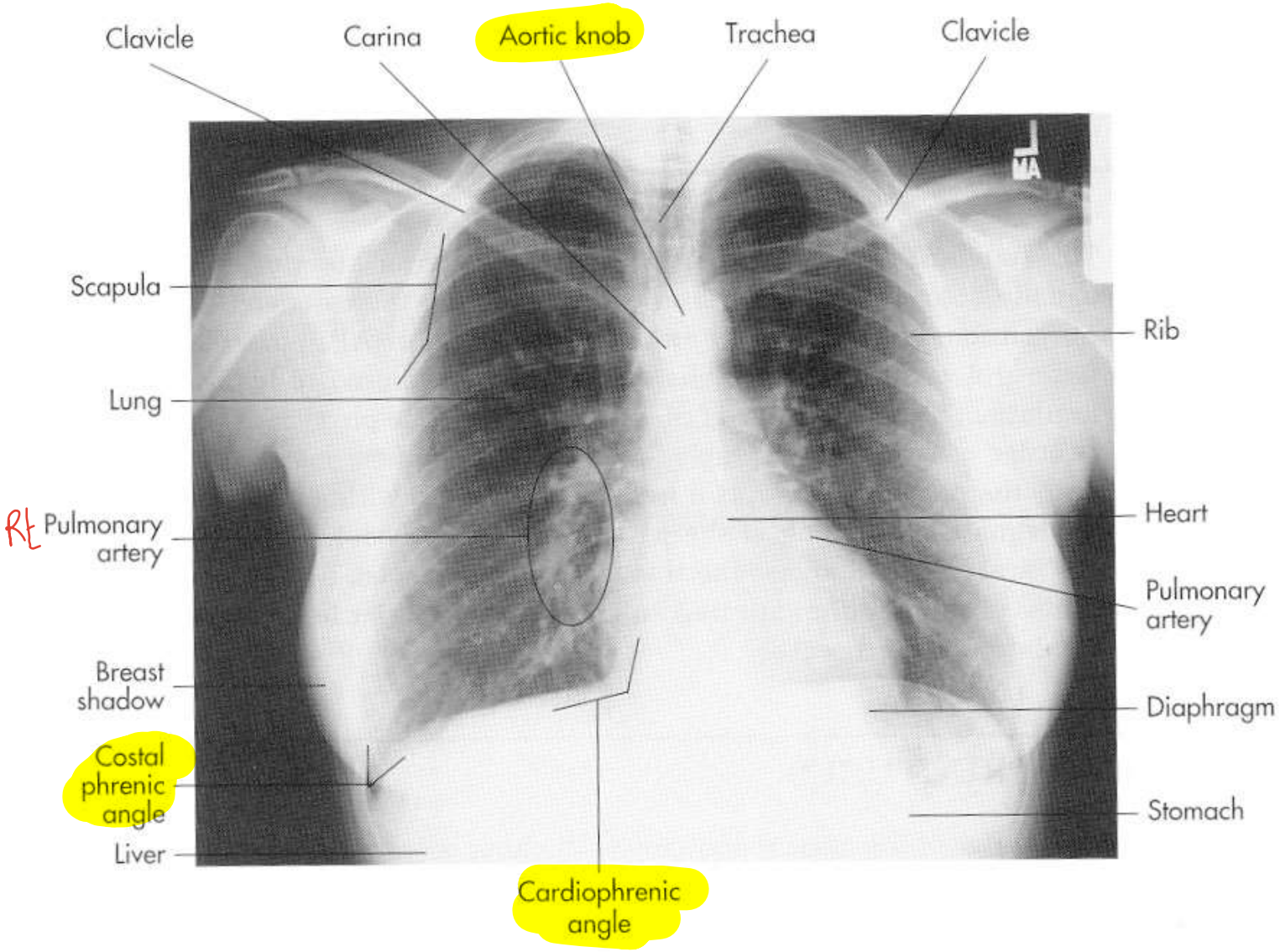
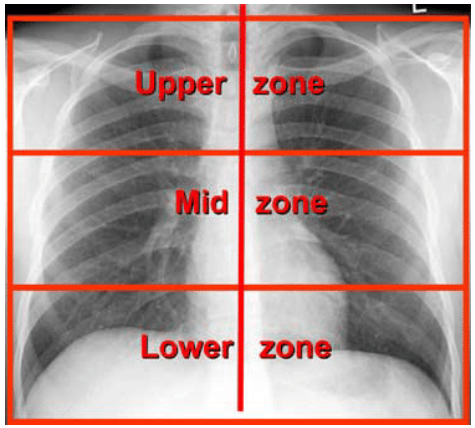
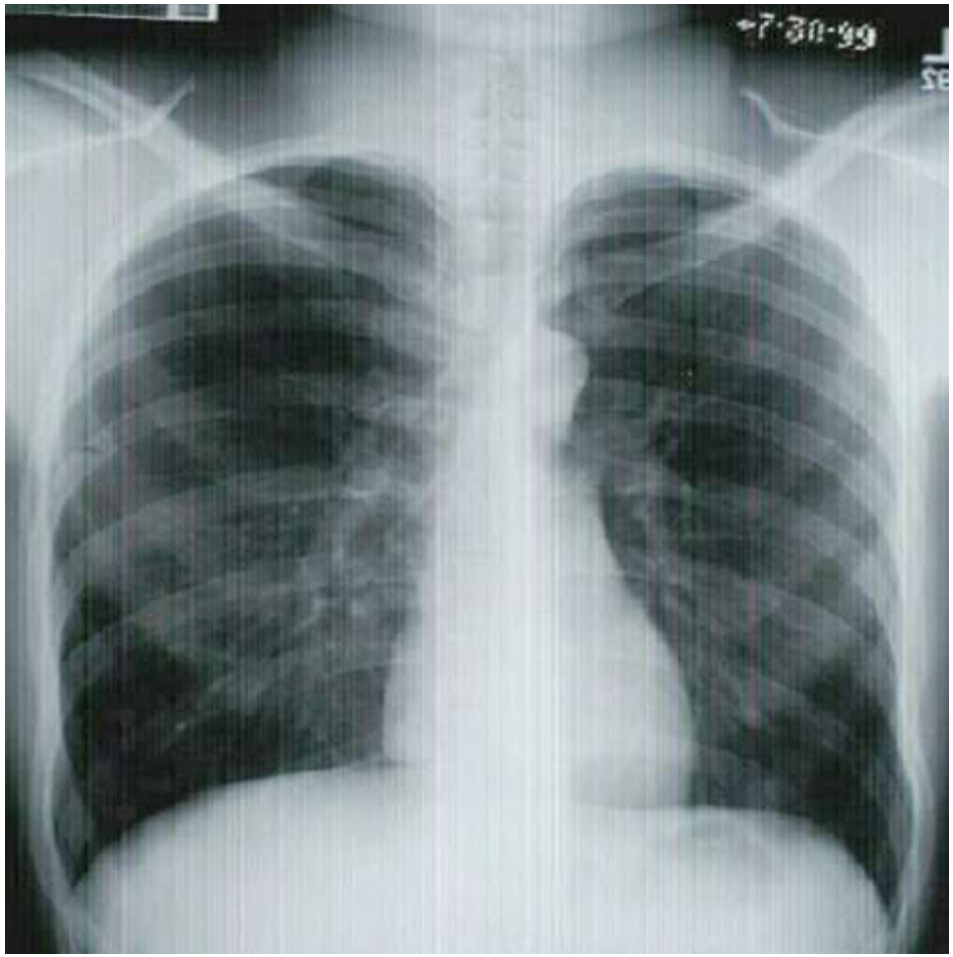


Fig. 3-1 Normal position of anatomical structures on a posterior or anterior chest radiograph.

Zones or lobes?

✓ if you are looking to a frontal CXR , we refer to the lung using Zones not Lobes
✓ we divide each lung into 3 thirds using imaginary lines (upper , middle, lower)





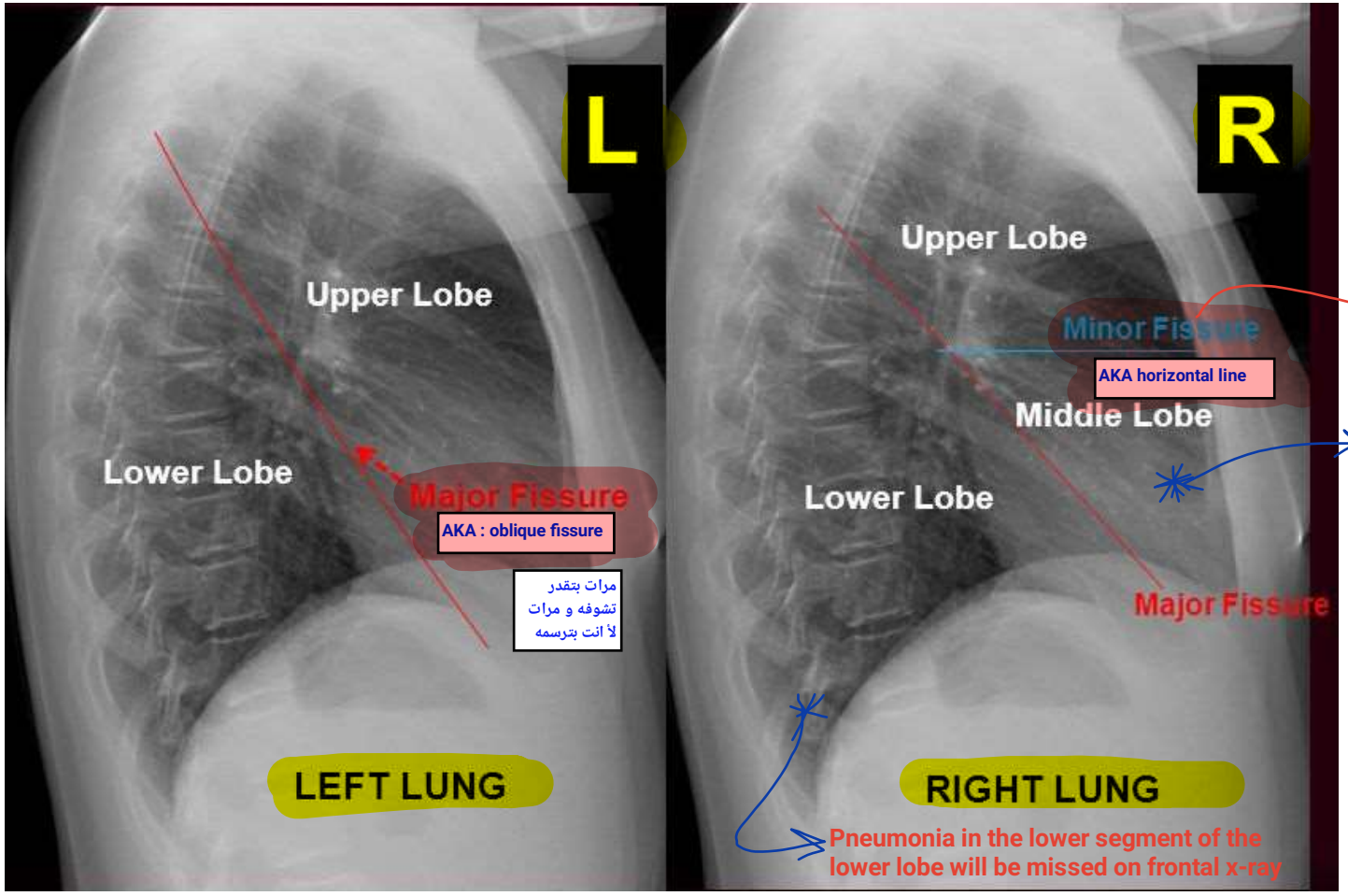
If you had a lesion in the lower ZONE of the right lung can you predict which LOBE is that ?
> If it's closer to the heart it's most probably the middle lobe while if it's closer the Costophrenic angle and hemidiaphragm most probably it's the lower lobe

We predict but we don't tell with confidence

must be ordered whenever you suspect pneumonia

Crackles on Physical Examination + Normal Frontal x-ray >> do lateral x-ray

Lateral CXR >> Here you can tell LOBES



بترسم من ال hilum

Normally the vertebral column on the lateral x-ray get darker as you go downward , if it was getting more white this indicates an abnormality in the lower lobe (consolidation , collapse...)

