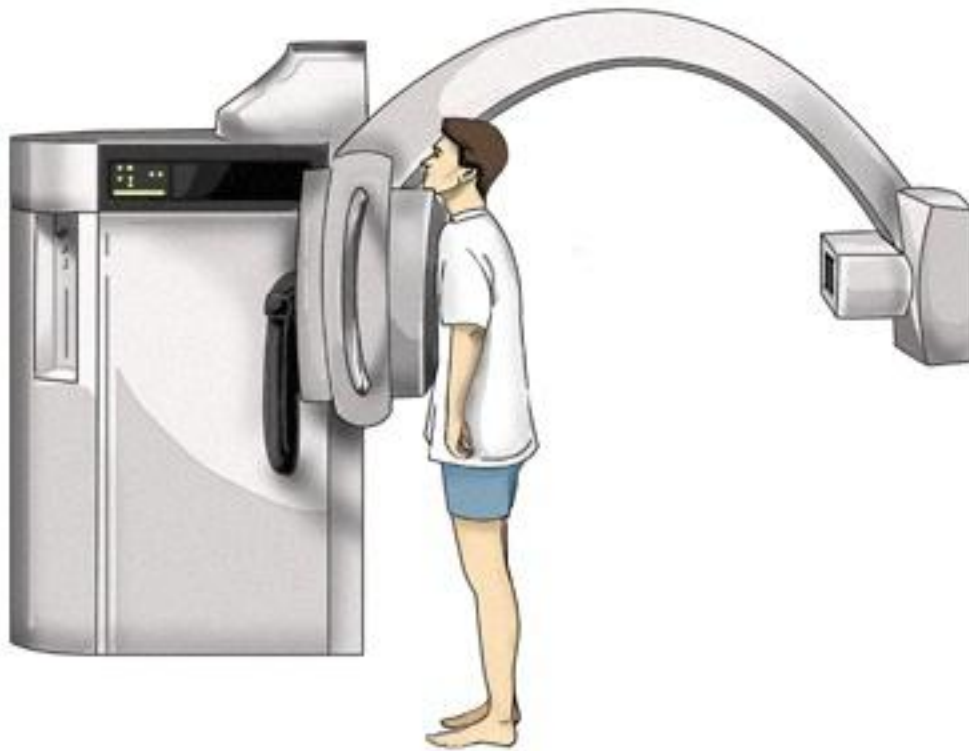


## Basic Chest X-Ray Interpretation



R. Baak, acute zorg presentatie

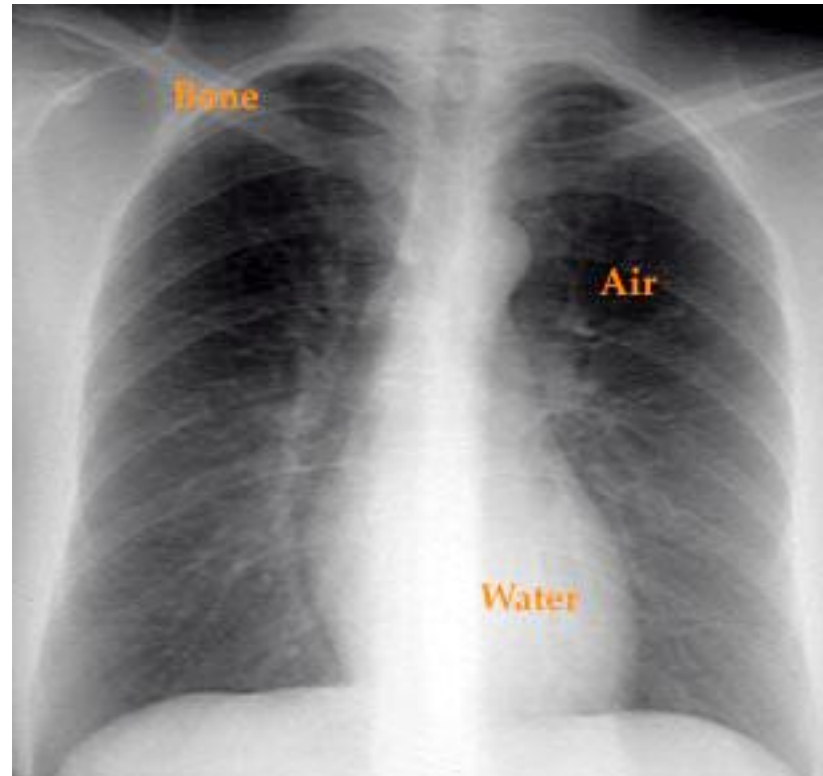
X-rays- describe radiation which is part of the spectrum which includes visible light, gamma rays and cosmic radiation.

Unlike visible light, radiation passes through stuff.

When you shine a beam of X-Ray at a person and put a film on the other side of them a shadow is produced of the inside of their body.

Different tissues in our body absorb X-rays at different extents:

- Bone- high absorption (white)
- Tissue- somewhere in the middle absorption (grey)
- Air- low absorption (black)



# Essentials Before Getting Started

- Exposure
  - Overexposure
  - Underexposure
- Sex of Patient
  - Male
  - Female



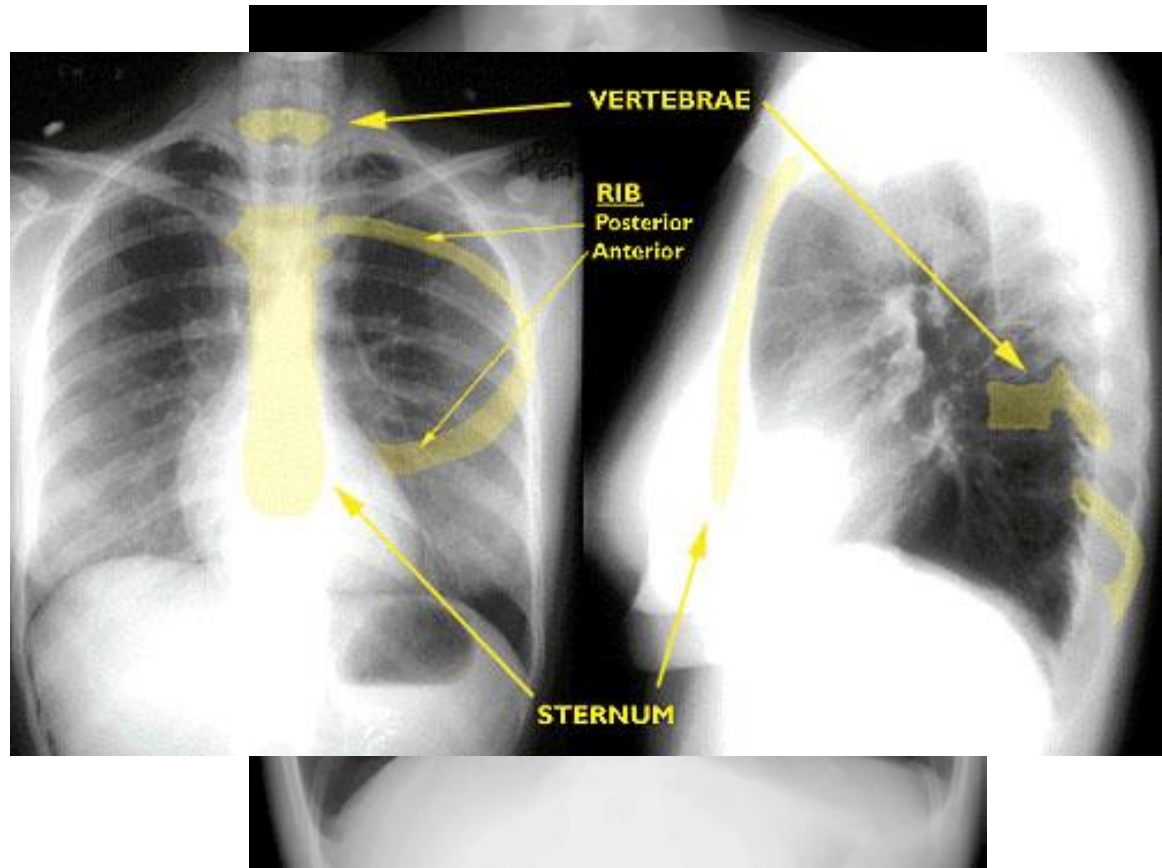
# **Be systematic**

:

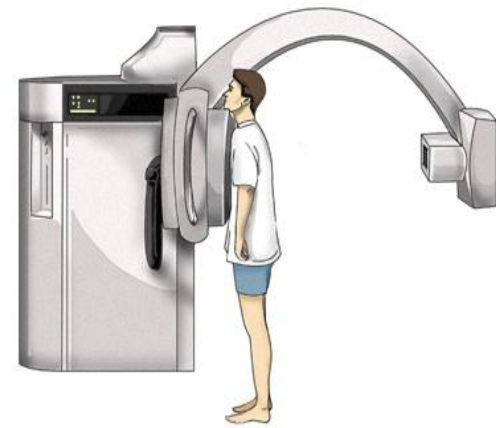
- 1) Check the quality of the film

# Systematic Approach

- Bony Fragments
  - Ribs
  - Sternum
  - Spine
  - Shoulder girdle
  - Clavicles



# Film Quality



- First determine is the film a PA or AP view.

PA- the x-rays penetrate through the back of the patient on to the film

AP-the x-rays penetrate through the front of the patient on to the film.

**All x-rays in the PICU are portable and are AP view**



# Film Quality (cont)

- Was film taken under full inspiration?
  - 10 posterior ribs should be visible.

Why do I say posterior here?

