

Respiratory imaging

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When we interpret chest XR we have to identify the patient (name, date and time), comment on the technique and finally on the pathology.

1) IDENTIFICATION

- ▶ **Correct patient**
- ▶ **Correct date & time**
- ▶ **Right vs. Left side (gastric bubble)** not very important

2) TECHNIQUE

- RIPE

Rotation: asses the alignment of the clavicle to the spinous processes (slide 4)
> equal distance between medial aspects of clavicles to spinous processes.

Inspiration: when taking a good, full inspiration, 6 anterior and 8 posterior ribs should be visualized. If more are visualized = hyperinflation. Less = error or true lung volume loss. (slide 5)

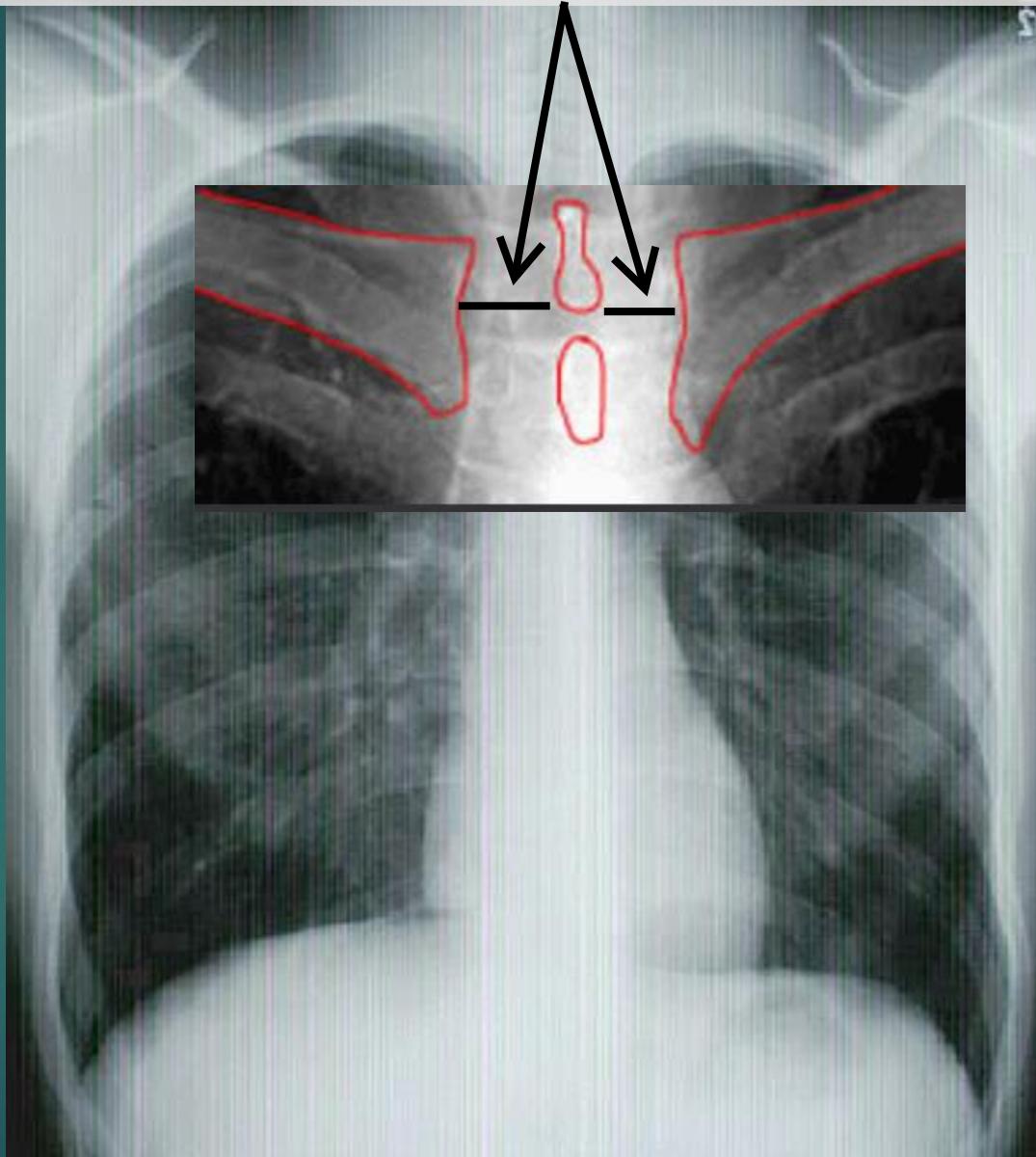
Projection: is it AP or PA? (slide 6)

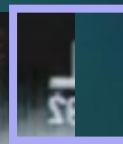
Exposure (can you see vertebral bodies behind the heart) (slide 7)

Rotation

To assess the rotation, the distance between the medial aspects of the clavicles and the spinous processes on each side should be equal.

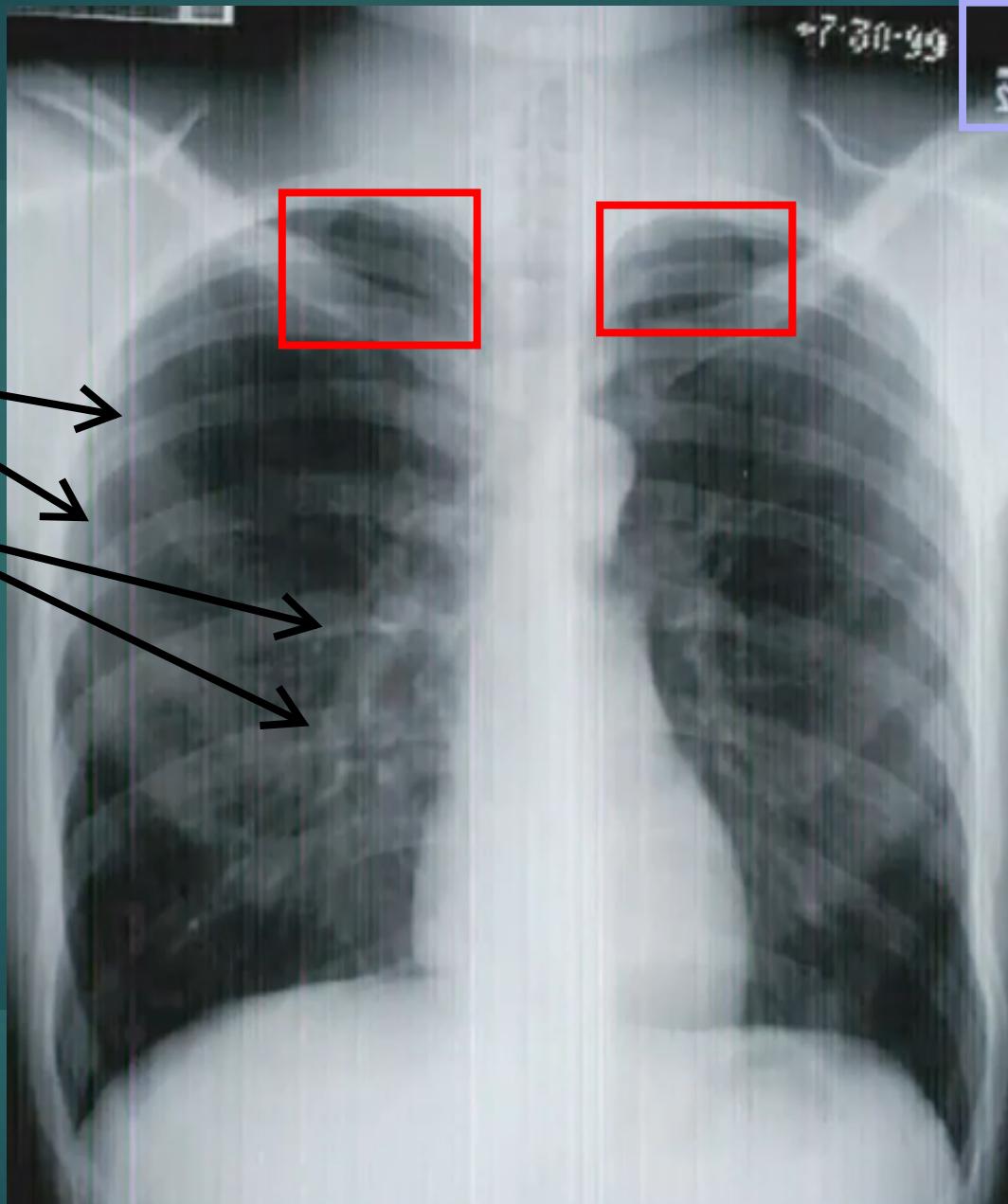
Comment: film is not rotated, or centralized