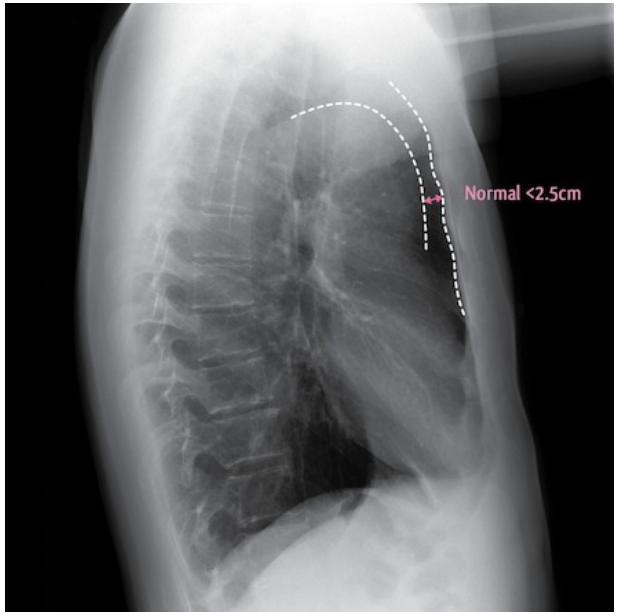
if you have pneumonia in the middle lobe >> you will have consolidation (it would be more white than other lobes) and mostly if you used your stethoscope to hear the lung posteriorly you will NOT hear crackles (it would be normal) عشانها بعيدة >> You must examine the chest anteriorly here and do a lateral CxR

Pneumonia in the lower segment of the lower lobe will be missed on frontal x-ray

✓ Major fissure : can be seen on the CxR or can't

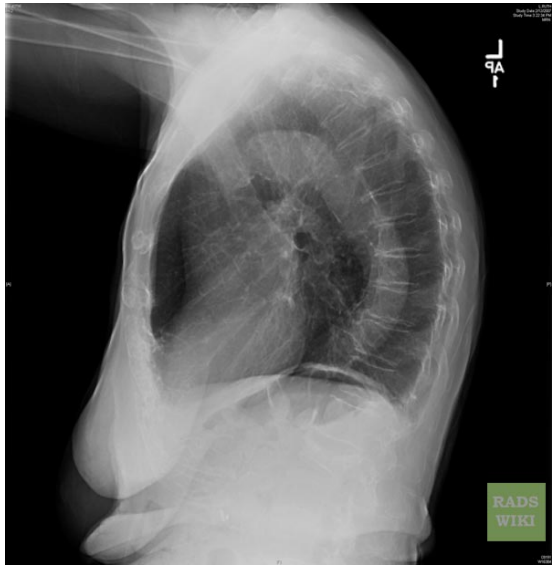
If can't just draw a line starting from the half of the diaphragm till the end (T4)

Anterior Half of the diaphragm >> Hilum >> T4



2 Also in lateral CxR we look at the retrosternal space which is widened in patients with COPD

Widening is a sign of hyperinflation

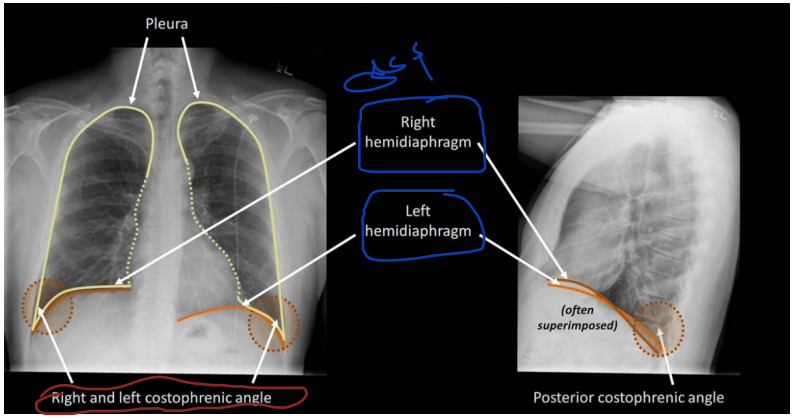


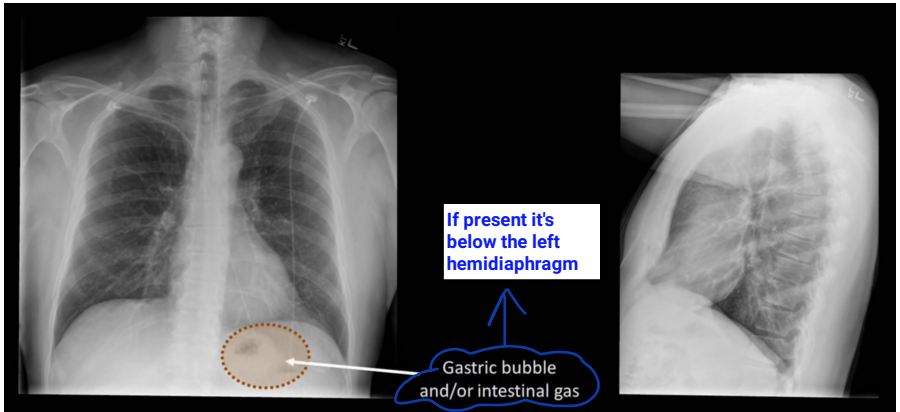
Diaphragm

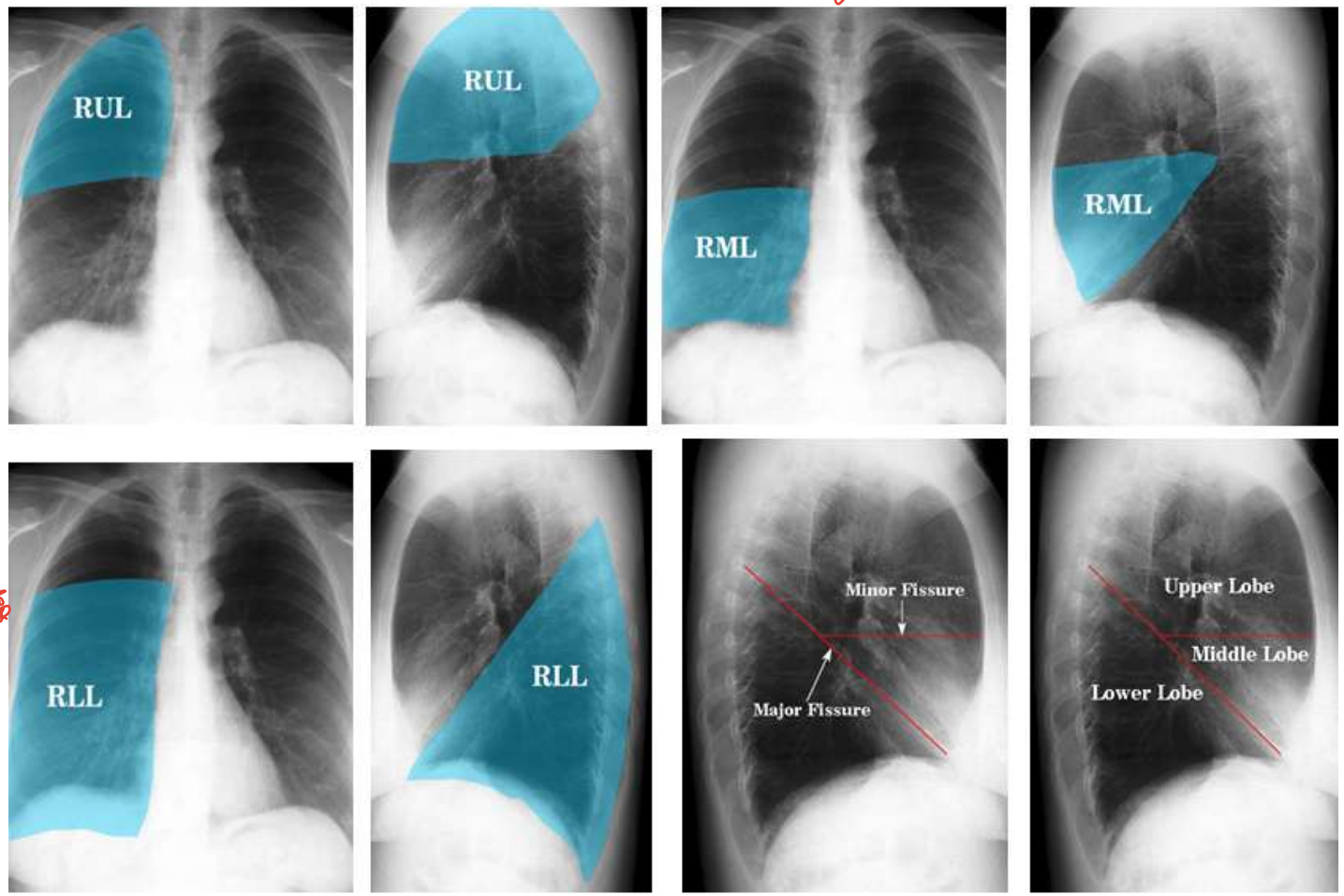
Comment on :
1) Rt & Lt hemidiaphragms
2) Costophrenic angles [sharp (normal) or blunted or closed (in pleural effusion)]

Hemidiaphragm (Right or Left ?)