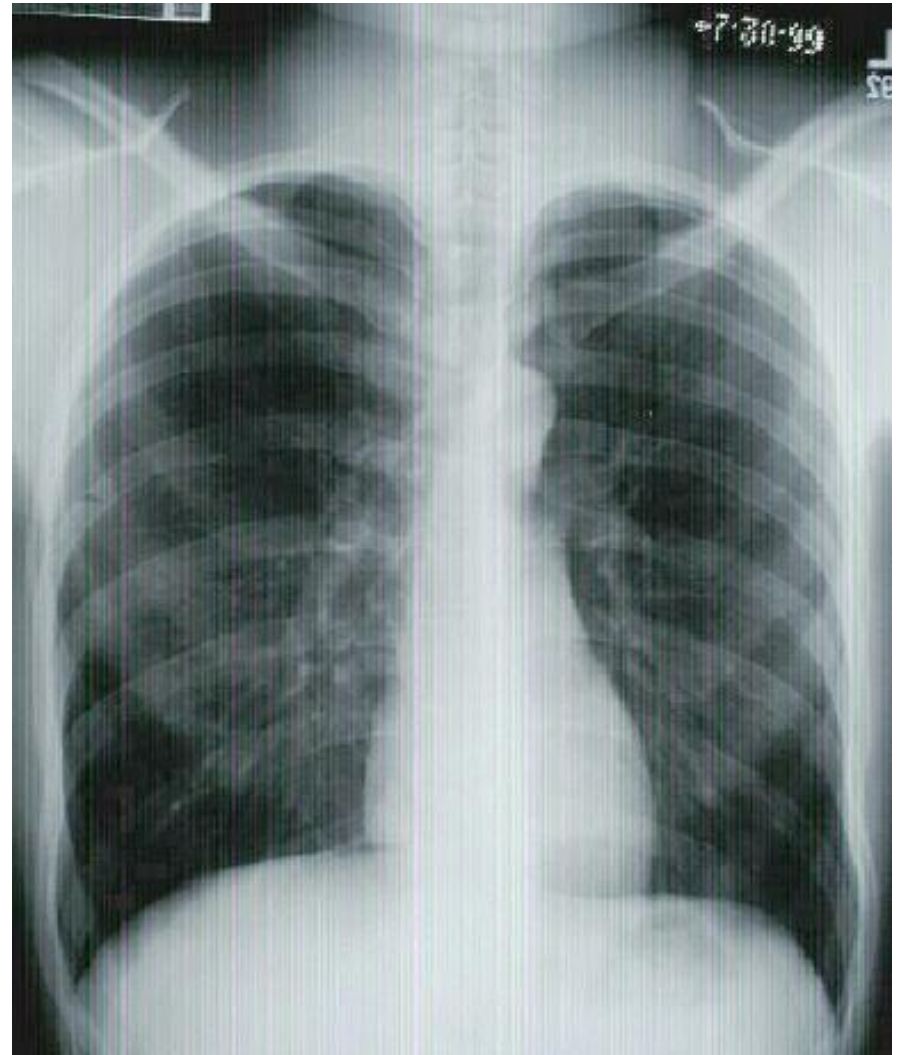
When X-ray beams pass through the anterior chest on to the film Under the patient, the ribs closer to the film (posterior) are most apparent.

A really good film will show anterior ribs too, there should Be 6 to qualify as a good inspiratory film.



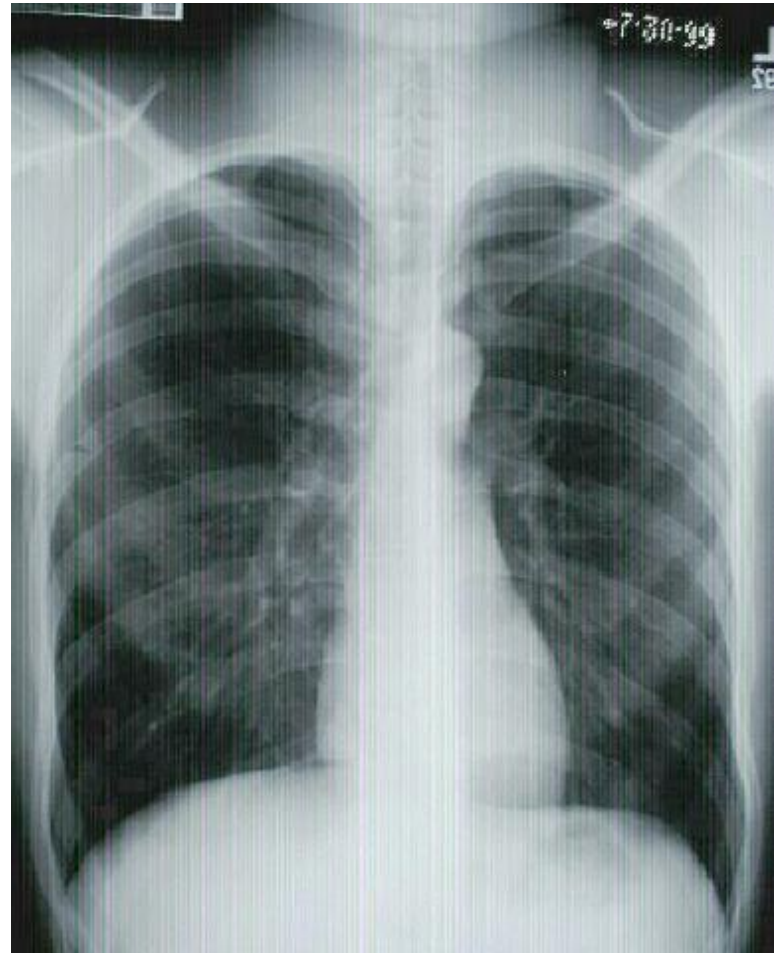
# Quality (cont.)

- Is the film over or under penetrated if under penetrated you will not be able to see the thoracic vertebrae.



# Quality (cont)

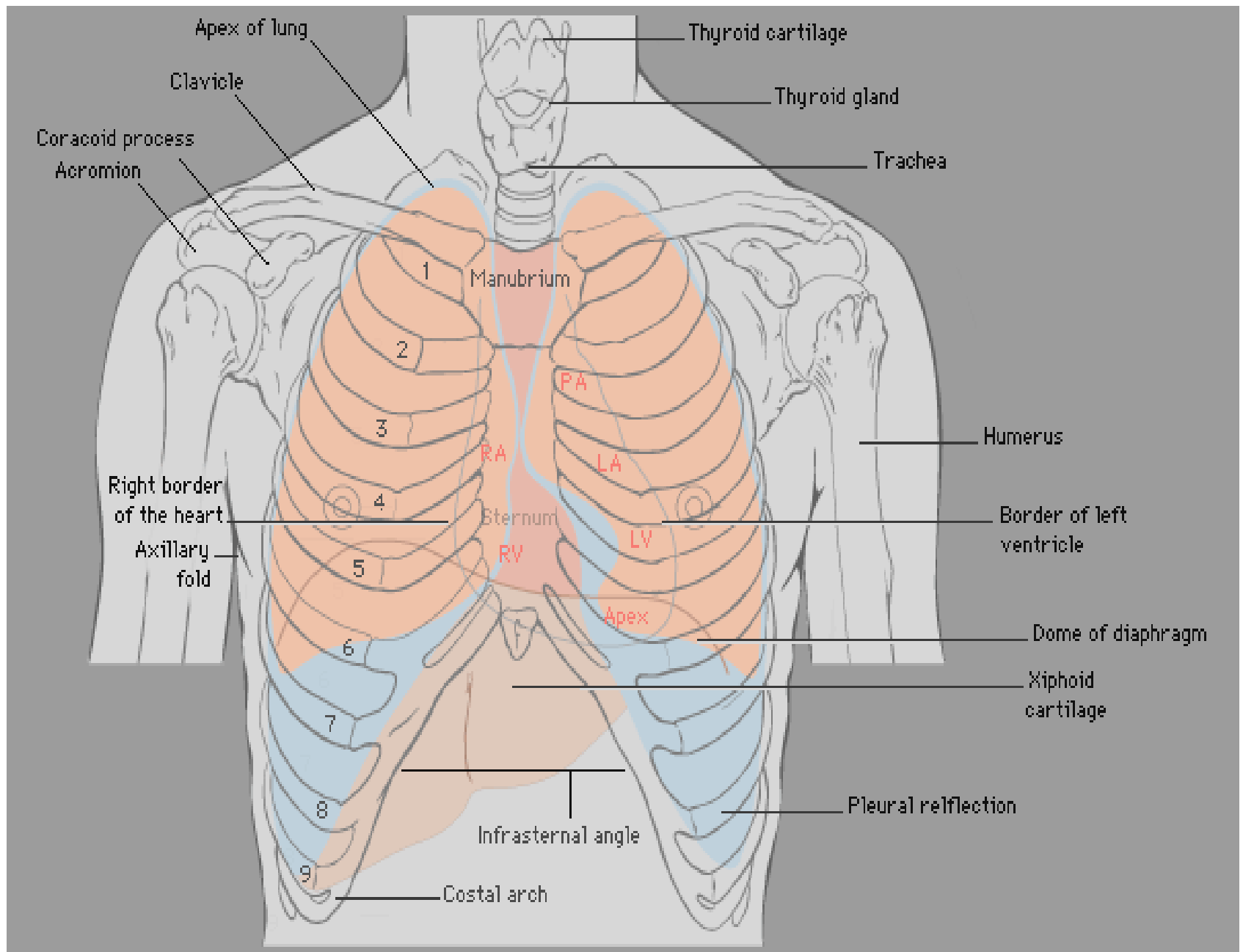
- Check for rotation
  - Does the thoracic spine align in the center of the sternum and between the clavicles?
  - Are the clavicles level?