+7.30.99

This signs, or a black line, mean that this is the left side of the patient



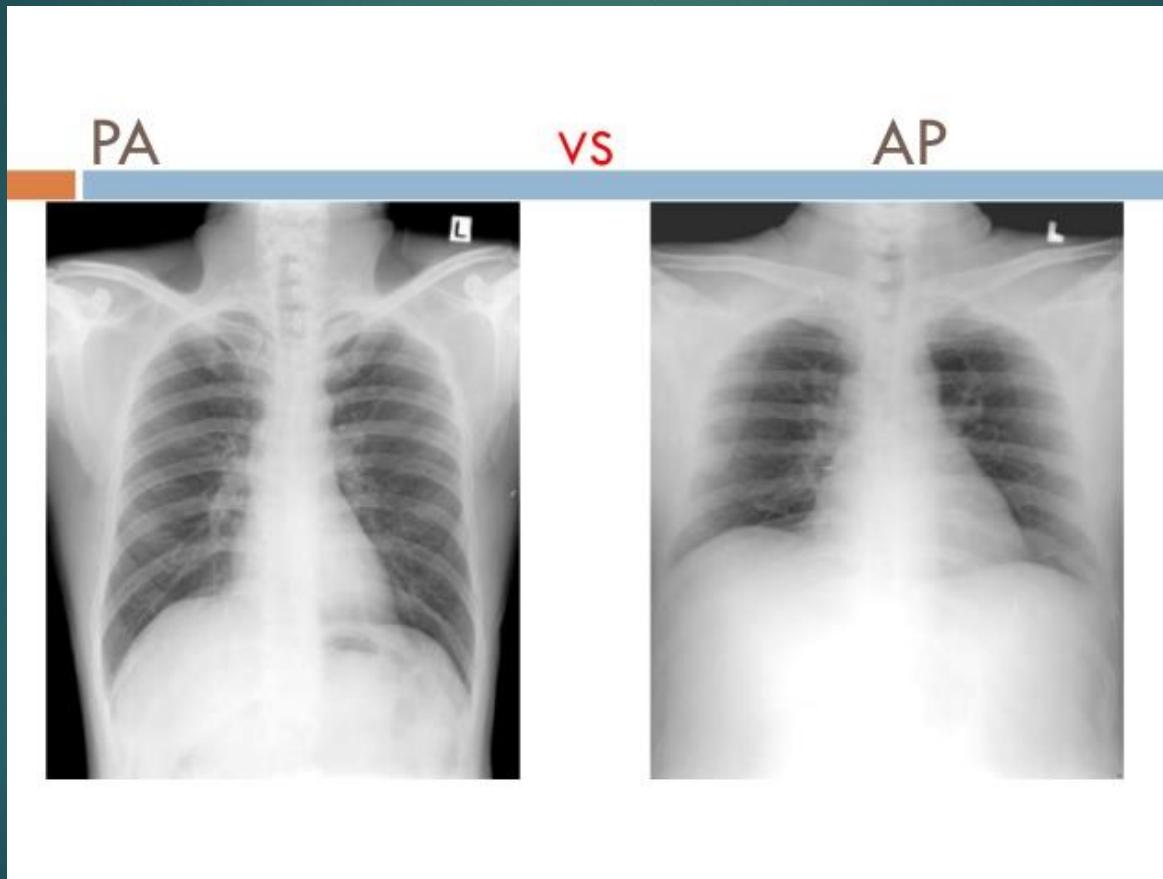
Ant ribs are oblique (6)
whereas post ribs
are horizontal (8)

Comment the
number of visualized
ribs and mention that
the apex of the lung
and the costophrenic
angles of both sides
are visualized.

Projection

Posterior - anterior (PA) refers to the direction of the X-Ray beam travel.; i e. X-Ray beams hit the posterior part of the chest before the anterior part and vice versa in AP view.

The AP shows magnification of the heart (ant surface is wider than the post surface), widening of the mediastinum and a smaller lung. AP views are less useful and should be reserved for very ill patients who cannot stand erect.



Not knowing that the view is AP can lead to the misdiagnosis of cardiomegaly, pleural effusion, wide mediastinum or basal lung infiltrate when these changes are not actually present.

Clinical-radiological correlation is required for accurate diagnosis of most non-neoplastic pulmonary conditions.

Exposure

Exposure / Penetration: it is the degree to which X-rays have passed through the body.

Ideally, you should be able to see the heart, the blood vessels, and the intervertebral spaces, i.e. the spine should be visualized behind the upper third of the cardiac shadow but not behind the lower 2/3.

(OR: Exposure should be adequate if you are able to see approximately T4 vertebra and spinal process).