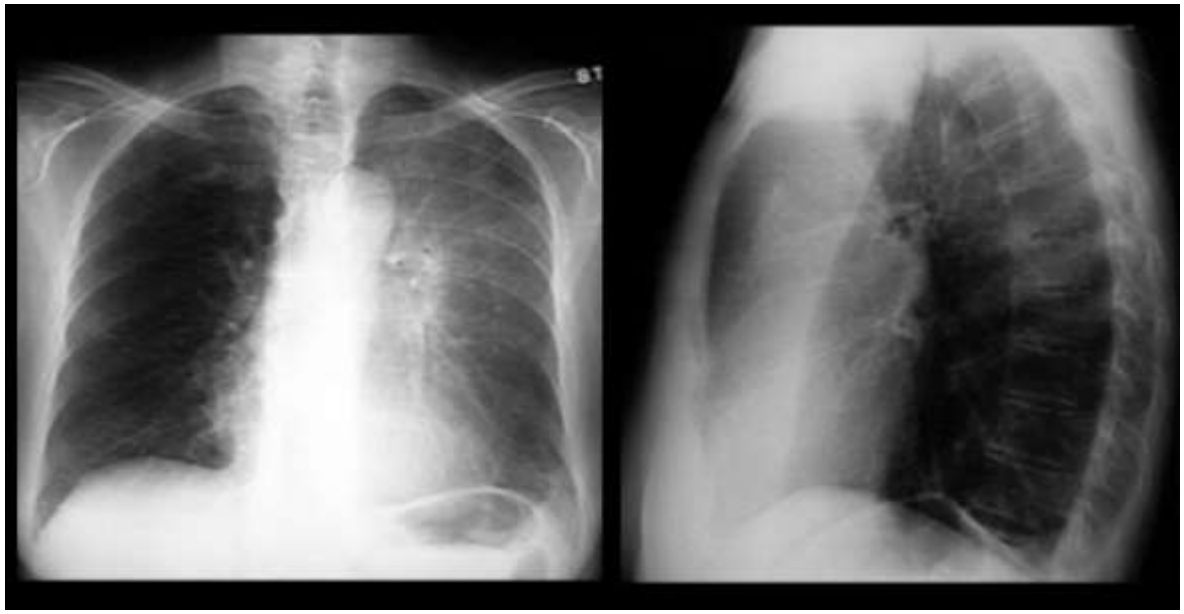
✓ Rt is higher than Lt in most patients
✓ Gas bubble >> Lt
✓ complete border >> Rt , as the Lt won't have a complete shadow since the heart is directed toward it (silhoueting)






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

discussed at the end

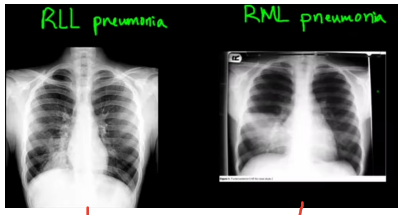


1. All lines and borders in X-Rays are the result of areas of different densities being adjacent to each other. Generally, there are three groups of distinct densities: air, connective tissue, and bone. Areas of similar densities adjacent to each other will appear as one giant blob, with no distinct borders within the blob.

2. The silhouette sign is when a line or border that is normally present in a X-Ray disappears - the classic example being the right heart border with a RML pneumonia.

helpful in predicting the location of the lesion

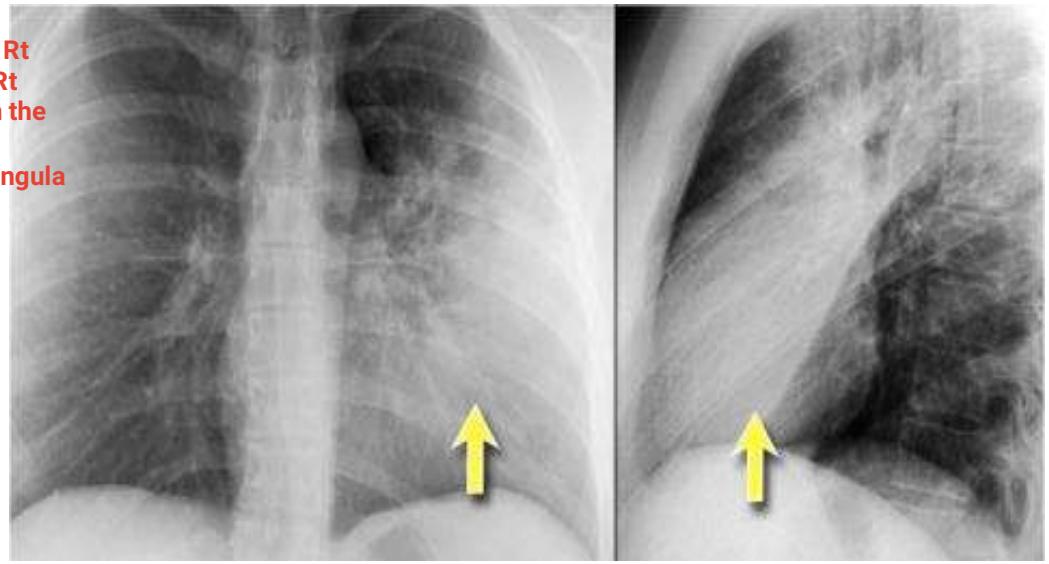
A silhouette sign



You can till them apart

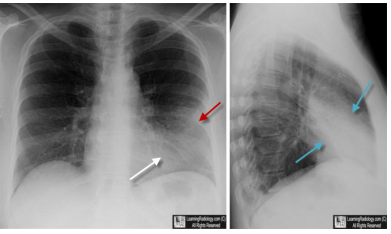
the Rt border of the heart is totally obscured

✓ Rt heart boreder is adjacent to the Rt middle lobe (lesions silhoueting the Rt bordervof the heart are most likely in the middle lobe)
✓ Lt heart border is adjacent to the lingula
✓ border of the Rt hemidiaphragm is adjacent to the Rt lower lobe
✓ border of the Lt hemidiaphragm is adjacent to the Lt lower lobe



Lt lower lobe pneumonia

pneumonia in the lingula



ABCDE

>> what to comment on :

- Airway. → location : usually centralized but slight deviation to the Rt is acceptable
- Breathing. >> = Lung

  Any lesion must be localized
  frontal >> zones
  Lateral >> Lobes

  Lesions (focal \ diffuse) , hyperinflation , ...etc
- Cardiac, hila and mediastinum.
- Diaphragm. part of diaphragm interpretation is looking at the Costophrenic angles : they must be sharp
- Everything else .

Air under diaphragm , soft tissue (subcutaneous air) , shoulder , clavicle, ribs (lytic lesions)

The ABCDEF System

(Assess the technical quality)

A – Airways

B – Bones (and soft tissue)

C – Cardiac silhouette (and mediastinum)

D – Diaphragm (and gastric bubble)

E – Effusions (i.e. Pleura)

F – "Fields" (i.e. Lung Fields)

(Lines, Tubes, Devices, Surgeries)

Nodule and mass are well defined rounded lesions
Nodule < 3cm \\ Mass ≥ 3cm
>> Mass --> higher likelihood of malignancy , higher rate of progression

Focal lung lesions

=Nodule , mass , cavity , patchy opacity

Fleischner guidelines (calculator)

Nodule

Mass

MINIOSCE: You have a nodule with 25mm what's next step ? Assess Fleischner guidelines for further evaluation

Circle within the lung that is empty or has tissue other than the lung

Cavity

✓ Empty cavity : bollous

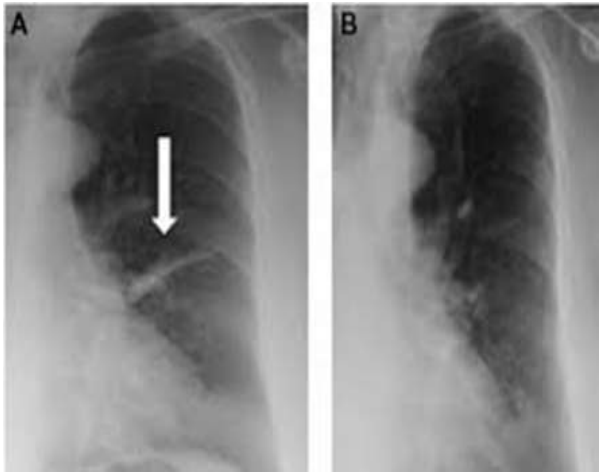
✓ Fluid filled cavity with thick wall : mostly abscess

Patchy opacity

ildefined area of increased whiteness of the lung

Airbronchogram ??!

Focal lung lesions. Cont'd



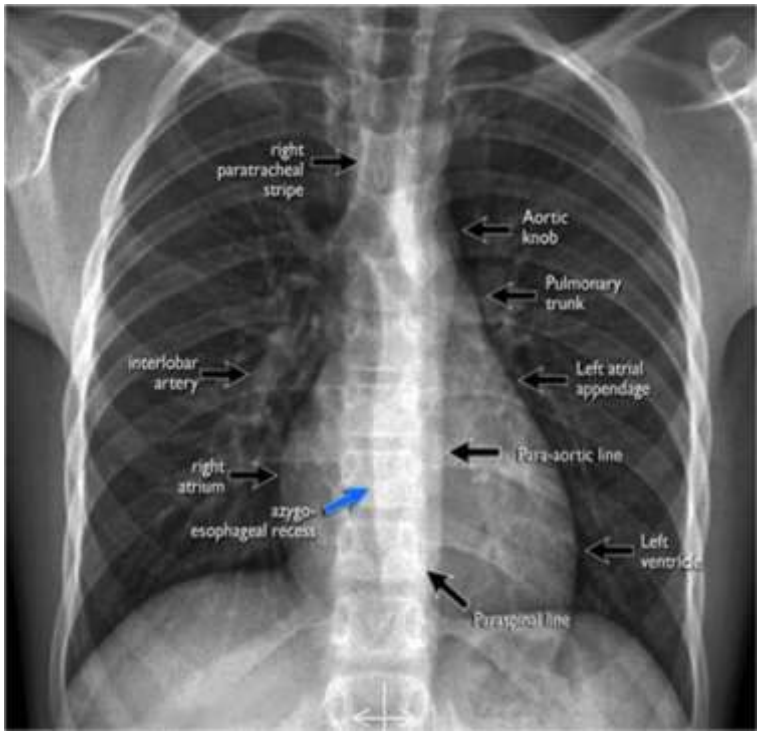
Diffuse lung lesions

Fibrosis??