# Verify Right and Left sides

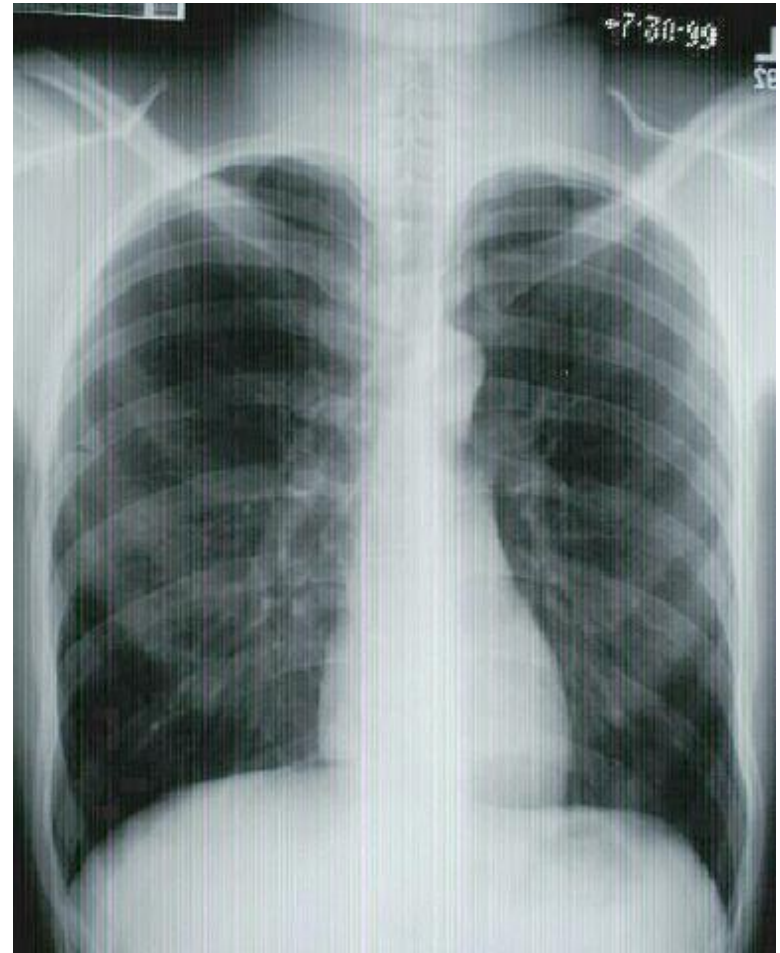
- Gastric bubble should be on the left





# Now you are ready

- Look at the diaphragm:  
for tenting  
free air  
abnormal elevation
- Margins should be sharp  
(the right hemidiaphragm is  
usually slightly higher than  
the left)





# Pitfalls to Chest X-ray Interpretation

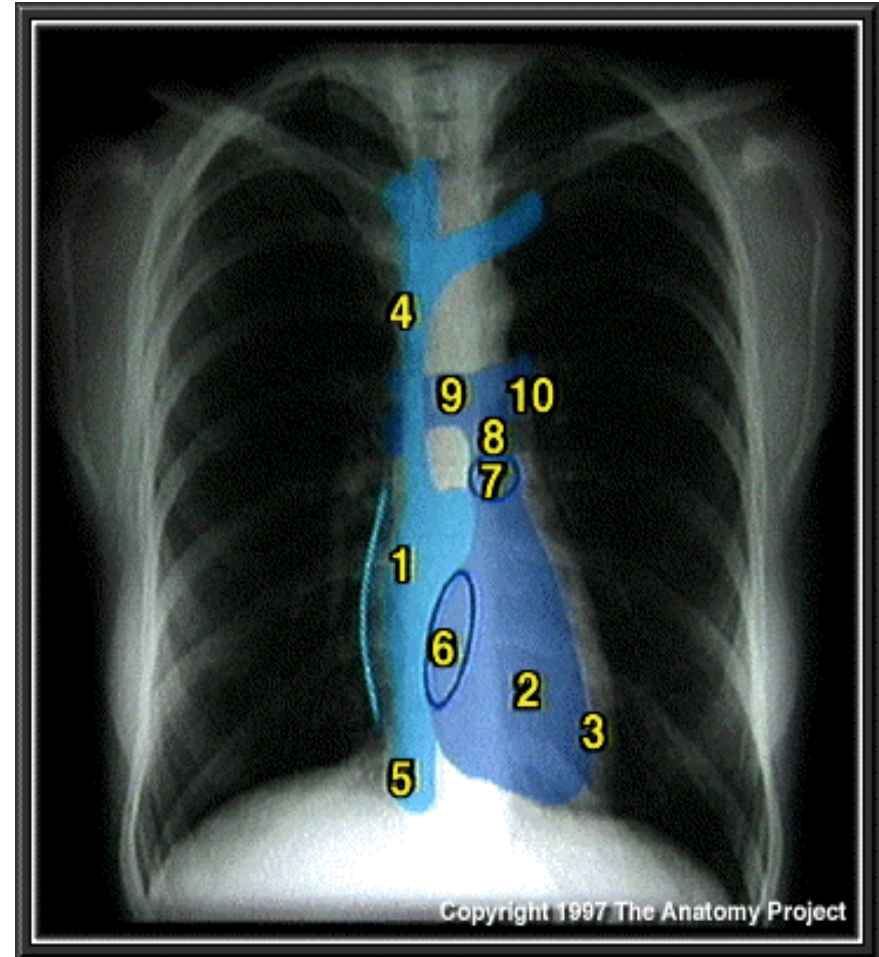
- Poor inspiration
- Over or under penetration
- Rotation
- Forgetting the path of the x-ray beam

# Check the Heart

- Size
- Shape
- Silhouette-margins should be sharp
- Diameter ( $>1/2$  thoracic diameter is enlarged heart)

Remember: AP views make heart appear larger than it actually is.