Over penetrated



Under penetrated



Look at the CXR at the chest as a whole not only the lungs

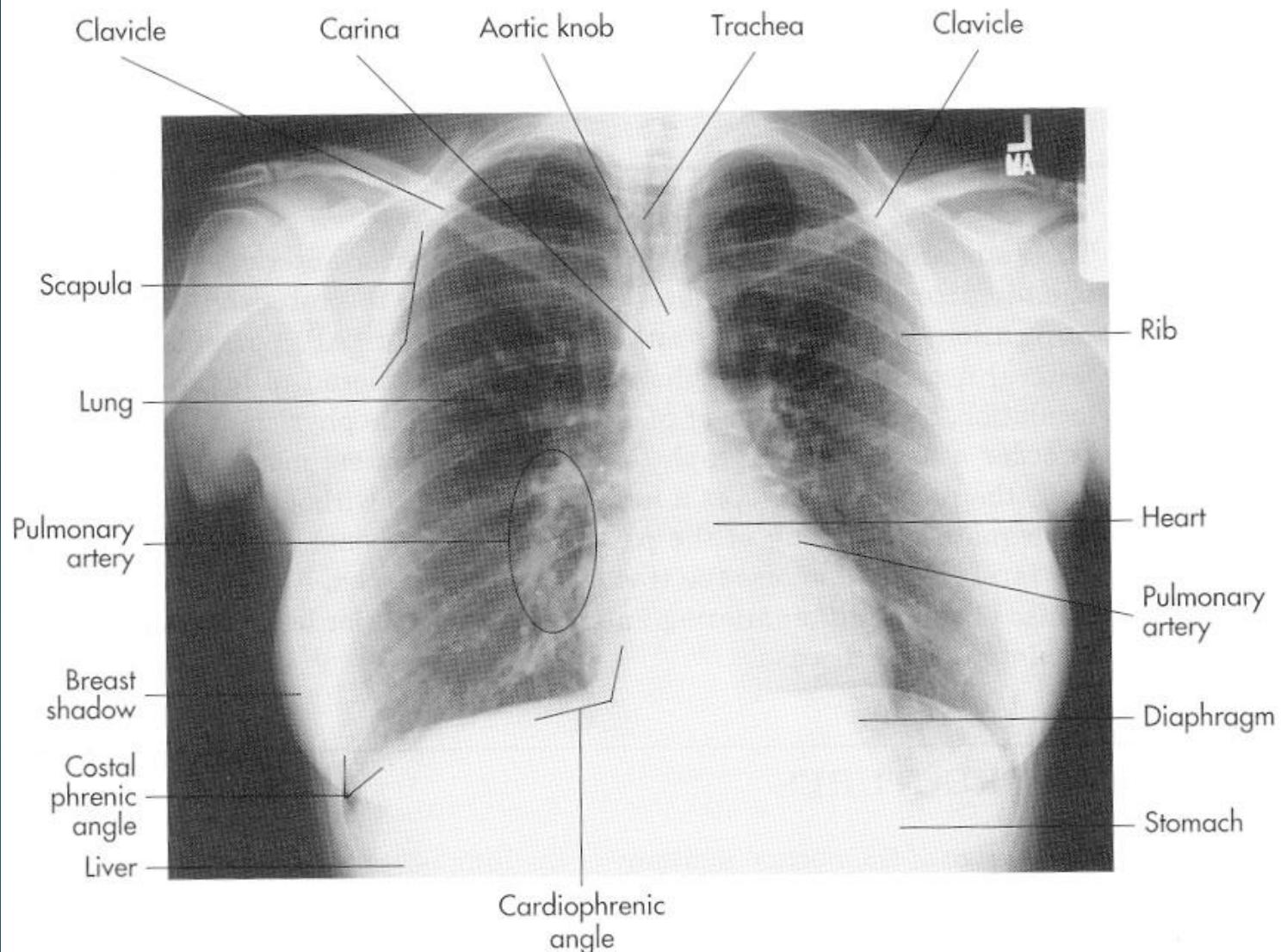


Fig. 3-1 Normal position of anatomical structures on a posterior or anterior chest radiograph.

After identifying the patient, commenting on the technique (RIPE), now we comment on the pathology:

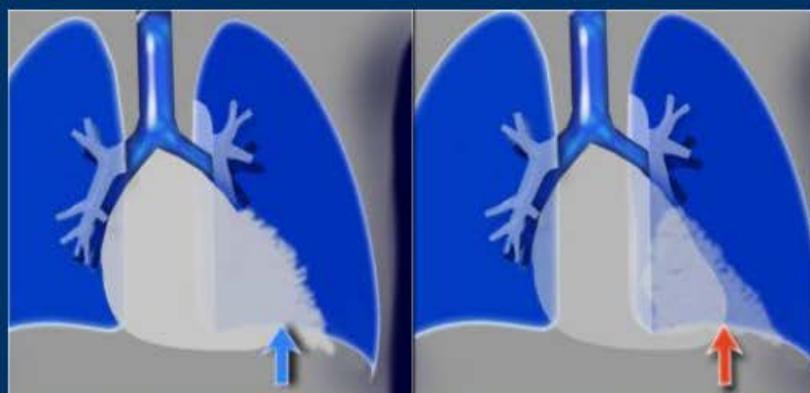
3) Pathology 'each will be discussed later on':

- A: Airway
- B: Lung
- C: Heart, Hilum, Mediastinum (wide or not)
- D: Diaphragm (costophrenic angles)
- E: Everything else (clavicles, ribs, joints, etc)

Keep in mind that Frontal film does not reflect the true anatomy of the lung; lesions appearing to be in the upper lobe could actually be in the lower lobe, that is why when locating a lesion we use zones not lobes. The Silhouette sign also enables us to locate pathologies within the chest (check next slide). Lateral films on the other hand shows the anatomical positions of the lobes.

When you see a focal lesion, its either a:

- 1- Nodule (rounded lesion with a well-defined border, < 3cm), next step: fleischner guidelines
- 2- Mass (rounded lesion with a well-defined border, almost 3cm)
- 3- Cavity (could be empty 'bolus', fluid 'abscess')
- 4- Patchy opacity (area of increased whiteness with an irregular border)



Silhouette sign in a consolidation located in the lingula (blue arrow). The silhouette of the left heart border will still be visible in a consolidation in the left lower lobe (red arrow).

Silhouette sign

This is a very important sign. It enables us to find subtle pathology and to locate it within the chest.

The loss of the normal silhouette of a structure is called *the silhouette sign*.

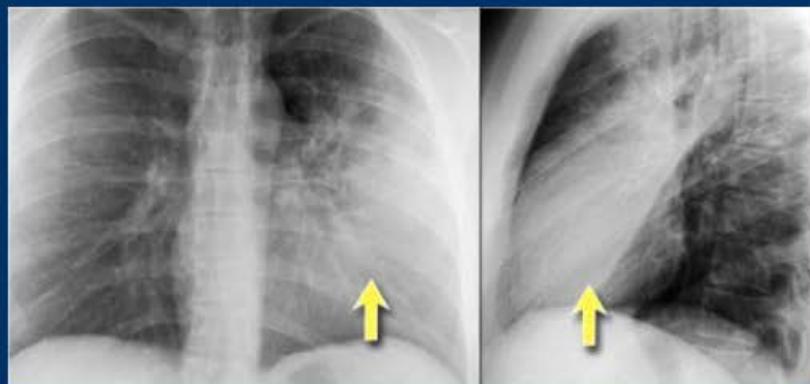
Here an example to explain the silhouette sign:

The heart is located anteriorly in the chest and it is bordered by the lingula of the left lung.

The difference in density between the heart and the air in the lung enables us to see the silhouette of the left ventricle.

When there is something in the lingula with the same 'water density' as the heart, the normal silhouette will be lost (blue arrow).

When there is a pneumonia in the left lower lobe, which is located more posteriorly in the chest, the left ventricle will still be bordered by air in the lingula and we will still see the silhouette of the heart (red arrow).



The PA-film shows a silhouette sign of the left heart border. Even without looking at the lateral film, we know, that the pathology must be located anteriorly in the left lung.