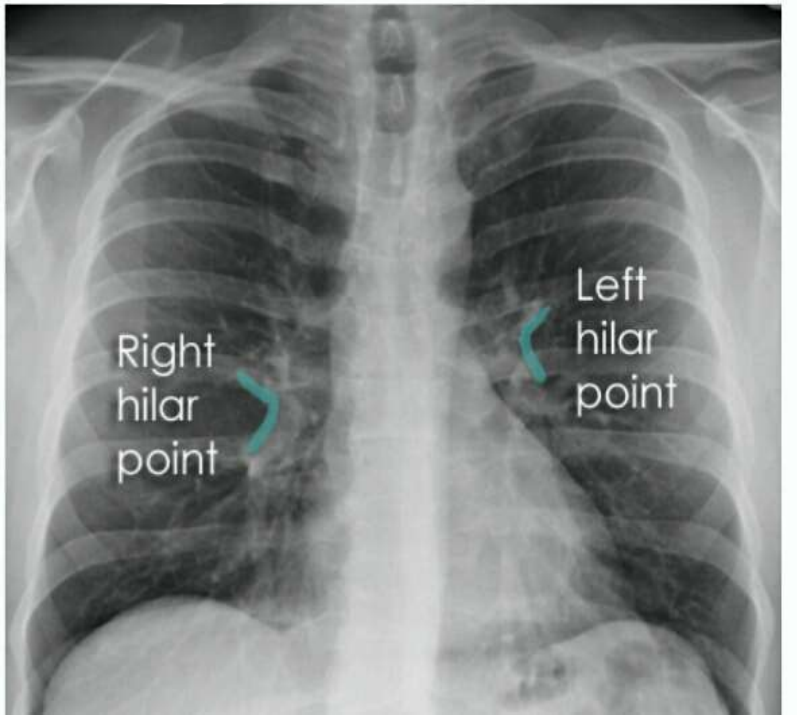
Pulmonary artery , pulmonary vein , LNs , Bronchus

Hilum

the projections related to the upper third of the heart shadow



Comment on size and location

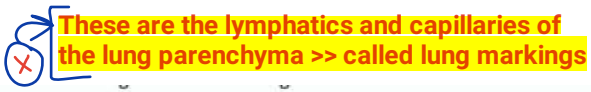


✓DON'T FORGET TO COMMENT ON THE LOCATION : Normally the Lt hilum is at a higher level than the Rt one (bcz of the presence of the aorta on Lt side (برفعها)

✓ Regarding the size : if there's hilar enlargement you have to comment whether it's unilateral or bilateral

✓ causes of hilar enlargement : VASCULAR (pulmonary HTN) , LYMPHADENOPATHY (TB , malignancy (lymphoma) , Sarcoidosis) , AIRWAYS (mass inside them)

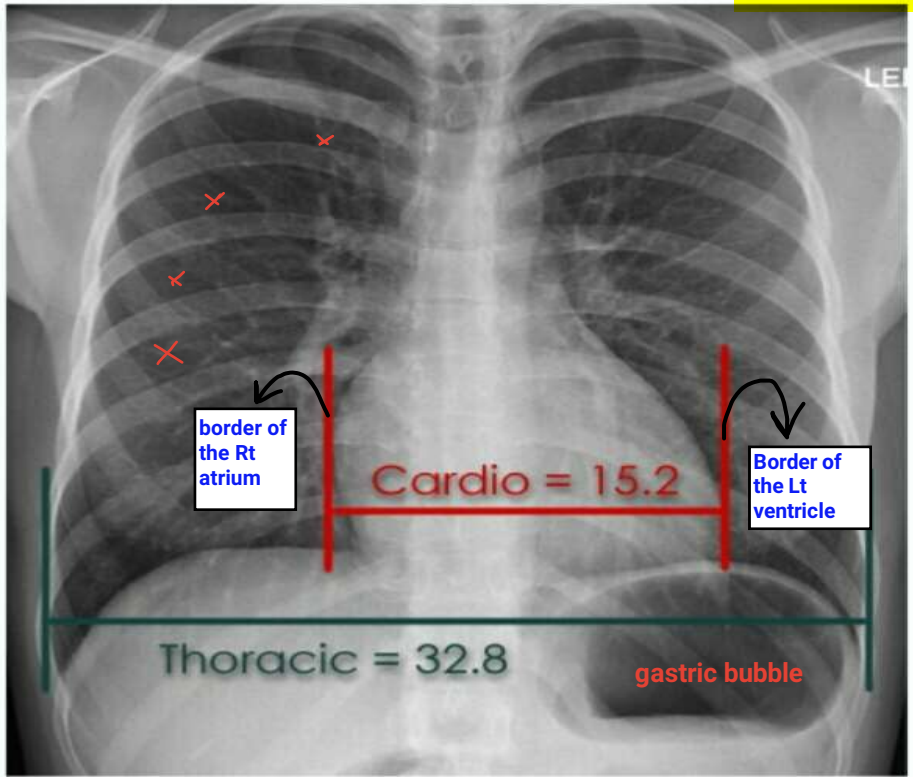
✓ Malignant causes of hilar enlargement are unilateral in most cases , So unilateral hilar enlargement is MALIGNANCY till proven otherwise

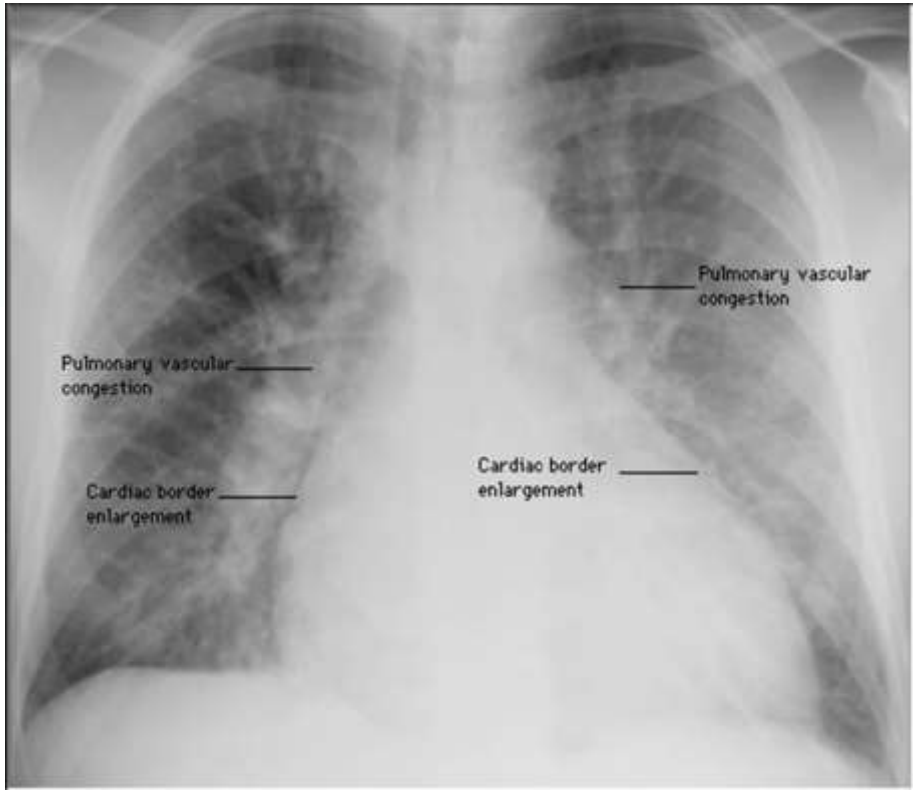


These are the lymphatics and capillaries of the lung parenchyma >> called lung markings

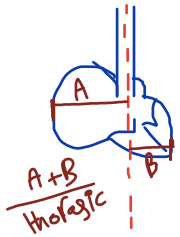
Heart Size :

we assess it using "cardiothorasic ratio" it must be 50% or less
> higher than 50% indicates cardiomegaly

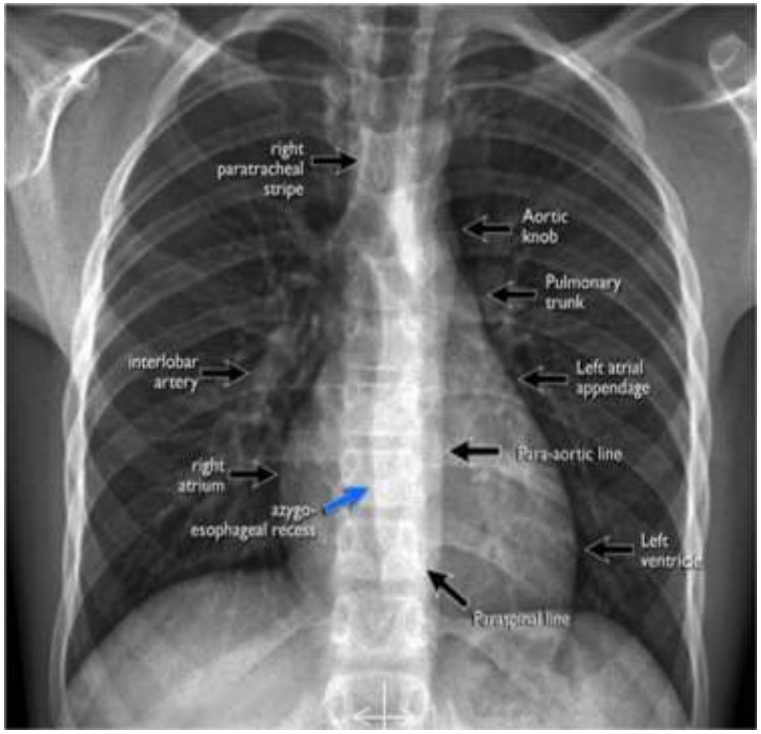


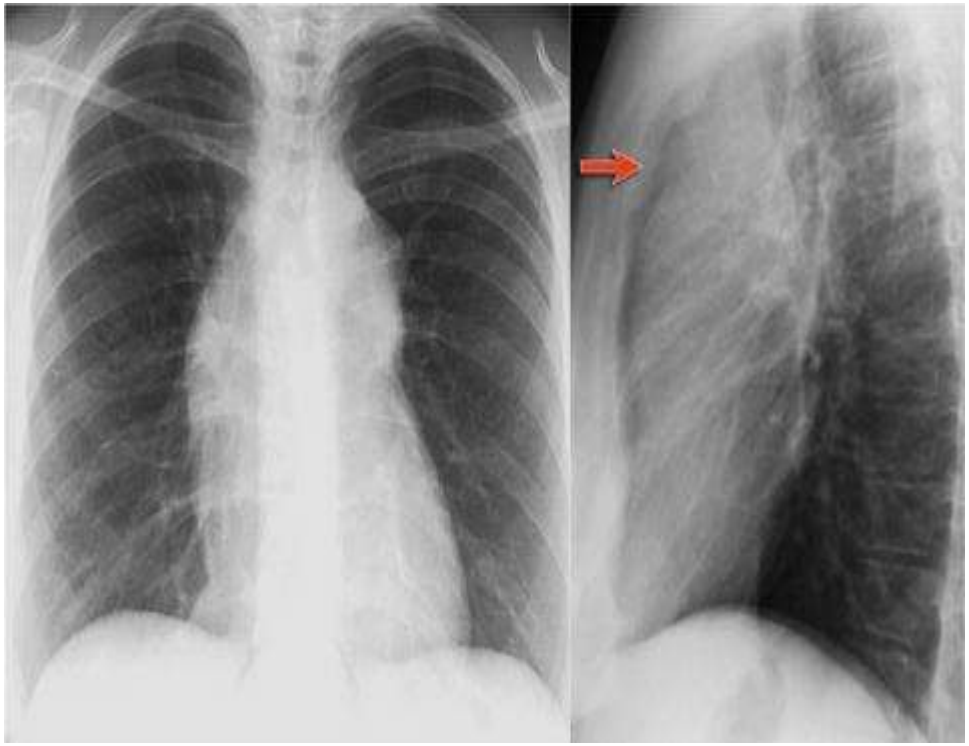


No alignment between the points ???
If there's isolated chamber enlargement (for example : Rt atrium enlargement) ,, there won't be alignment between the farthest point in the Lt of the heart (which is normal here) and the farthest point on the Rt of the heart , so you won't be able to measure the horizontal distance btw them .. what to do ?
mideline-farest point on the Lt + midline farthest point on the Rt then divide them on the distance between the 2 farthest points of the inner chest



Mediastinum





INTRODUCTION AND TECHNIQUE :