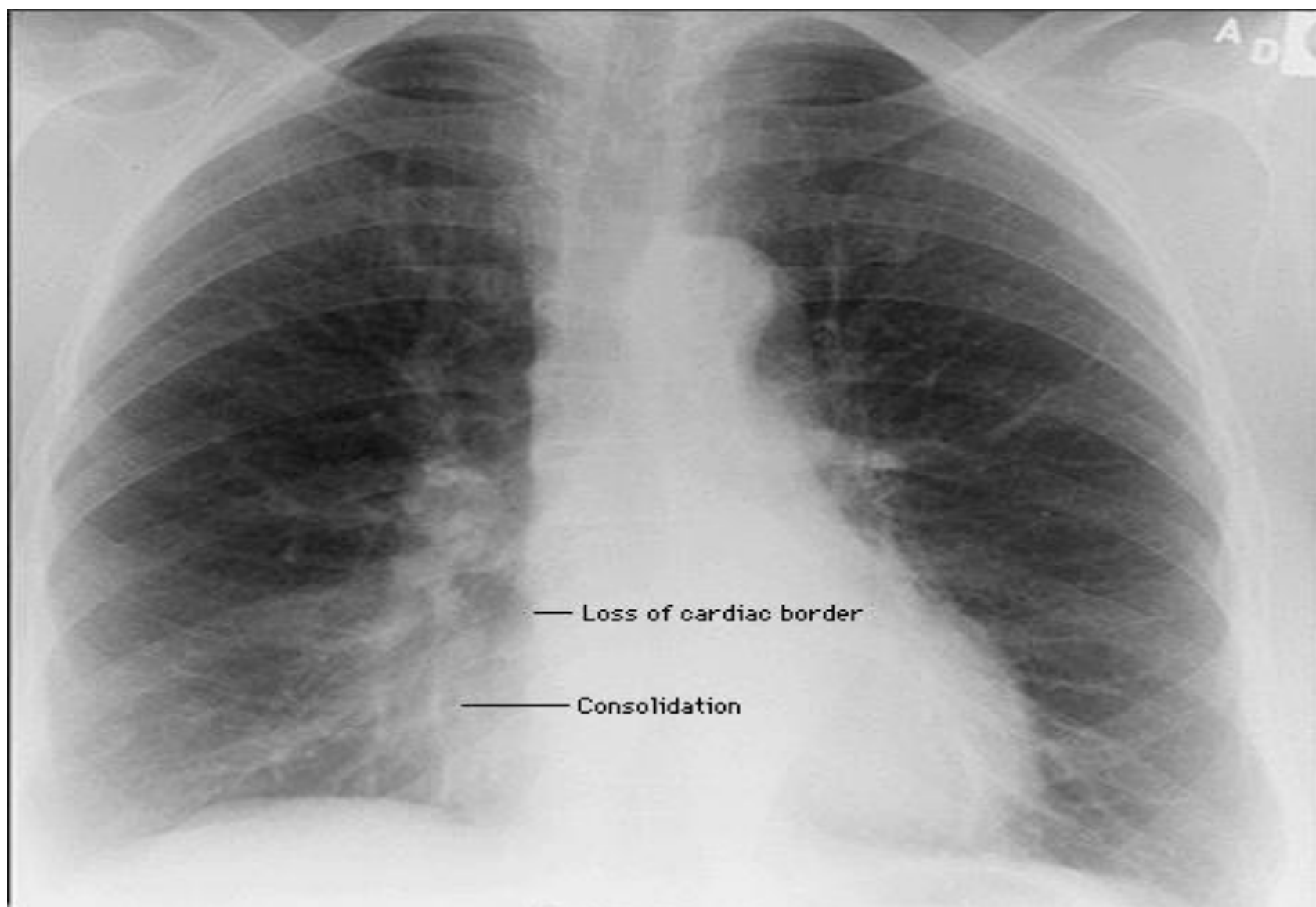
# Cardiac Silhouette

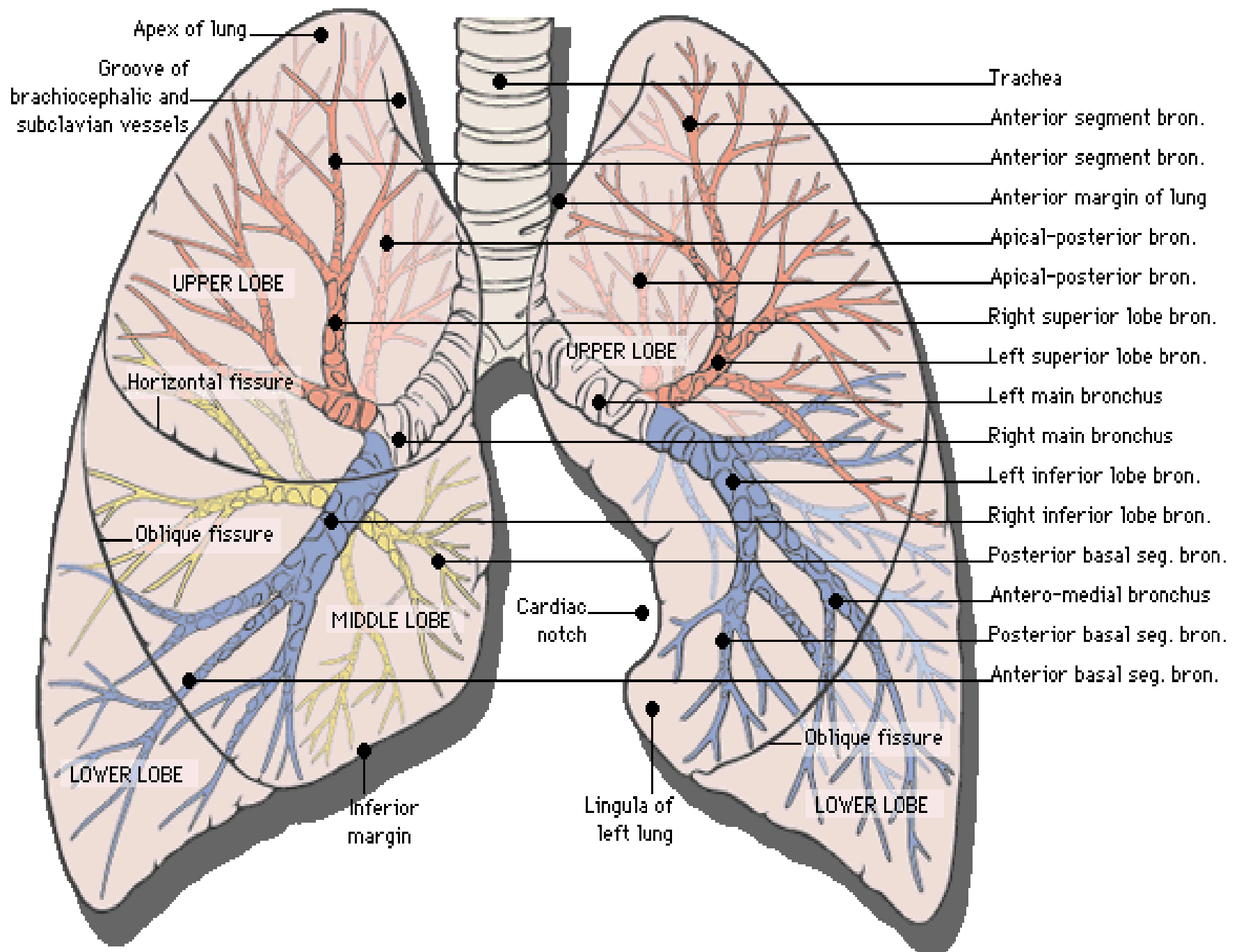


1. R Atrium
2. R Ventricle
3. Apex of L Ventricle

4. Superior Vena Cava
5. Inferior Vena Cava
6. Tricuspid Valve

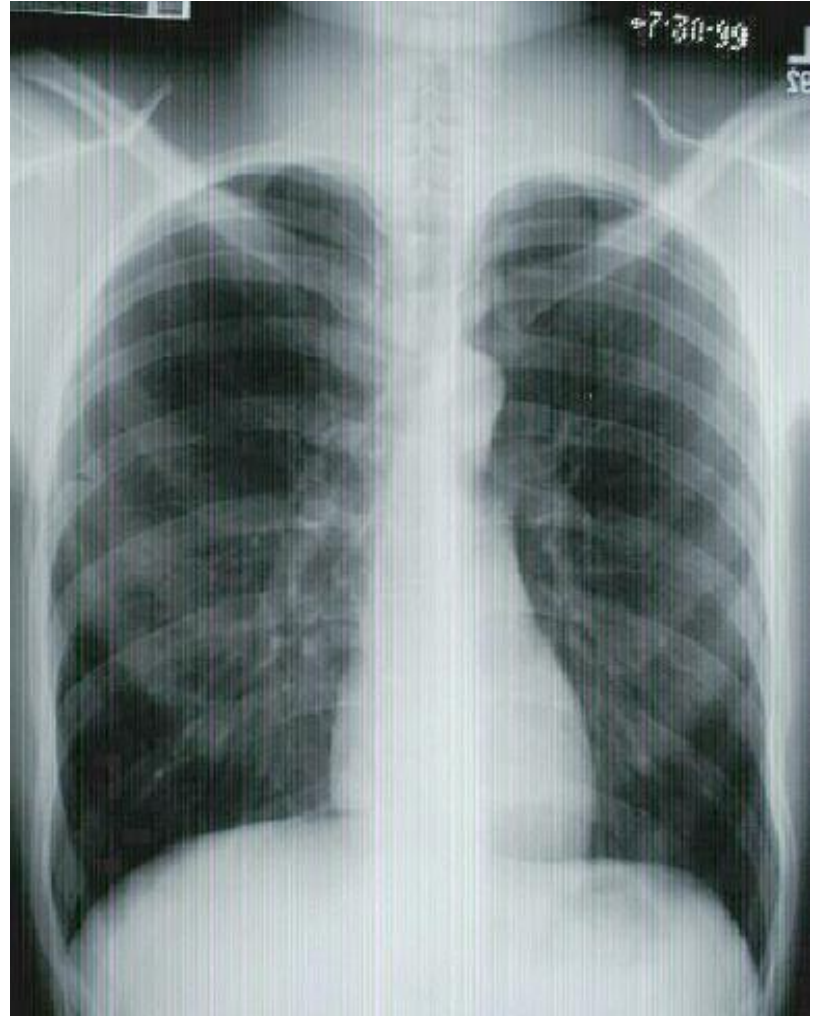
7. Pulmonary Valve
8. Pulmonary Trunk
9. R PA
10. L PA