This was a consolidation due to a pneumonia caused by *Sterptococcus pneumoniae*.

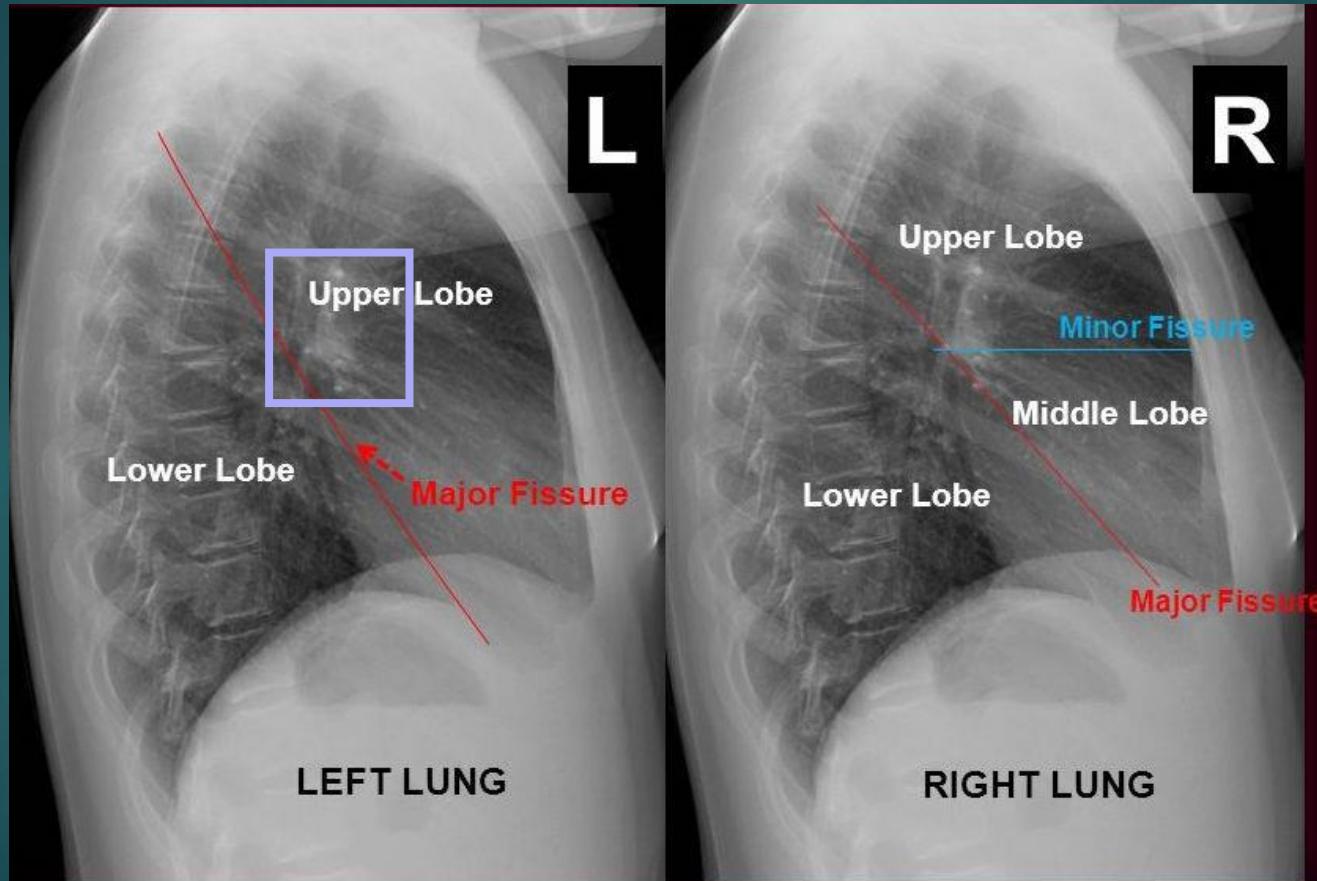


Here we see a consolidation which is located in the left lower lobe. There is a normal silhouette of the left heart border.

Normally the major fissure can be visualized, or identified through imaginary lungs through many ways:

- 1- Behind the hilum (area of increased whiteness 'square') or the heart's shadow.
- 2- Line between ant half, of the ant half of the diaphragm, and T4.

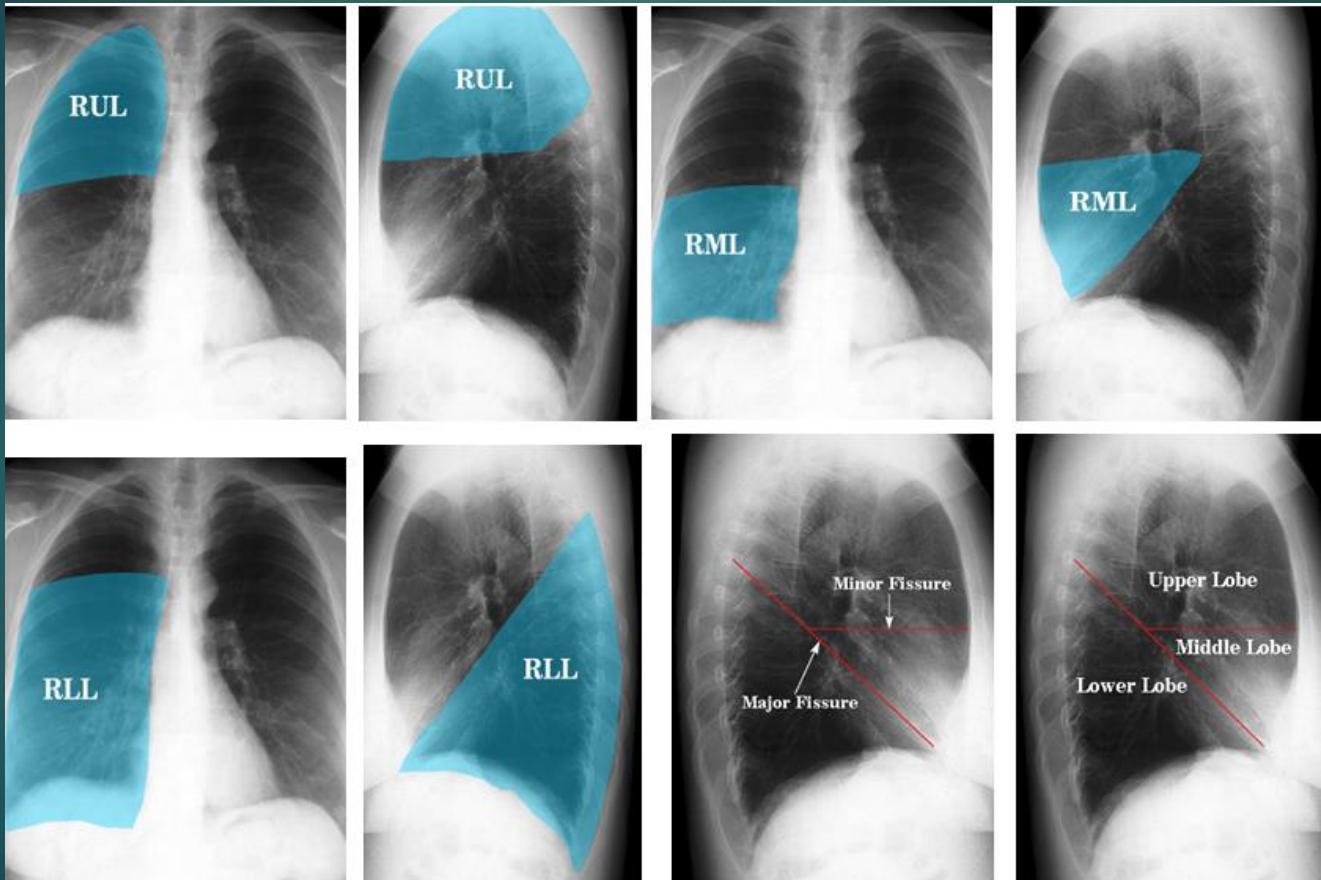
The minor fissure imaginary line on the right side is drawn from the intersecting point of the hilum and the major fissure.