This is a frontal chest x-ray , it's not labeled (there is no patient name or date) , regarding the technique : No rotation (since the spine is equally distant from both medial clavicular ends) , regarding inspiration (9 post. rips , both apices and both Costophrenic angles are visualized >> good inspiration) , projection (not written but it seems PA to me since the heart size isn't enlarged) , penetration (I can visualize the spines to the upper third of the heart >> good exposure)

ANALYSIS :

ABCDE method :

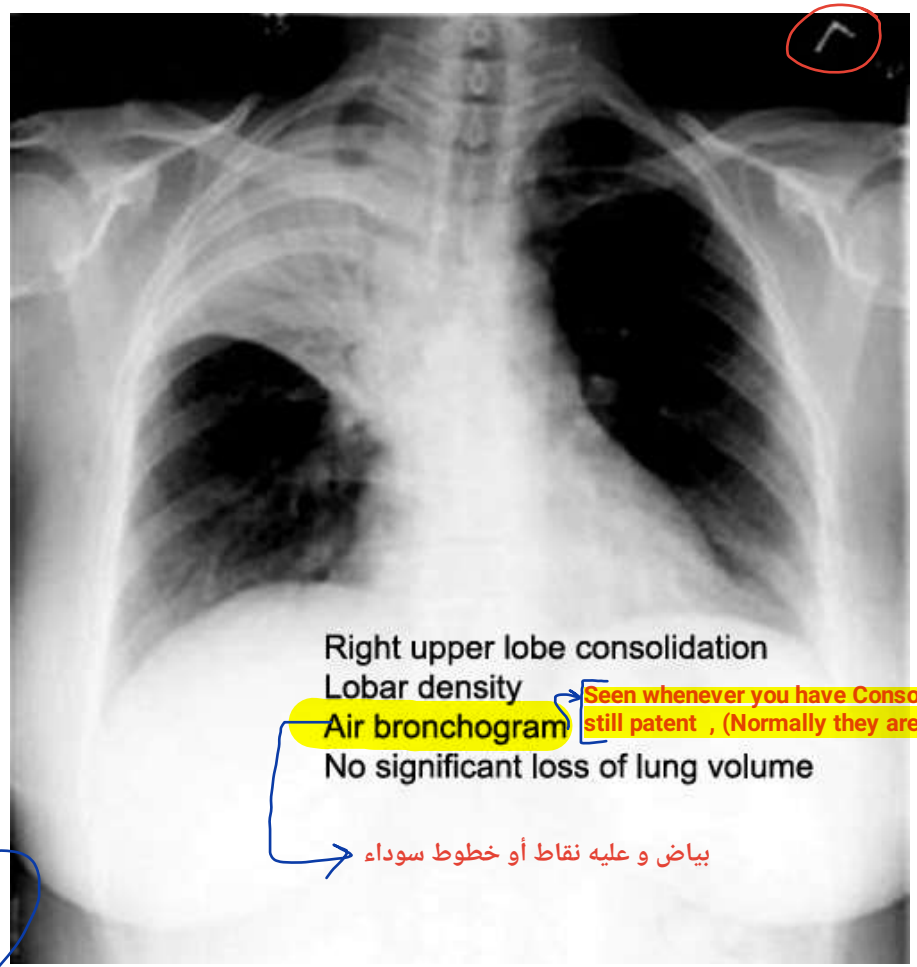
✓ Airways >> the trachea is centralized

✓ Breathing >> There's patchy opacity and Air Bronchogram on the upper and middle zones of the right lung , no focal lesions on the left lung

✓ Cardiac : Rt hilum is not visualized (silhoueting) , Lt hilum seems fine , cardiothorasic shadow is okay

✓ Diaphragm : Rt is higher than left (normal) , Rt Costophrenic angle is sharp , Lt Costophrenic angle is hard to be visualized (maybe blunted)

✓ Everything else : No Subcutaneous air , No air under diaphragm , No joint destruction



Patchy opacity + Air Bronchogram = consolidation

Seen whenever you have Consolidation in the alveoli but the brochioli are still patent , (Normally they aren't not seen , only the lung markings are)

DIAGNOSIS :

Patchy opacity + Air Bronchogram = Consolidation = pneumonia

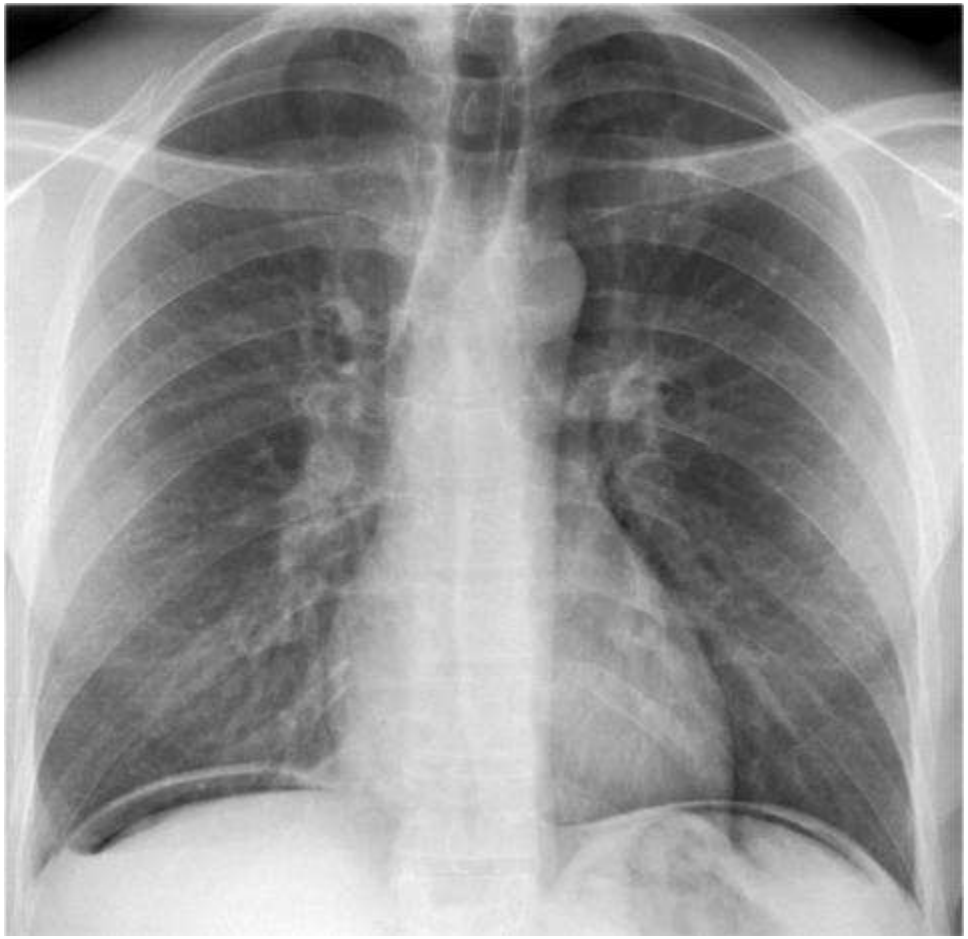
>> pneumonia of the Rt upper and middle zones

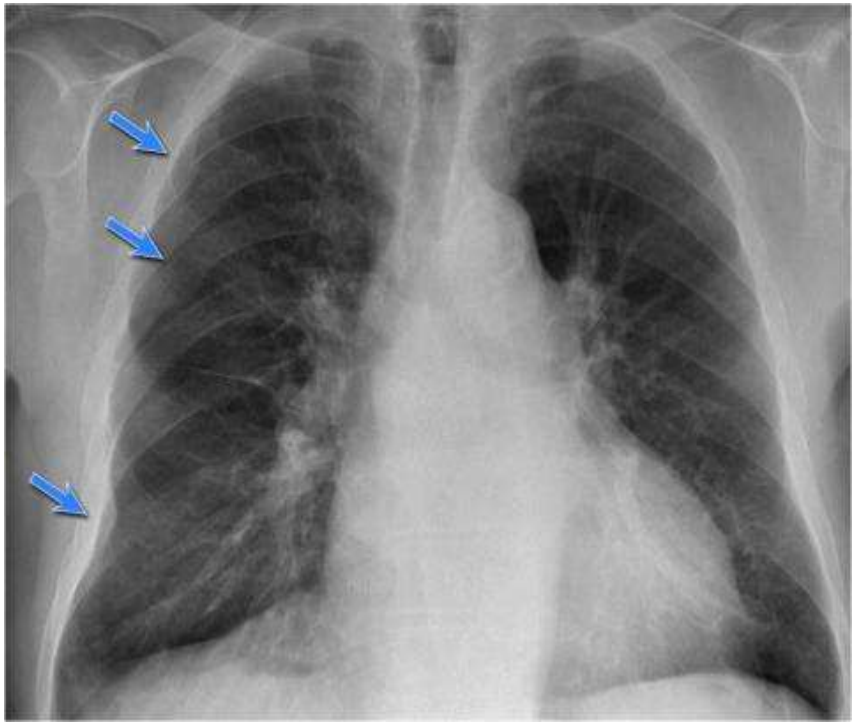
pneumonia doesn't cause Tracheal deviation and doesn't affect lung volume (doesn't shrink)

here diagnosis is clear no need for CT scan

---> Vs. lung collapse : (As if there's a mass that blocks the Rt main bronchus >> No air reaching the bronchioles >> No Air bronchogam >> only complete white lesion)

•• in collapse there's no Airbronchogram , There's shrinkage in lung volume , there's Tracheal deviation






R

✓ Identification > No patient name , No date

✓ technique : RIPE : The film isn't rotated , good inspiration (rips ✓✓ \ apices are visualized , Costophrenic angles aren't) , Not written but seems PA , adequately exposed