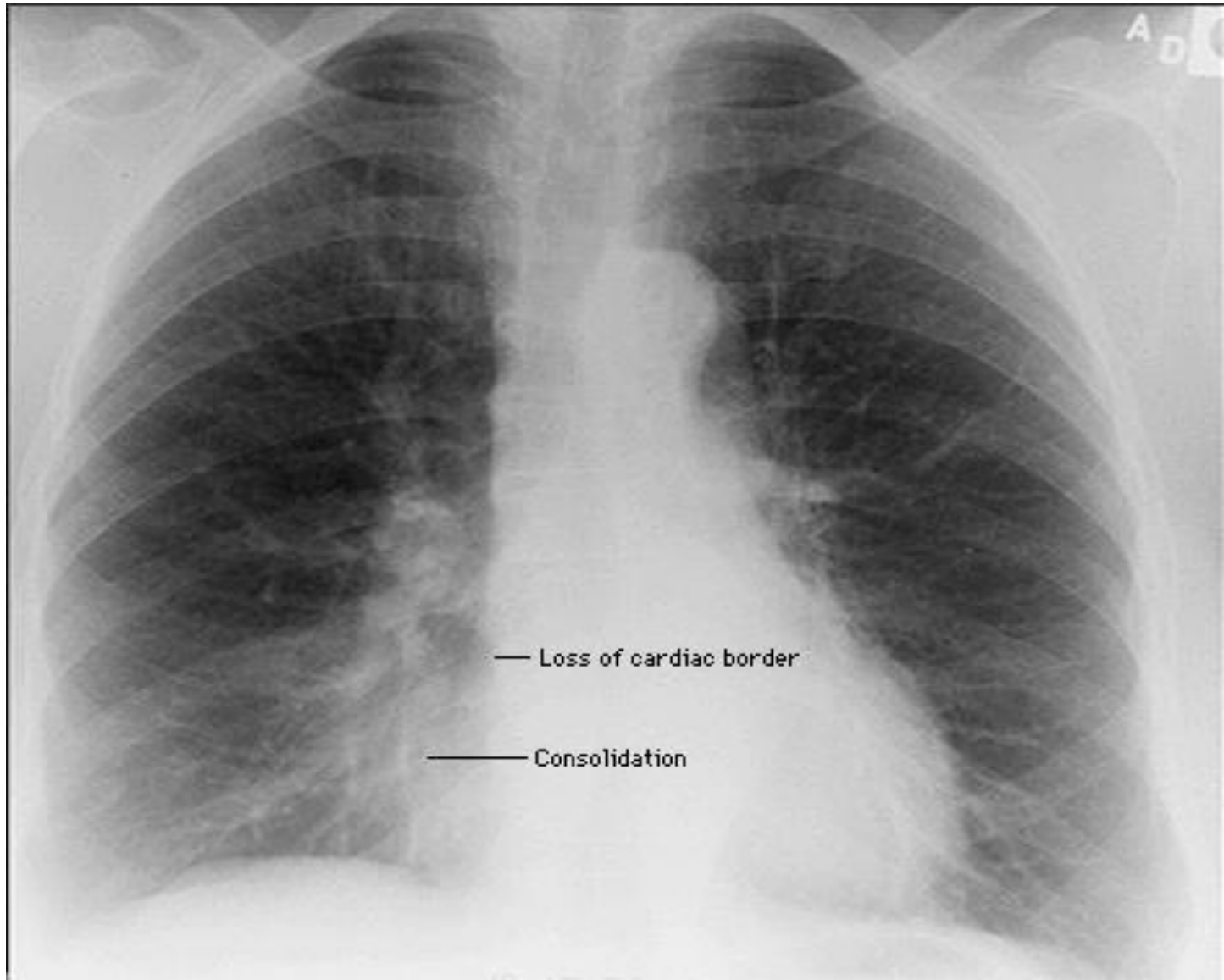


# Check the costophrenic angles

**Margins should  
be sharp**



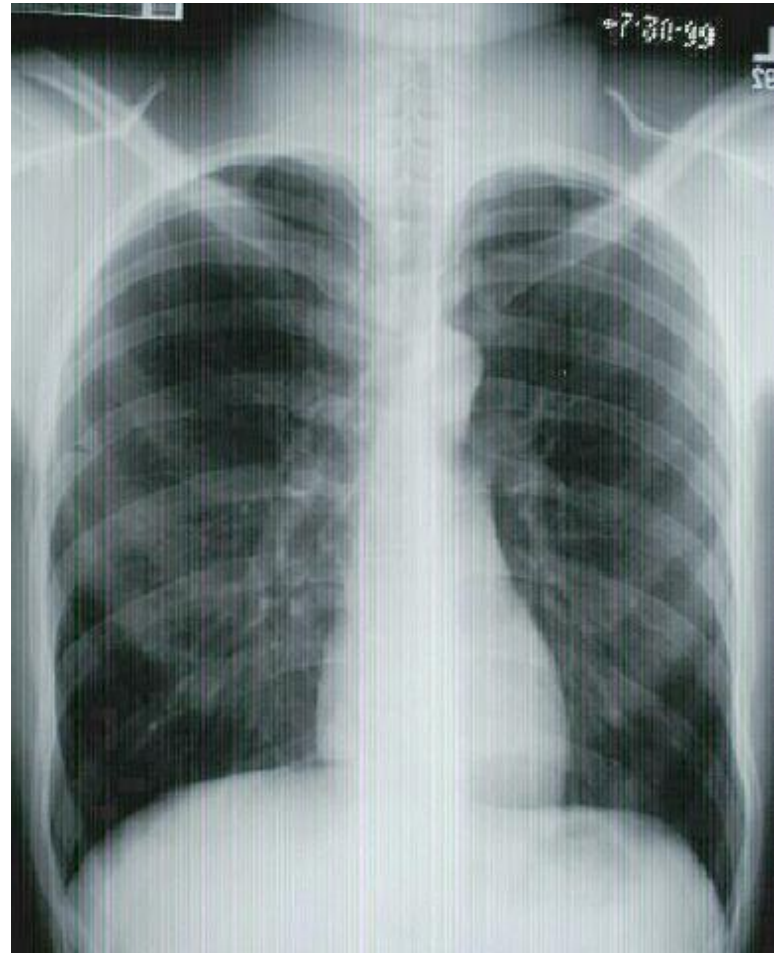
## Loss of Sharp Costophrenic Angles



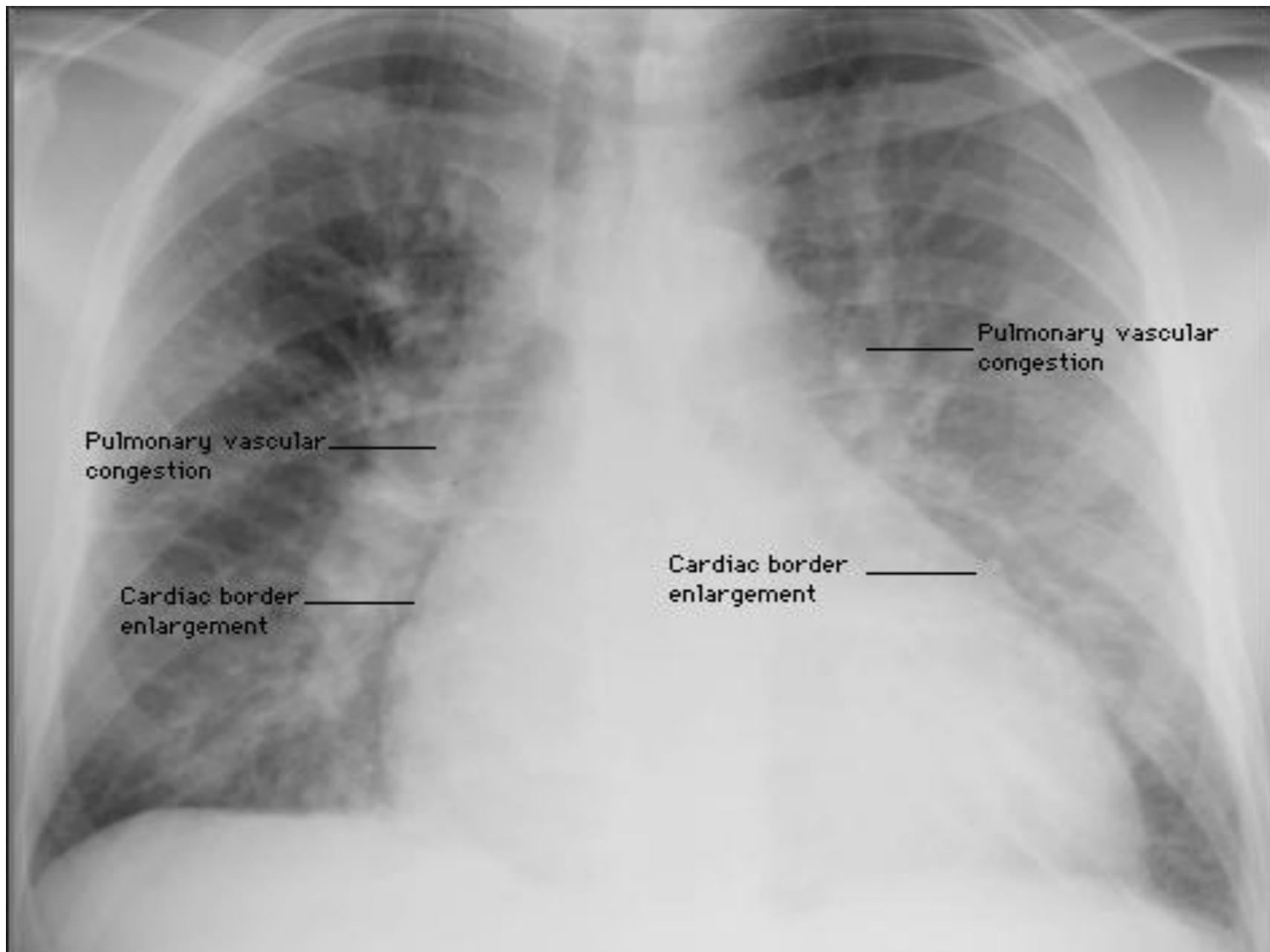


# Check the hilar region

- The hilar – the large blood vessels going to and from the lung at the root of each lung where it meets the heart.
- Check for size and shape of aorta, nodes, enlarged vessels





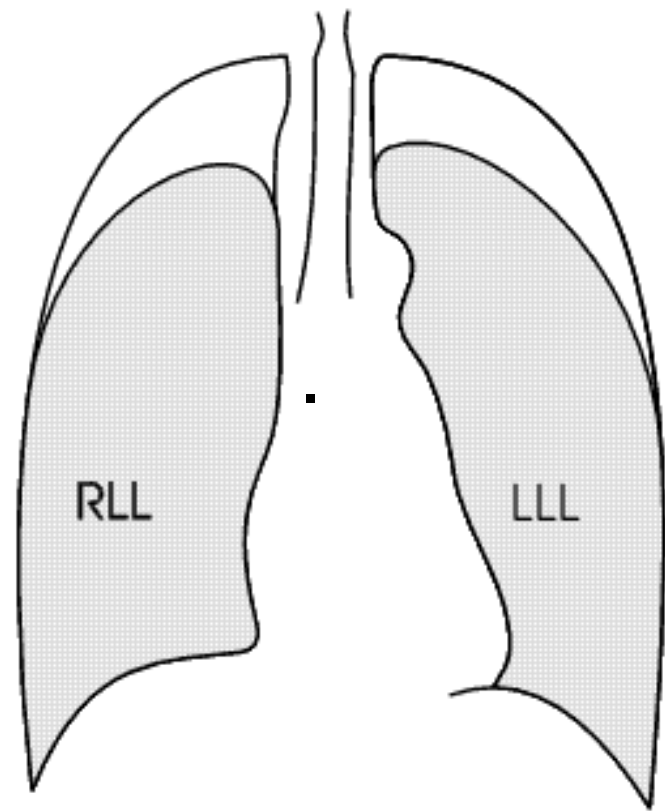


# Finally, Check the Lung Fields

- Infiltrates
- Increased interstitial markings
- Masses
- Absence of normal margins
- Air bronchograms
- Increased vascularity

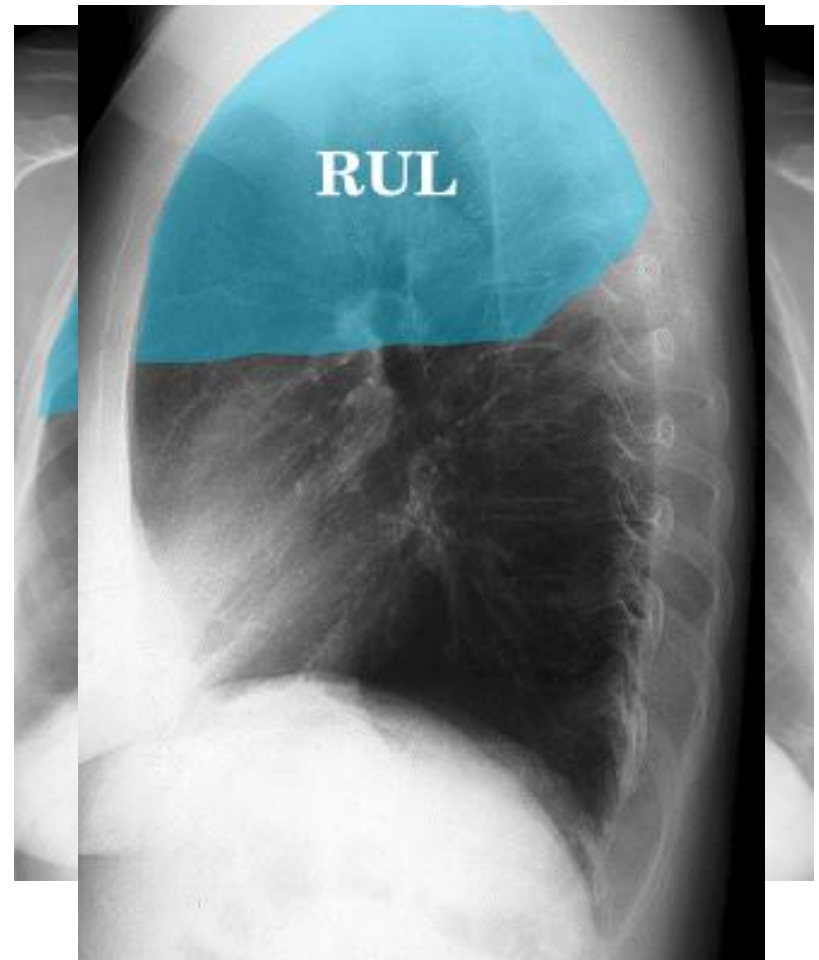
# Lung Anatomy on Chest X-ray

- PA View:
  - Extensive overlap
  - Lower lobes extend high
- Lateral View:
  - Extent of lower lobes