This is a lateral film, lobes can be defined. It also helps in spotting lower lobe pathologies which can be missed on frontal films.

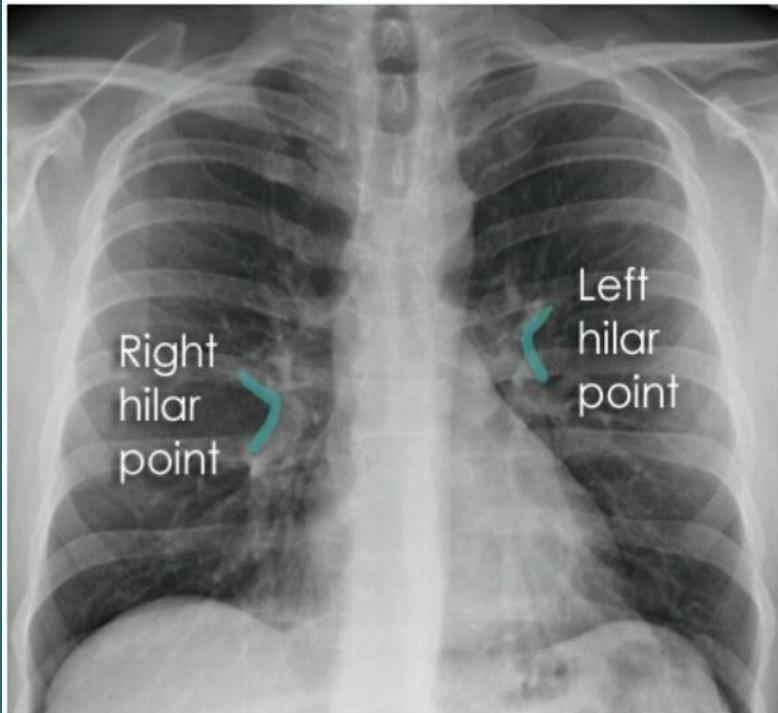
We can differentiate between the right and left diaphragm knowing that:

- 1- Right diaphragm is higher than the left diaphragm.
- 2- Left diaphragm ant. border disappears, since its covered by the heart and covers the gas bubble in the stomach's fundus.



Normal hilar position

Hover over image to show findings



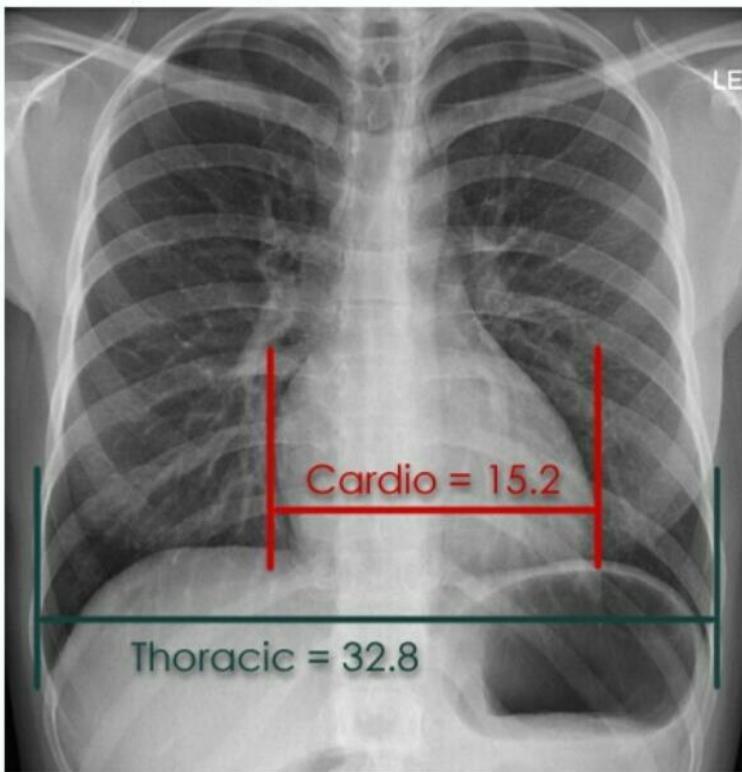
The hilar region is where the bronchi, arteries, veins, and nerves enter and exit the lungs.

1- Position: Left hilum is slightly higher than the right hilum (normal case).

2- Size: hilar enlargement presents as white circle surrounding the hilar points. We should clarify whether enlargement is bilateral or unilateral. Enlargement is malignancy until proven otherwise (especially when unilateral).

Normal heart size

Hover over image to show findings



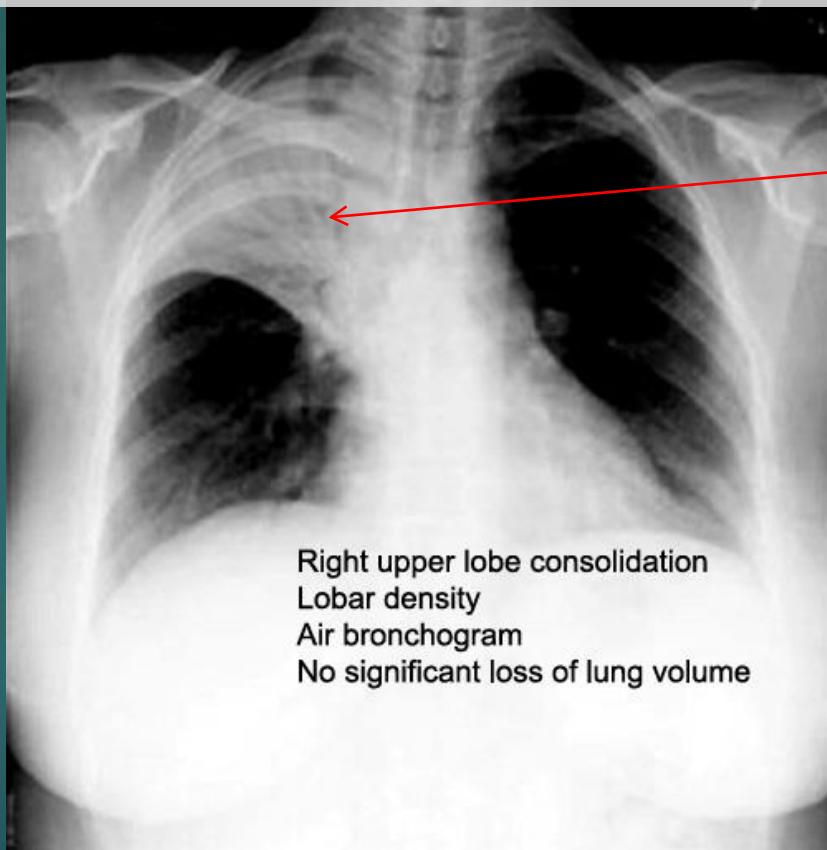
Normally, the Cardiothoracic ratio measured on a PA chest x-ray should be <50%; it is the ratio of maximal horizontal cardiac diameter to maximal horizontal thoracic diameter.