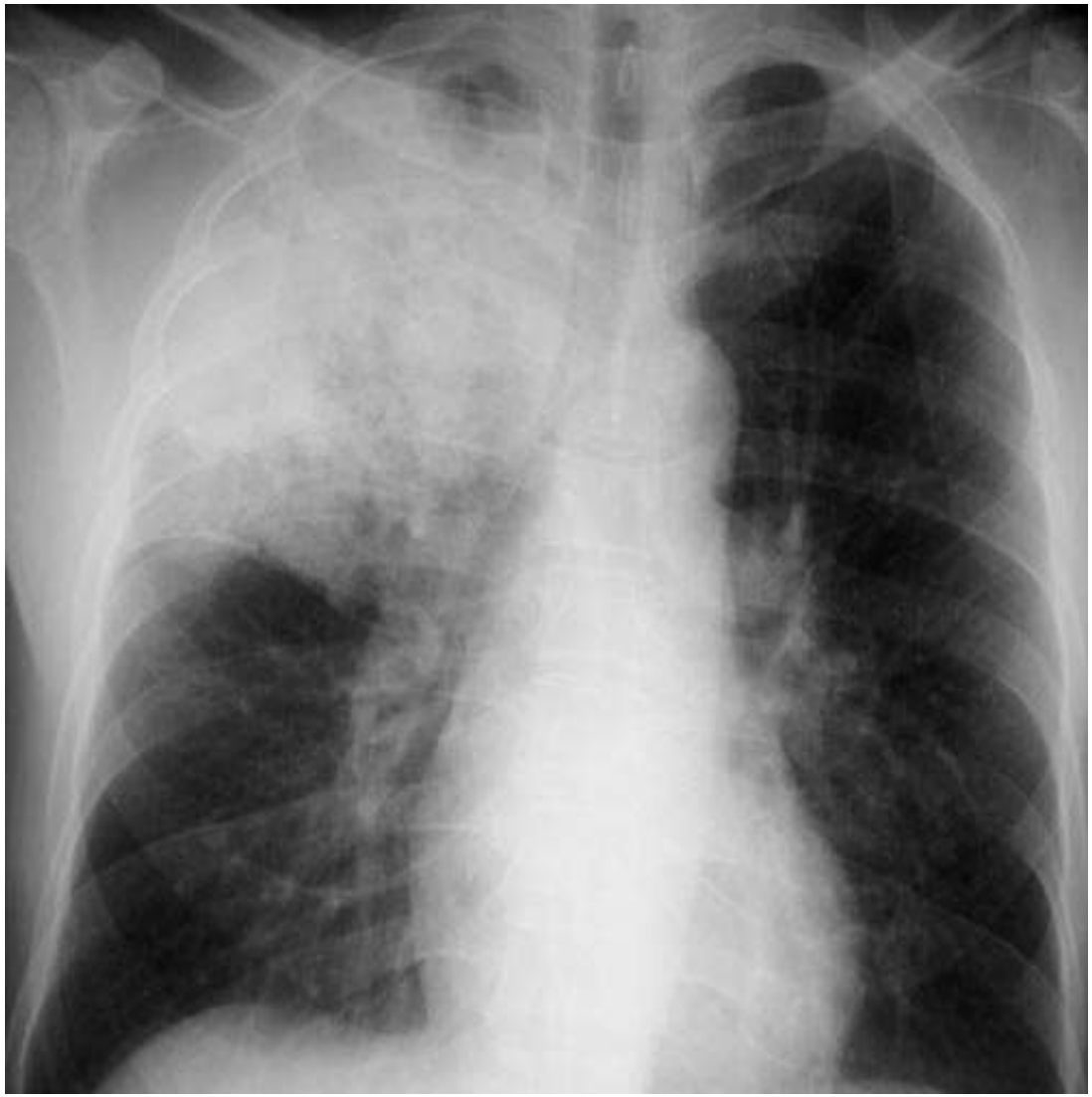
Analysis : ABCDE

✓ Trachea is centralized or slightly shifted to the right

✓ There's upper and middle zone patchy opacity with Air Bronchogram >> Consolidation
and since this consolidation isn't causing airways deviation and not causing lung shrinkage This is mostly pneumonic consolidation
The rest of the visualized lung tissue seems normal with prominent lung markings

✓ Normal cardiothorasic ratio , normal Lt hilum , the visualized part of the Rt hilum is normal but the upper part is silhoueting with the patchy opacity so I can't comment on this area , normal mediastinum

✓ No subcutaneous emphysema , no joint destruction , no fractures , No air under the right hemidiaphragm , I can't comment if there's air under Lt hemidiaphragm .



This is a typical x-ray of heart failure

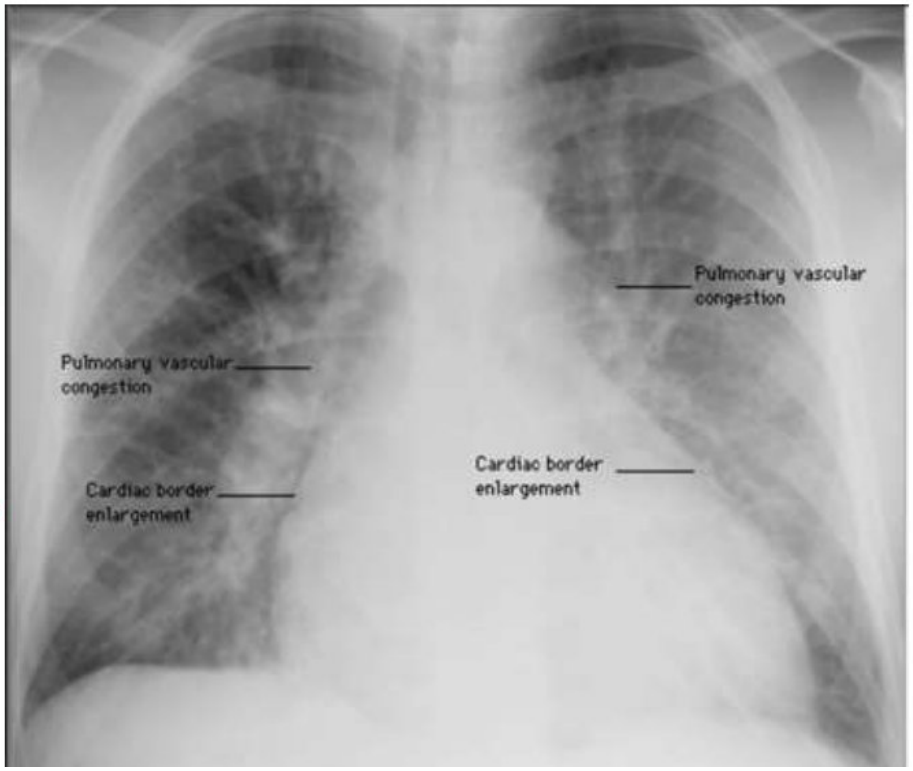
✓ Cardiomegaly

✓ Pulmonary vascular congestion >> prominent vascular markings

✓ Bilateral pleural effusion (blunting the Costophrenic angles)

✓ Upper lobe diversion (cephalization) >> Normally upper lobe vasculature (markings) are less prominent than the lower , they become prominent with effusion

Cephalization: Vessels in upper chest is more prominent as a manifestation of pulmonary venous hypertension. (Note the blood vessels are more prominent in the upper lung fields compared to the lung base, just the opposite of normal.)

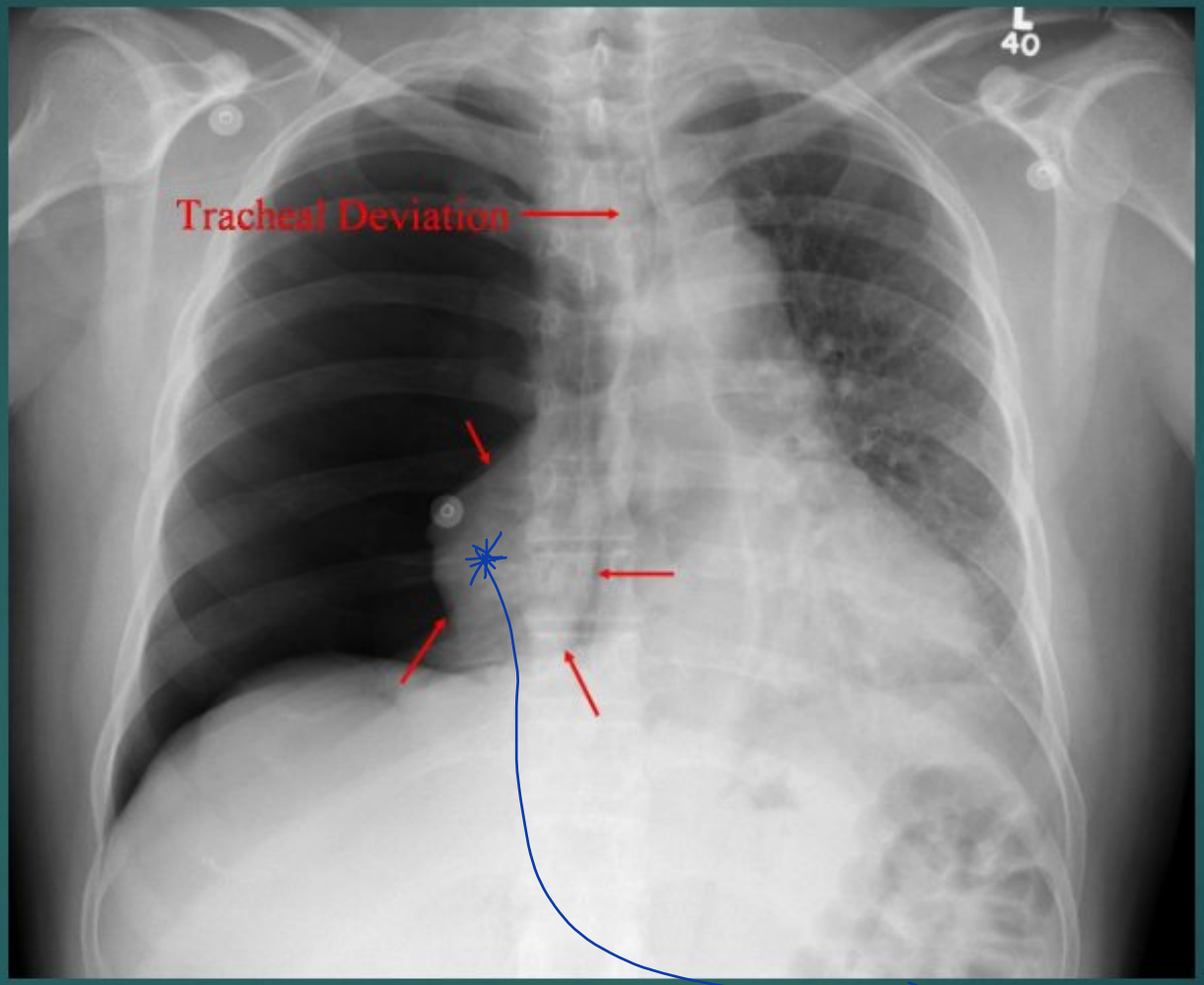


✓ Rotated to the right

✓ the whole apex is not visualized

Tracheal deviation to the left, visualized vascular markings on the left but they are absent on the right (dark black), patchy opacity in the right mid-zone. silhoueting the right heart border