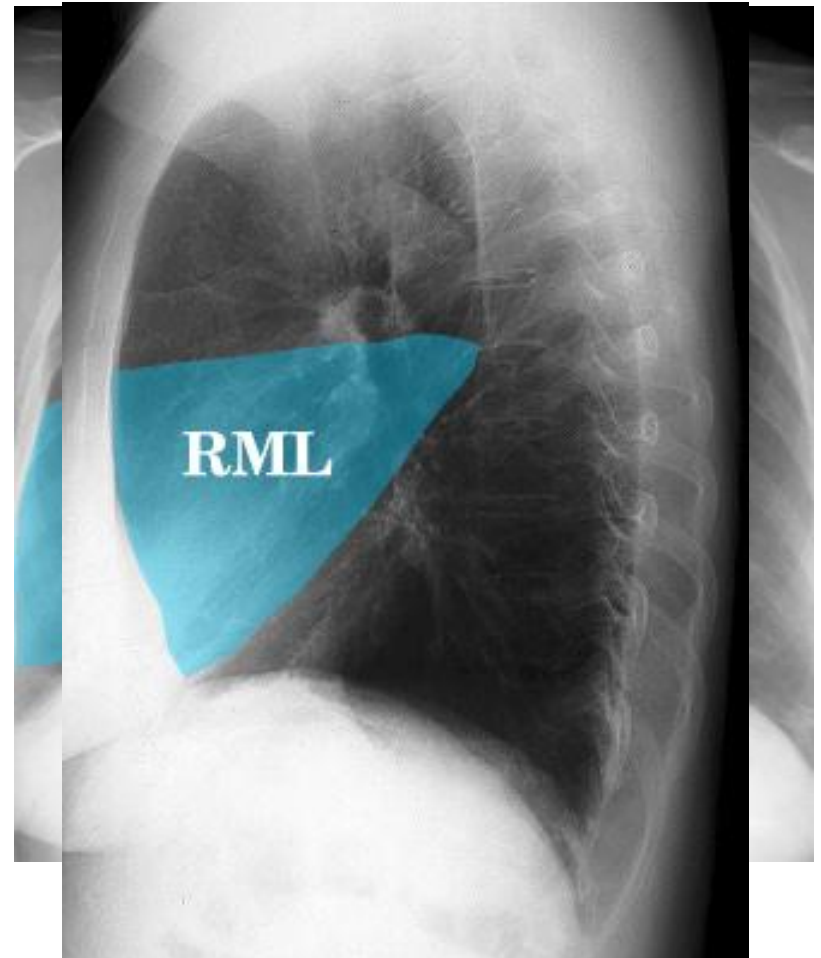
# Lung Anatomy on Chest X-ray

- The right upper lobe (RUL) occupies the upper 1/3 of the right lung.
- Posteriorly, the RUL is adjacent to the first three to five ribs.
- Anteriorly, the RUL extends inferiorly as far as the 4th right anterior rib



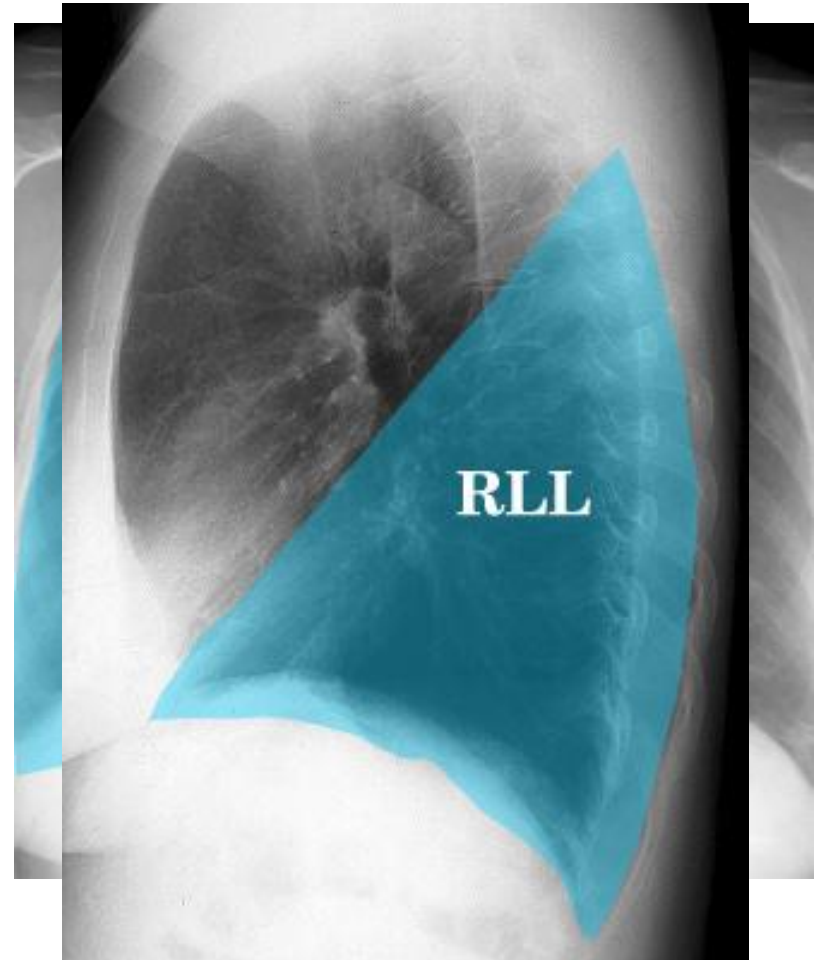
# Lung Anatomy on Chest X-ray

- The right middle lobe is typically the smallest of the three, and appears triangular in shape, being narrowest near the hilum



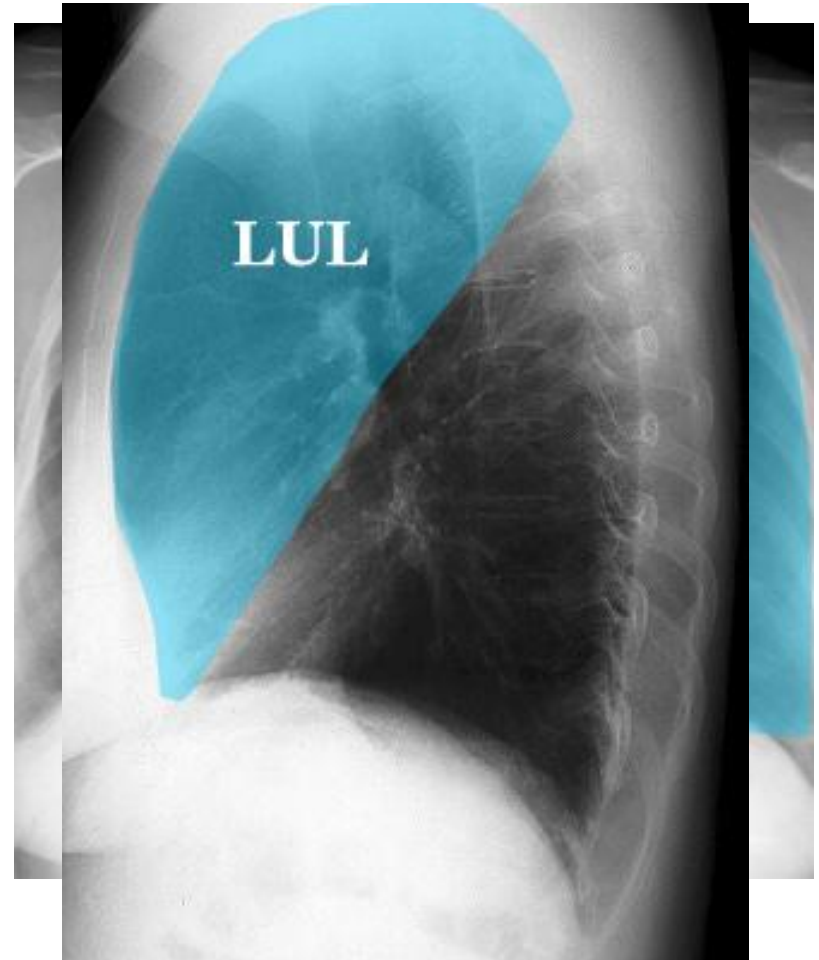
# Lung Anatomy on Chest X-ray

- The right lower lobe is the largest of all three lobes, separated from the others by the major fissure.
- Posteriorly, the RLL extend as far superiorly as the 6th thoracic vertebral body, and extends inferiorly to the diaphragm.
- Review of the lateral plain film surprisingly shows the superior extent of the RLL.