Costophrenic angles should be sharp as seen in the image. When blunted, this indicates the presence of fluid.

- 1- This a frontal film, unlabeled with the patient's identity and the sign on the right corner signifies the left side of the patient.
2- Regarding the technique, the film is not rotated, 8 ribs posteriorly and the both apexes and costophrenic angles' areas can be visualized indicating a good inspiration, the projection is PA, and finally the exposure seems adequate.

3- Pathology:

- A: Trachea is centralized
B: Rt upper and mid-zones have patchy opacities, air-bronchogram (black lines), while there are no abnormal lesions on the left lung.
C: The right hilum cannot be visualized while the left seems to be okay. The cardiac shadow seems fine.
D: The right diaphragm is higher than the left. Costophrenic angles on the right side is sharp, on the left its hard to visualize.
E: There is no subcutaneous air, no joint destruction, or air under the diaphragm.



Diagnosis:
Air-bronchogram + patchy opacities
= consolidation (pneumonia)

Supportive findings:
Pneumonia usually does not affect the anatomy and volume of the lung and does not cause tracheal deviation.

Note: patchy opacities without bronchogram can be fluids (whiter, goes down with gravity) or a mass obstructing bronchi (causes collapse and tracheal deviation)

1- This a frontal film, unlabeled with the patient's identity.

2- Regarding the technique, the film is not rotated, 6 ribs anteriorly, 8 ribs posteriorly and the both apices can be visualized whereas the costophrenic angles' areas cannot be seen properly, the projection is most likely PA, and finally the exposure seems adequate.

3- Pathology:

A: Trachea is centralized

B: Rt upper and mid-zones have patchy opacities, air-bronchogram (black lines), while there are no abnormal lesions on the left lung.

C: The right hilum cannot be visualized properly while the left seems to be okay. The cardiac shadow seems fine.

D: The right diaphragm is higher than the left.

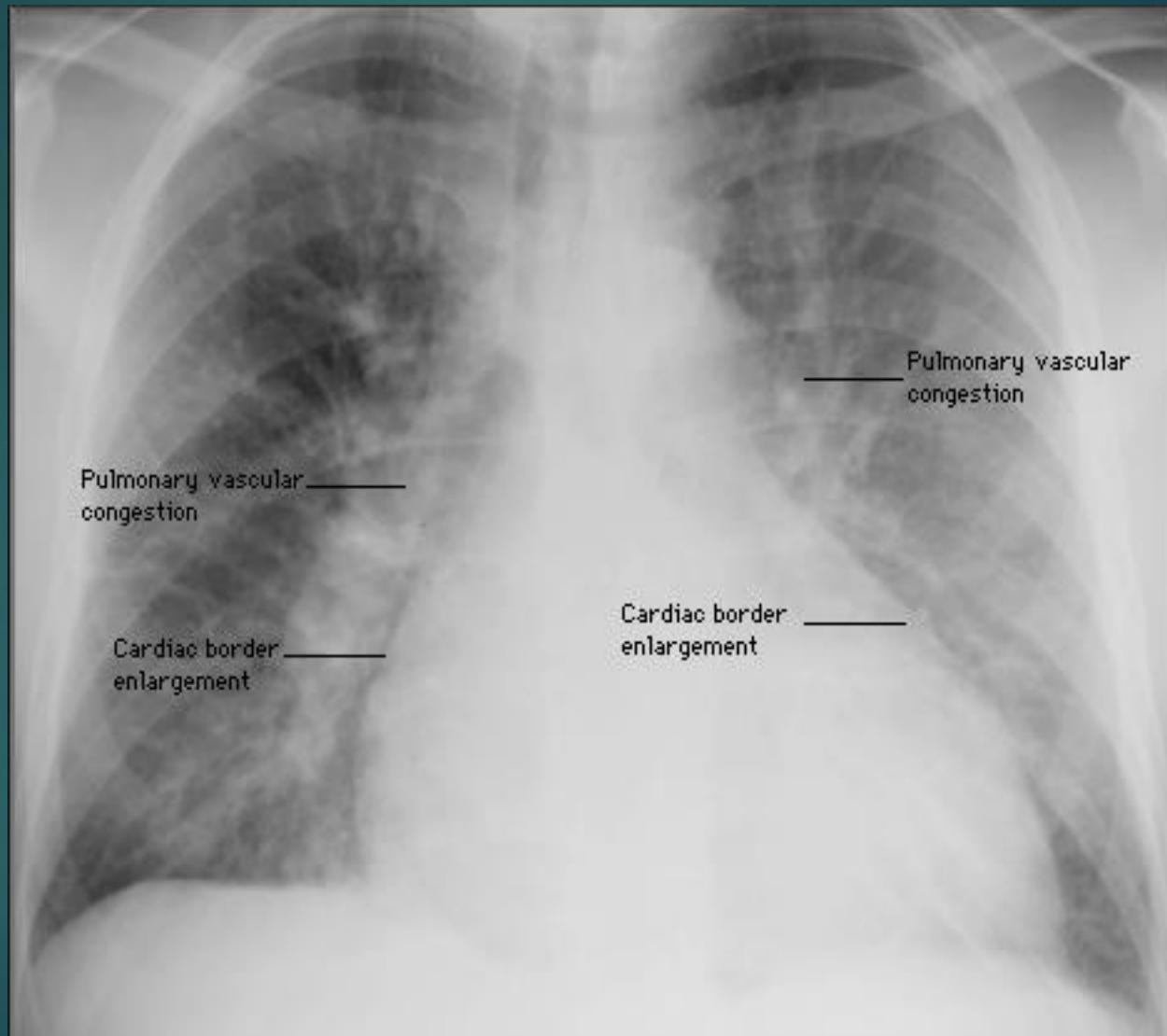
E: There is no subcutaneous air, no joint destruction or fractures, and the presence of air under the diaphragm cannot be commented on.