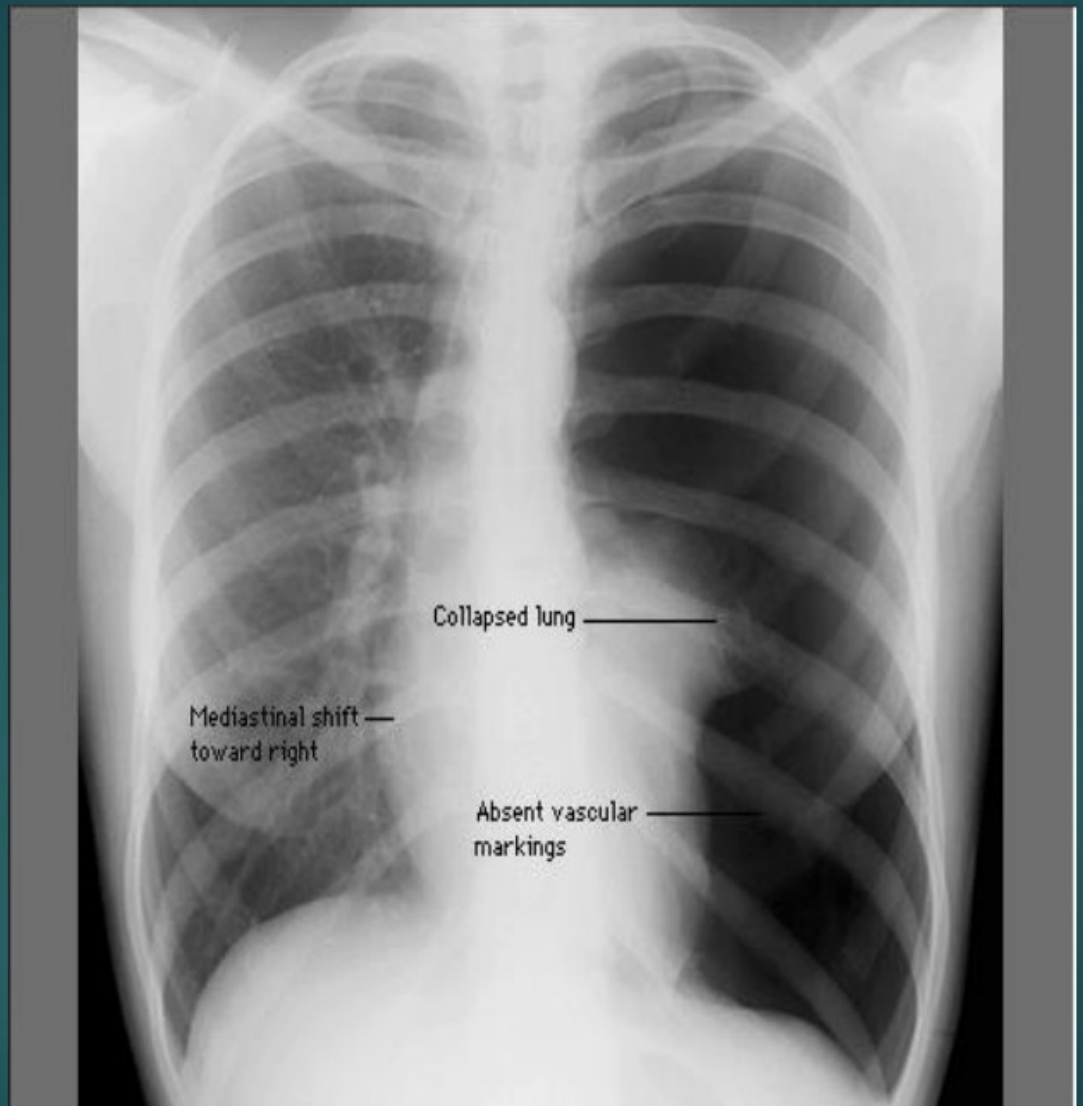
Diagnosis: right lung collapse secondary to pneumothorax causing tracheal and mediastinal deviation to the left.



✓ I can't comment on Cardiac shadow \ heart size since this patchy opacity is silhoueting the right heart border
✓ can't comment on the hilum \ mediastinum

this is the collapsed lung

The mediastinum , the trachea and the heart are all shifted to the left



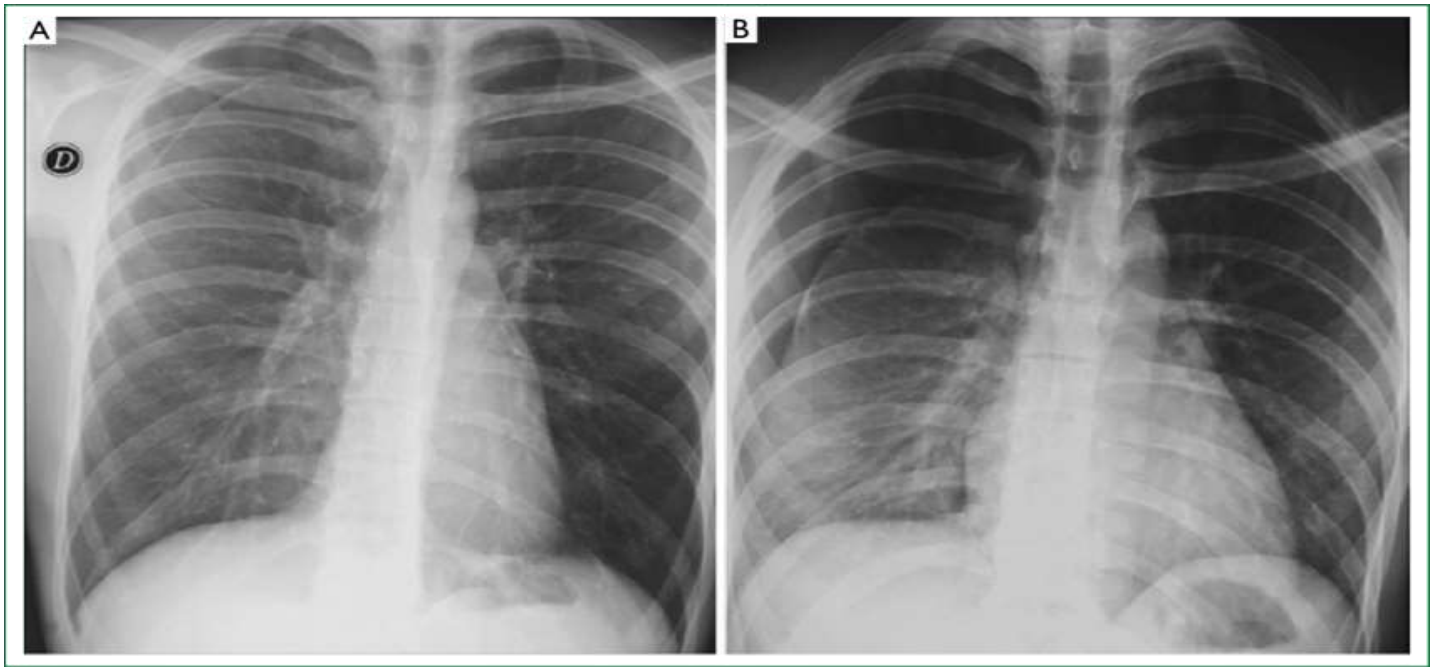
Left pneumothorax

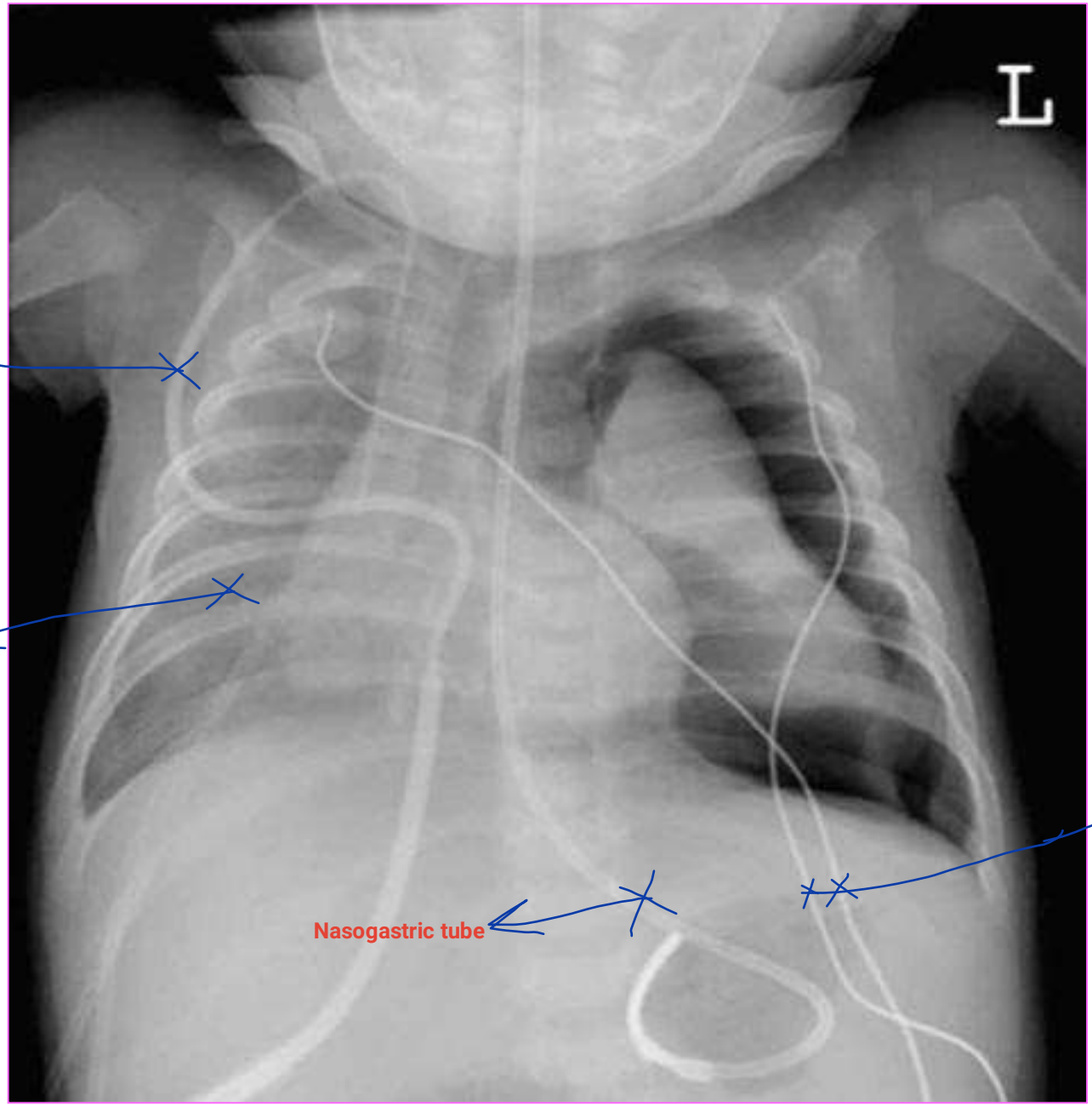
clue :

✓ No lung tissue in the Lt lung normal site

✓ Lt lung bigger than the right (abnormal)

✓ mediastinal shift to the Rt


A
B



central line inserted in Rt atrium

increased opacity of Rt lung maybe due to fluids

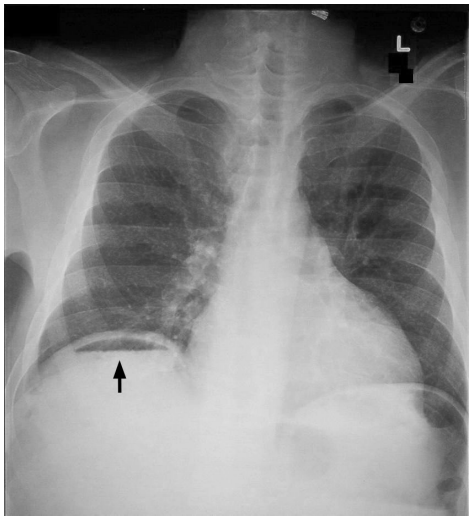
✓ Left pneumothorax (collapsed lung not showing Airbronchogram)
✓ boot shaped heart