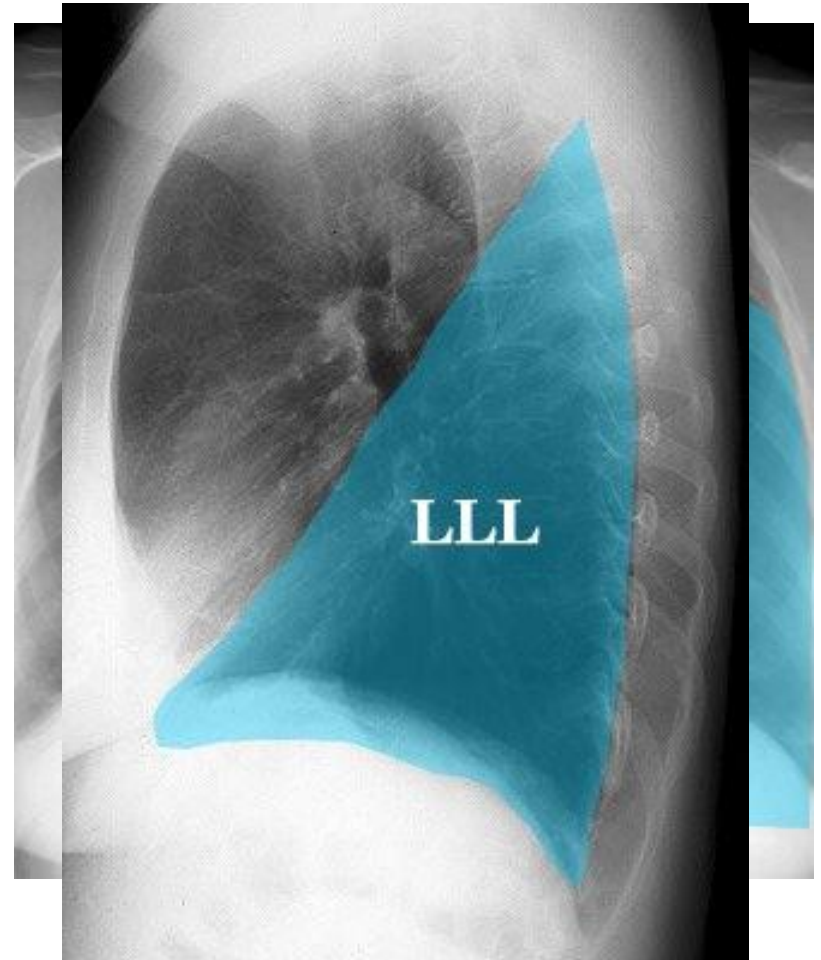
# Lung Anatomy on Chest X-ray

- The lobar architecture of the left lung is slightly different than the right.
- Because there is no defined left minor fissure, there are only two lobes on the left; the left upper



# Lung Anatomy on Chest X-ray

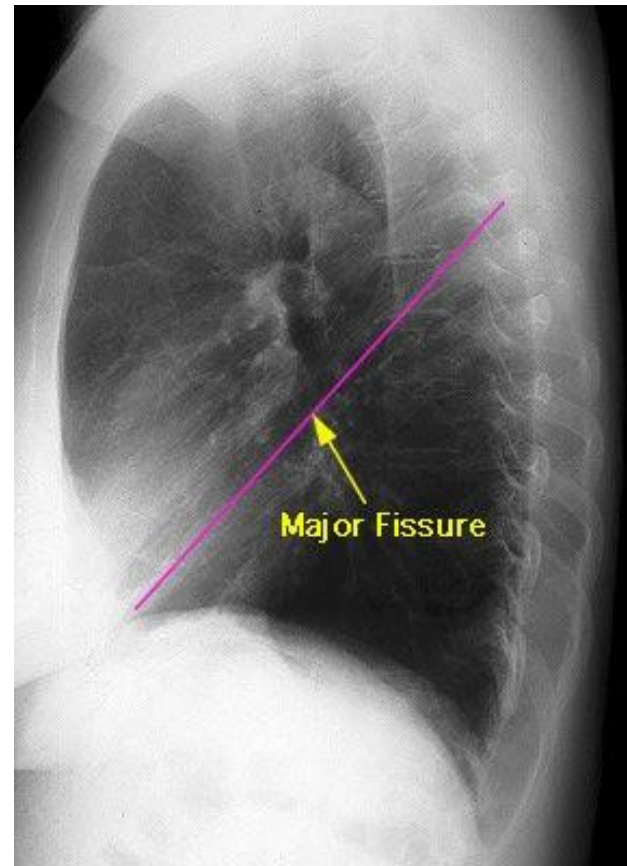
- Left lower lobes





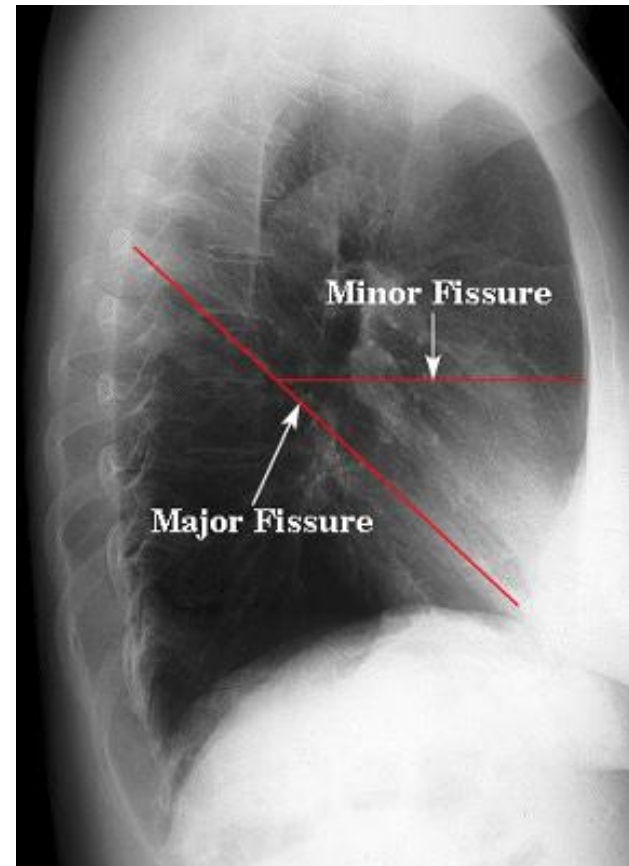
# Lung Anatomy on Chest X-ray

- These two lobes are separated by a major fissure, identical to that seen on the right side, although often slightly more inferior in location.
- The portion of the left lung that corresponds anatomically to the right middle lobe is incorporated into the left upper lobe.



# Lung Anatomy on Chest X-ray

- These lobes can be separated from one another by two fissures.
- The minor fissure separates the RUL from the RML, and thus represents the visceral pleural surfaces of both of these lobes.
- Oriented obliquely, the major fissure extends posteriorly and superiorly approximately to the level of the fourth vertebral body.



# Describing Abnormal Findings on a Chest Radiograph

- When addressing an abnormal finding on a chest radiograph, only a description of what is seen, rather than a diagnosis, should be presented (a chest radiograph alone is not diagnostic, but is only one piece of descriptive information used to formulate a diagnosis)
- Descriptive words such as shadows, density, or patchiness, should be used to discuss the findings

# Liquid Density

Liquid density		Increased air density
Generalized	Localized	
Diffuse alveolar Diffuse interstitial Mixed Vascular	Infiltrate Consolidation Cavitation Mass Congestion Atelectasis	Localized airway obstruction Diffuse airway obstruction Emphysema Bulla

# Common Abnormal Findings on Chest Radiographs

# Silhouette Sign

- The loss of the lung/soft tissue interface due to the presence of fluid in the normally air-filled lung
- If an intrathoracic opacity is in anatomic contact with a border, then the opacity will obscure that border
- Commonly seen with the borders of the heart, aorta, chest wall, and diaphragm



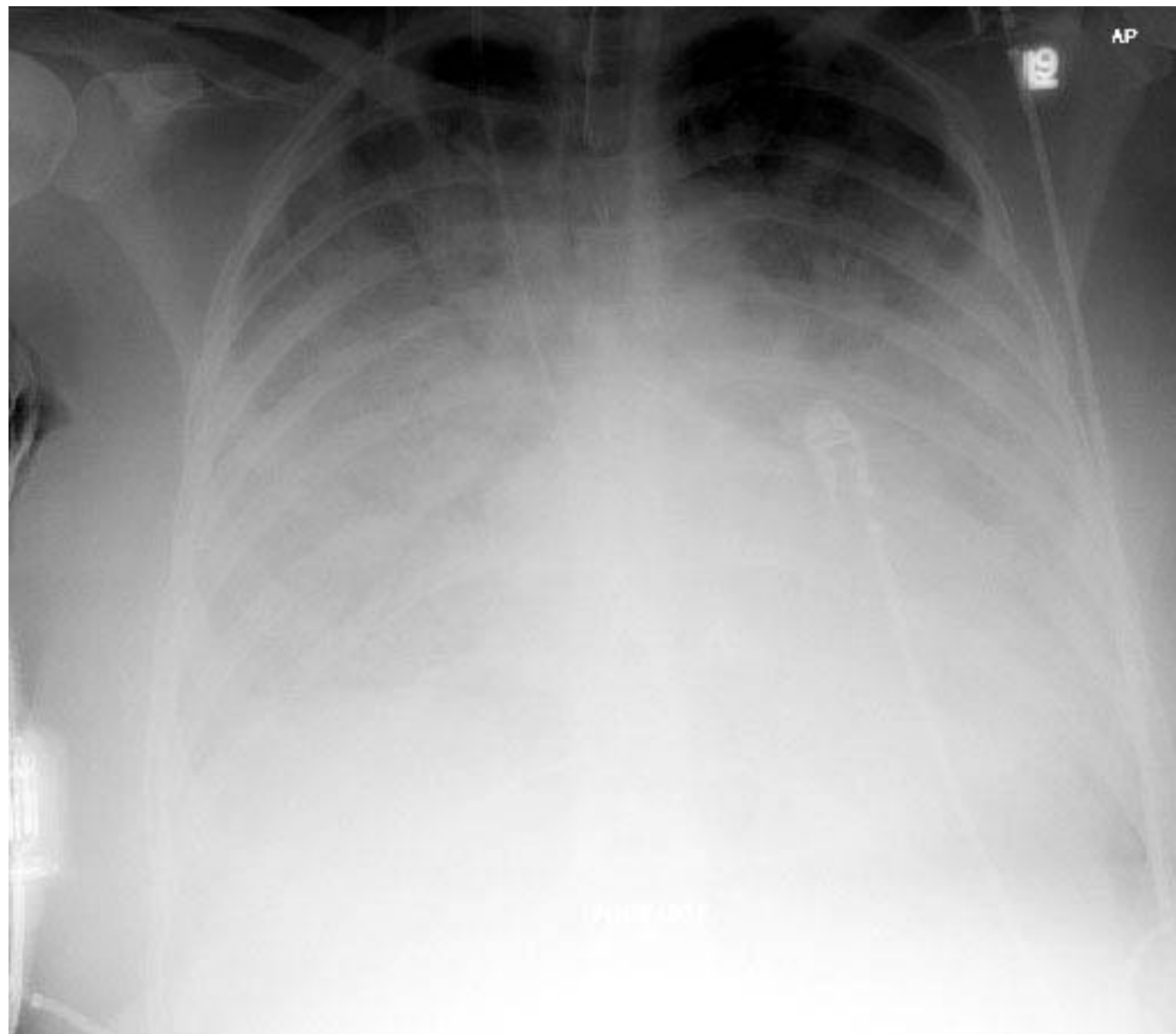
# Air Bronchogram

A tubular outline of an airway made visible due to the filling of the surrounding alveoli by fluid or inflammatory exudates