Diagnosis:

Air-bronchogram + patchy opacities = consolidation (pneumonia)

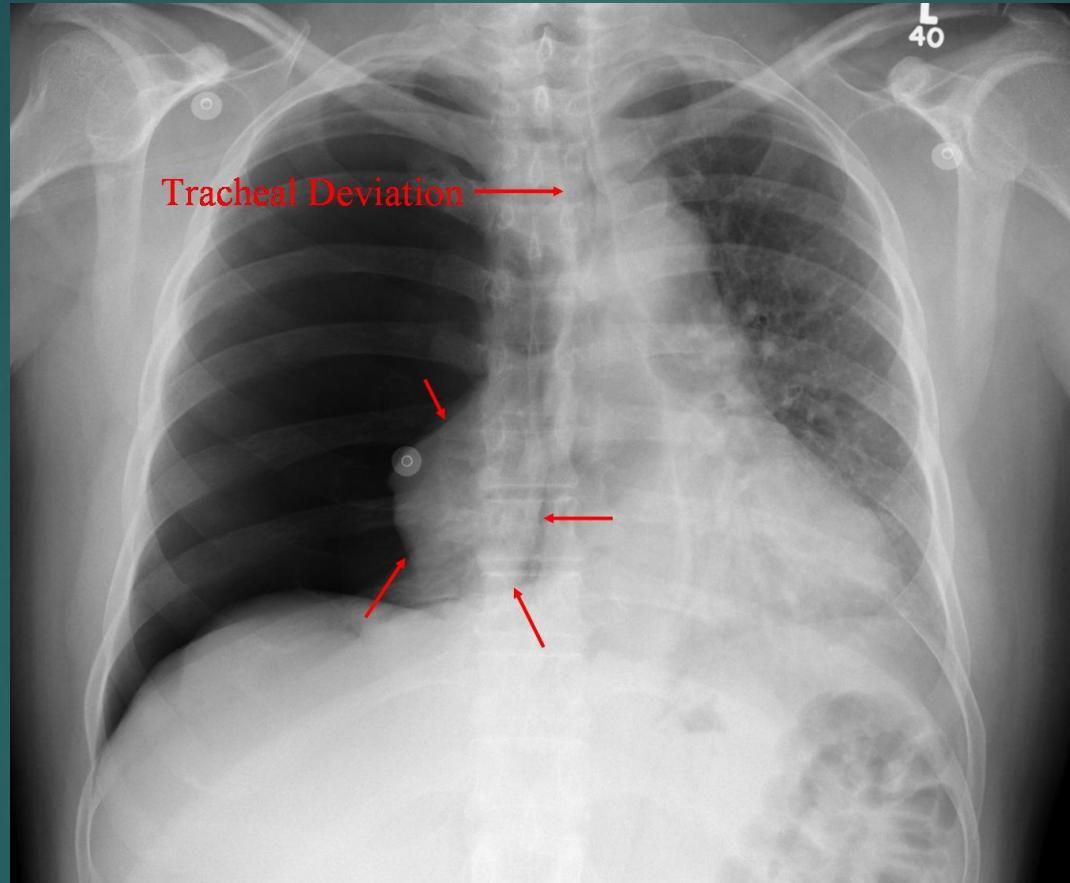


Typical CXR of HF where we can see cardiomegaly and increased markings (vascular congestion). There is fluid accumulation bilaterally (pleural effusion) blunting the angles.

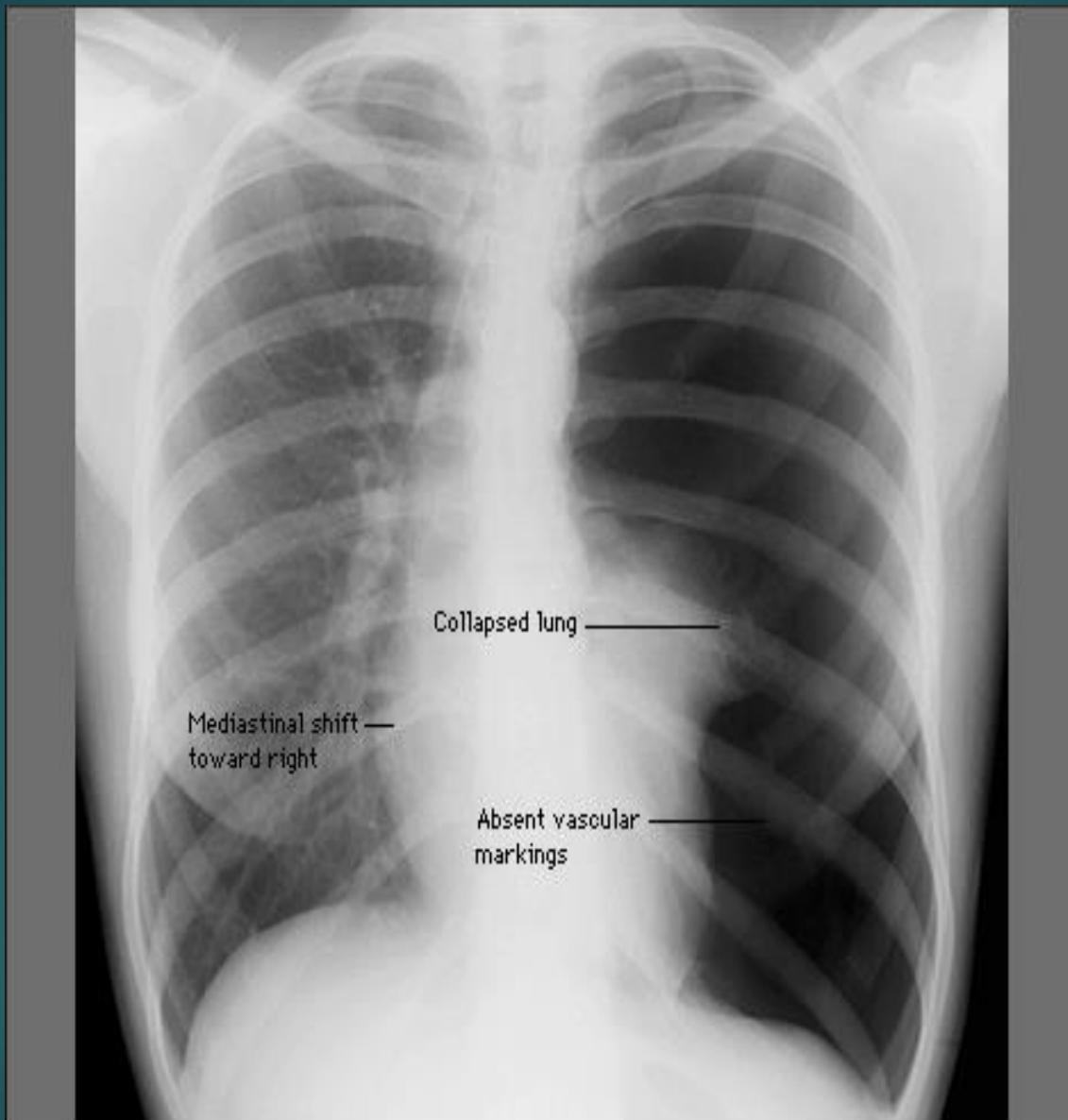


Tracheal deviation to the left, visualized vascular markings on the left but they are absent on the right (dark black), patchy opacity in the right mid-zone.