ECG leads

Nasogastric tube

Air under diaphragm
>> perforated viscous
or postoperative

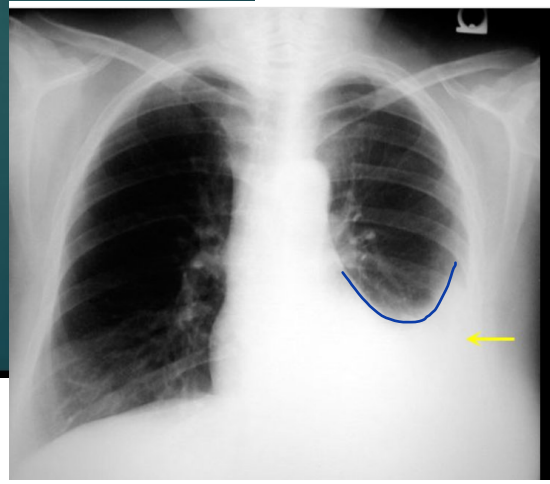
Left >> if circular This is
gastric bubble \\ Crescent
this is air under diaphragm

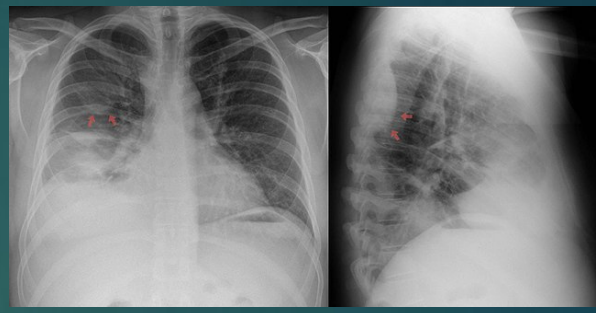


Homogenous opacity blunting the angle.

Meniscal Sign = left pleural effusion.

meniscus >> a concave line obscuring the costophrenic angle and part or all of the hemidiaphragm .





Incomplete border or
Pregnant lady sign:

Pocket-like, indicating an extrapulmonary mass, could be empyema

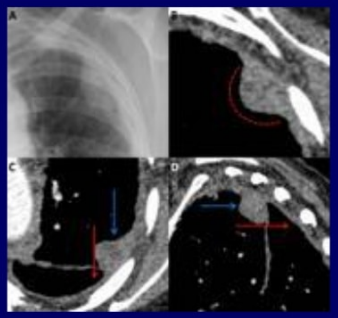
inflammation of the pleural cavity

بكون لوكاليزد مو زي الافيوجن اللي قبل

Incomplete Border Sign (Pregnant Lady Sign)

The incomplete border sign is useful to depict an extrapulmonary mass on chest radiograph.

An extrapulmonary mass will often have a inner well defined border and an ill-defined outer margin · This can be attributed to the inner margin being tangential to the x-ray beam and has good inherent contrast with the adjacent lung. On the other hand, the outer margin is enface or partially enface with the x-ray beam and merges with the pleural or chest wall thus the border is obscured



Patchy opacity with no air bronchogram in the upper zone with loss of right lung volume = right upper lobe collapse

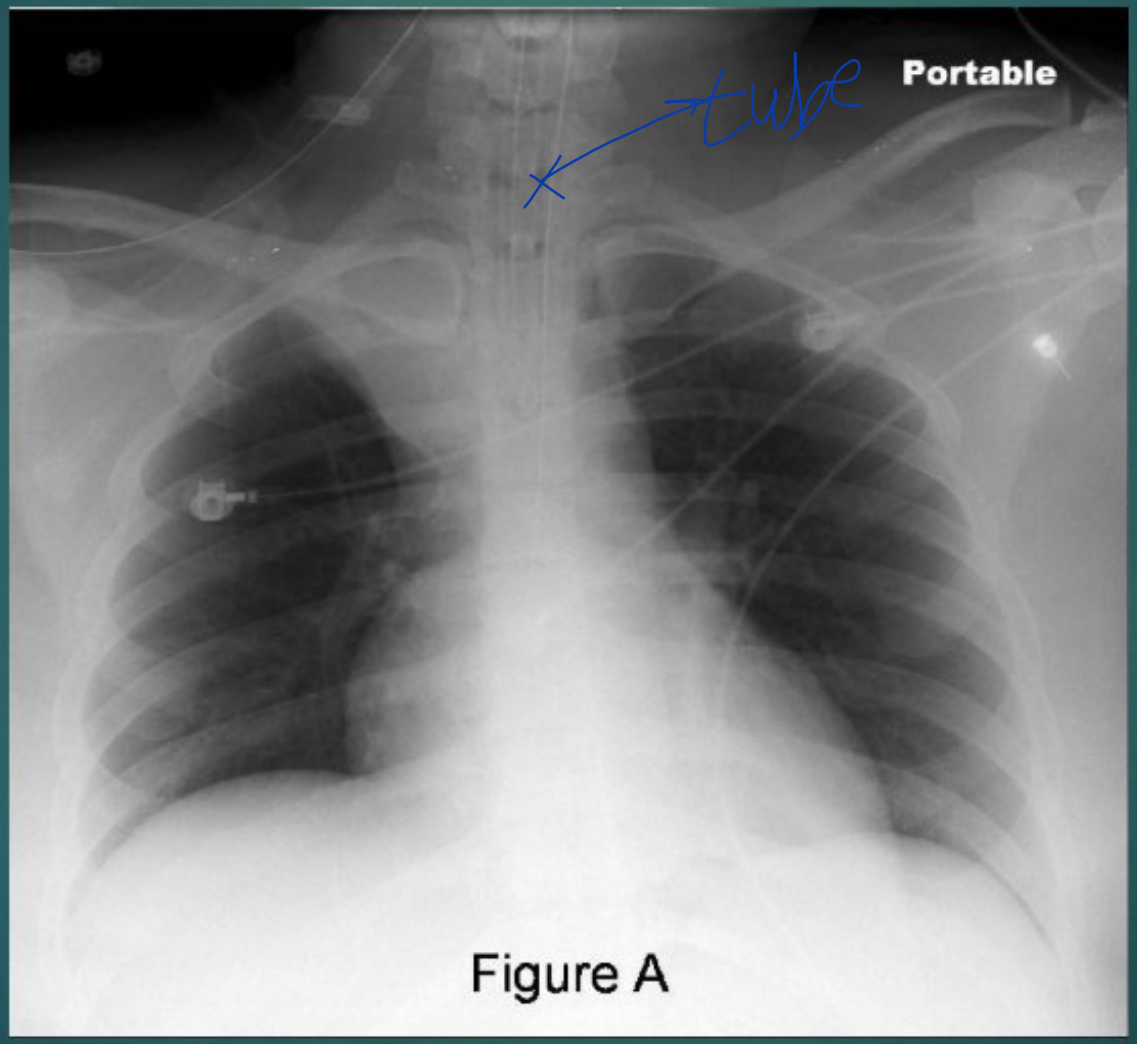
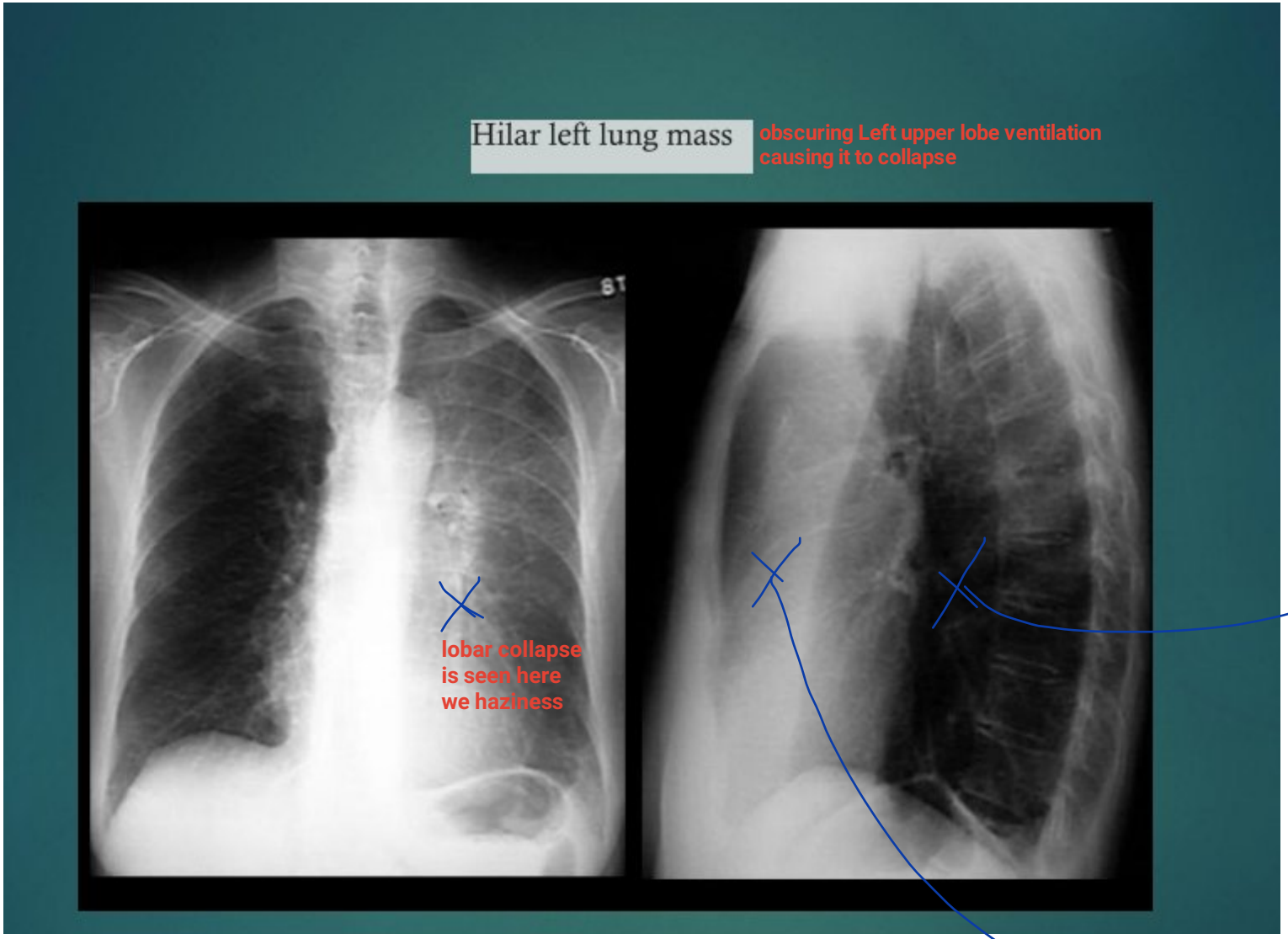


Figure A

The cause of this collapse is the endotracheal tube for mechanical ventilation as it is below the level where it's supposed to be (obscuring the airways going to Rt upper zone)


Hilar left lung mass
obscuring Left upper lobe ventilation causing it to collapse
lobar collapse is seen here we haziness
hyperinflated Lt lower lobe
Collapsed Left upper lobe

Typical CXR of Lung fibrosis showing diffuse reticular lines