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



Left pneumothorax

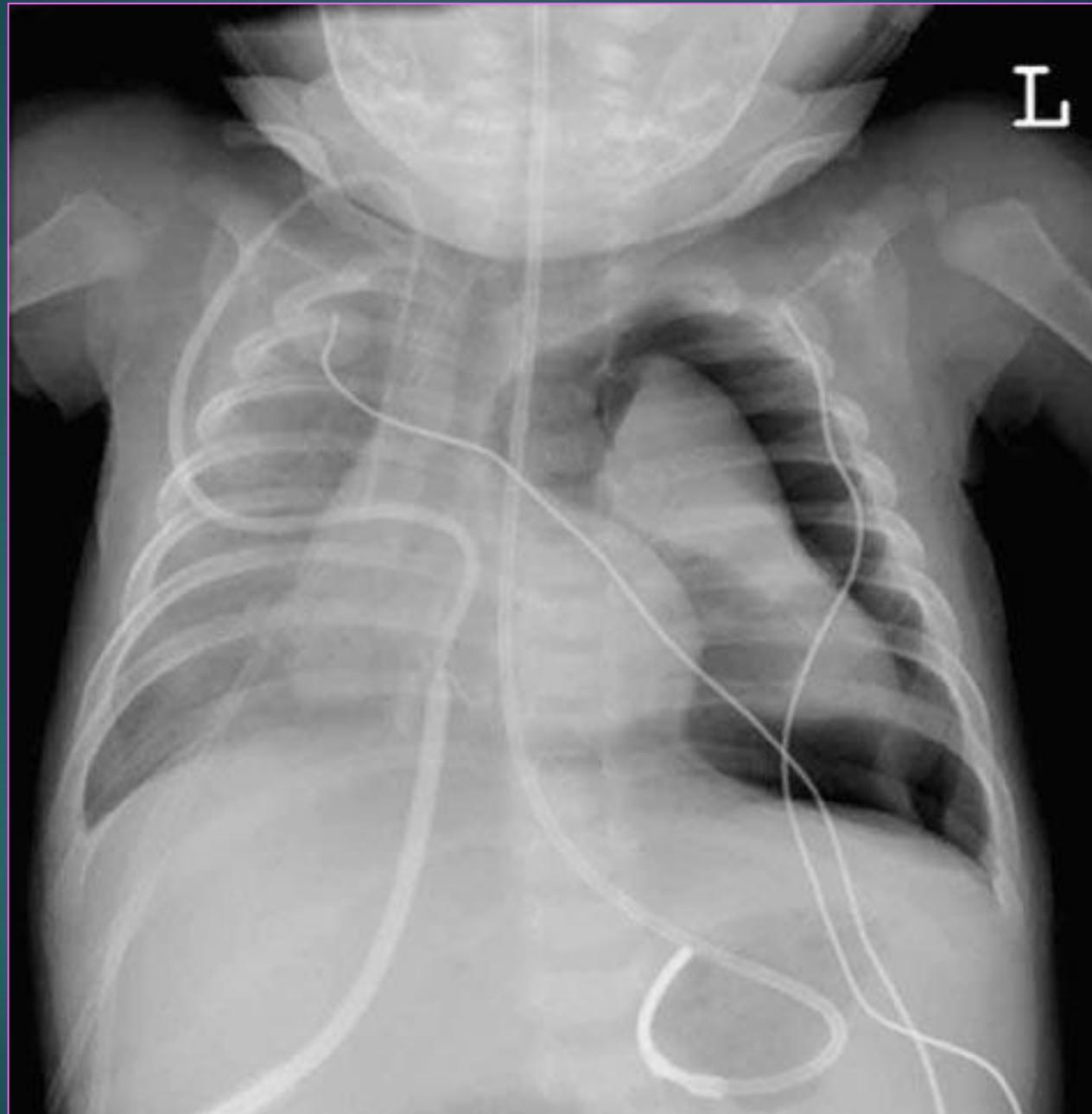


L

Boot-shaped heart =
congenital heart
disease.

Loss of lung
markings on the left
with an opacity with
no air-bronchogram
(probably the lung
itself) = collapsed left
lung with
pneumothorax.

There is a nasogastric
tube, ECG leads,
central and oxygen
line.





Hazy CXR, technical error.

Crescentic air under the diaphragm = viscous perforation.



Homogenous opacity
blunting the angle.

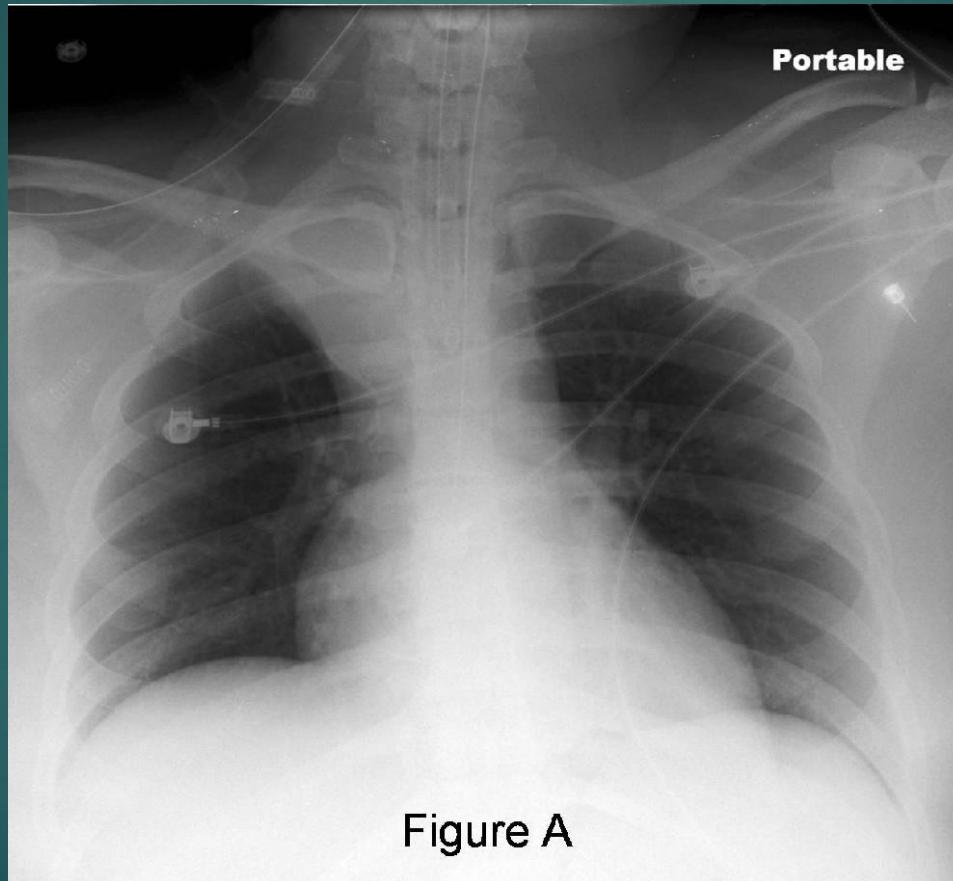
Meniscal Sign = left
pleural effusion.



Incomplete border or
Pregnant lady sign:

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

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



Hilar left lung mass



Typical CXR of Lung fibrosis showing diffuse reticular lines