Conditions in which air bronchograms are seen:

- Lung consolidation
- Pulmonary edema
- Non-obstructive pulmonary atelectasis
- Interstitial disease
- Neoplasm
- Normal expiration





# Consolidation

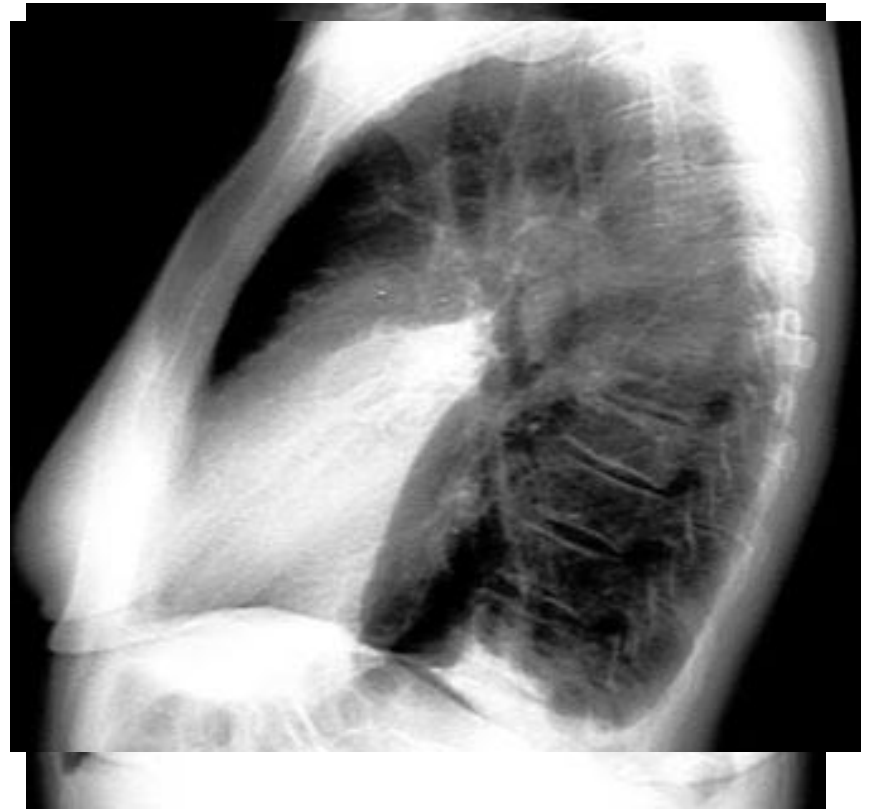
The lung is said to be consolidated when the alveoli and small airways are filled with dense material.

This dense material may consist of:

- Pus (pneumonia)
- Fluid (pulmonary edema)
- Blood (pulmonary hemorrhage)
- Cells (cancer)

# Consolidation

- Lobar consolidation:
  - Alveolar space filled with inflammatory exudate
  - Interstitium and architecture remain intact
  - The airway is patent
  - Radiologically:
    - A density corresponding to a segment or lobe
    - Airbronchogram, and
    - No significant loss of lung volume



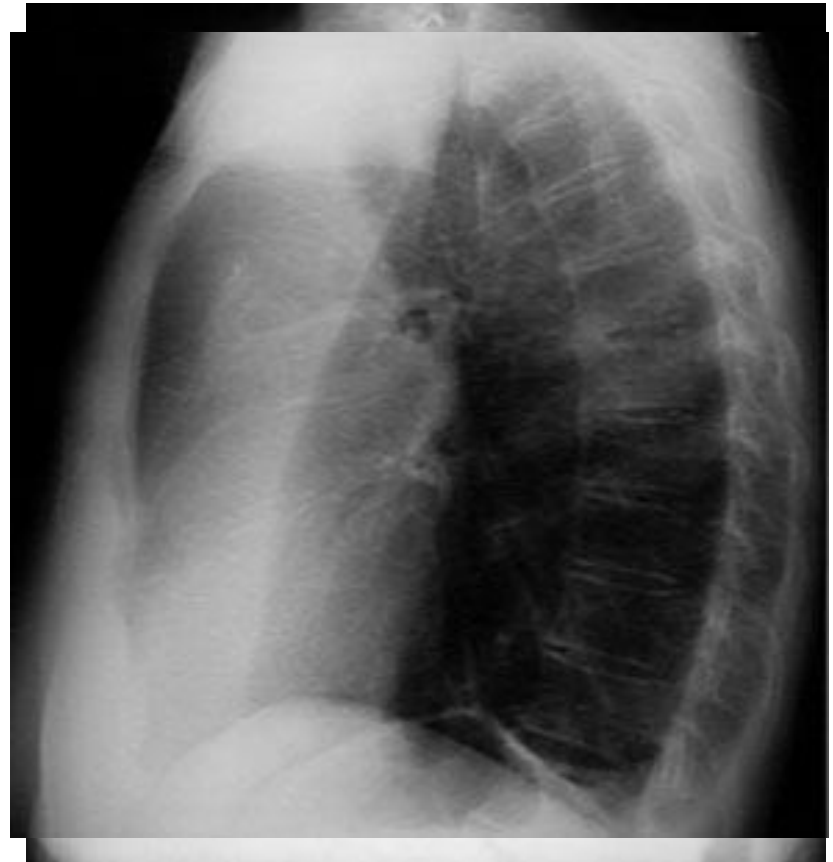


# Atelectasis

- Almost always associated with a linear increased density due to volume loss
- Indirect indications of volume loss include vascular crowding or mediastinal shift toward the collapse
- Possible observance of hilar elevation with an upper lobe collapse, or a hilar depression with a lower lobe collapse

# Atelectasis

- Loss of air
- Obstructive atelectasis:
  - No ventilation to the lobe beyond obstruction
  - Radiologically:
    - Density corresponding to a segment or lobe
    - Significant loss of volume
    - Compensatory hyperinflation of normal lungs





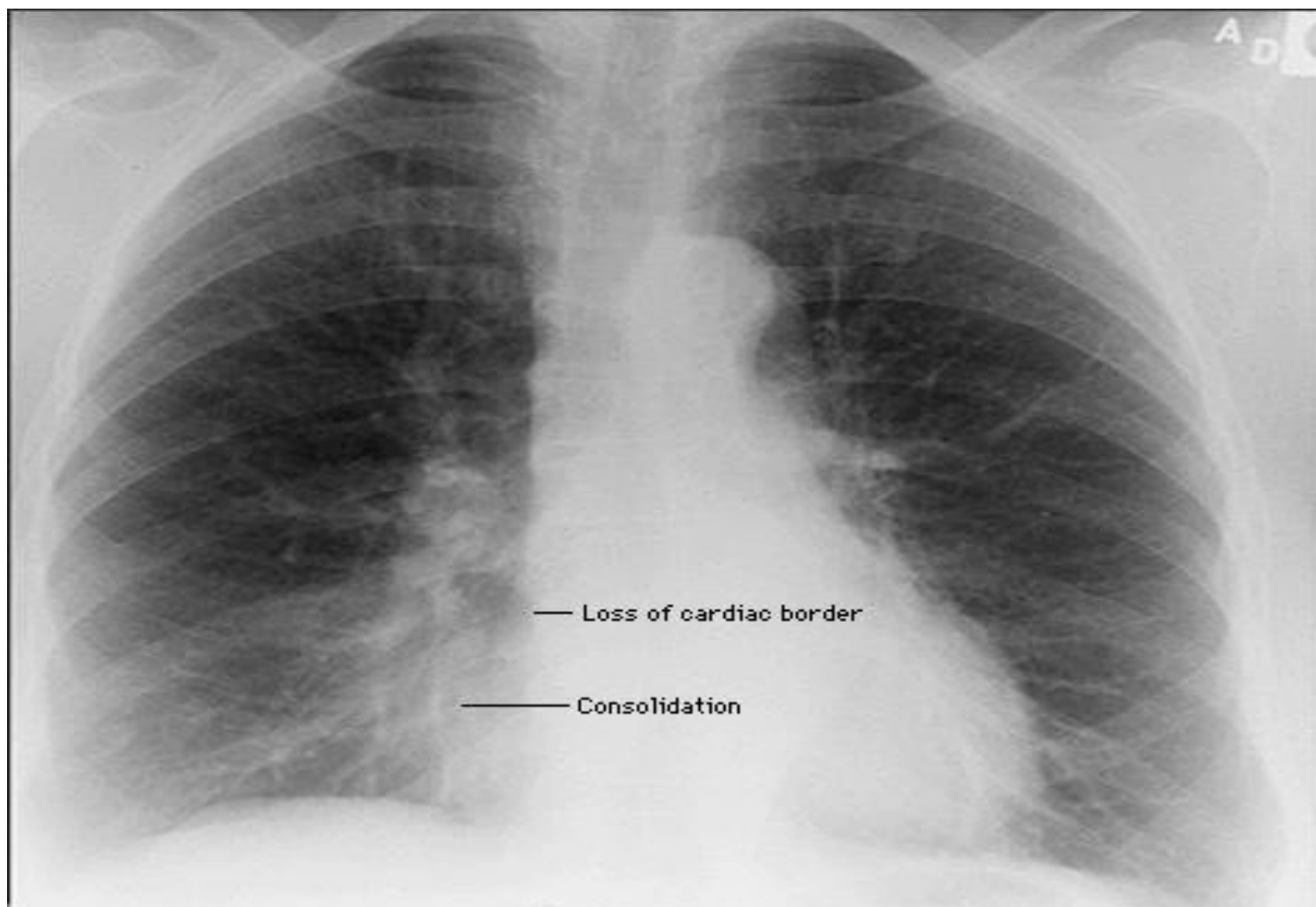




# Pneumonia

Typical findings on the chest radiograph include:

- Airspace opacity
- Lobar consolidation
- Interstitial opacities

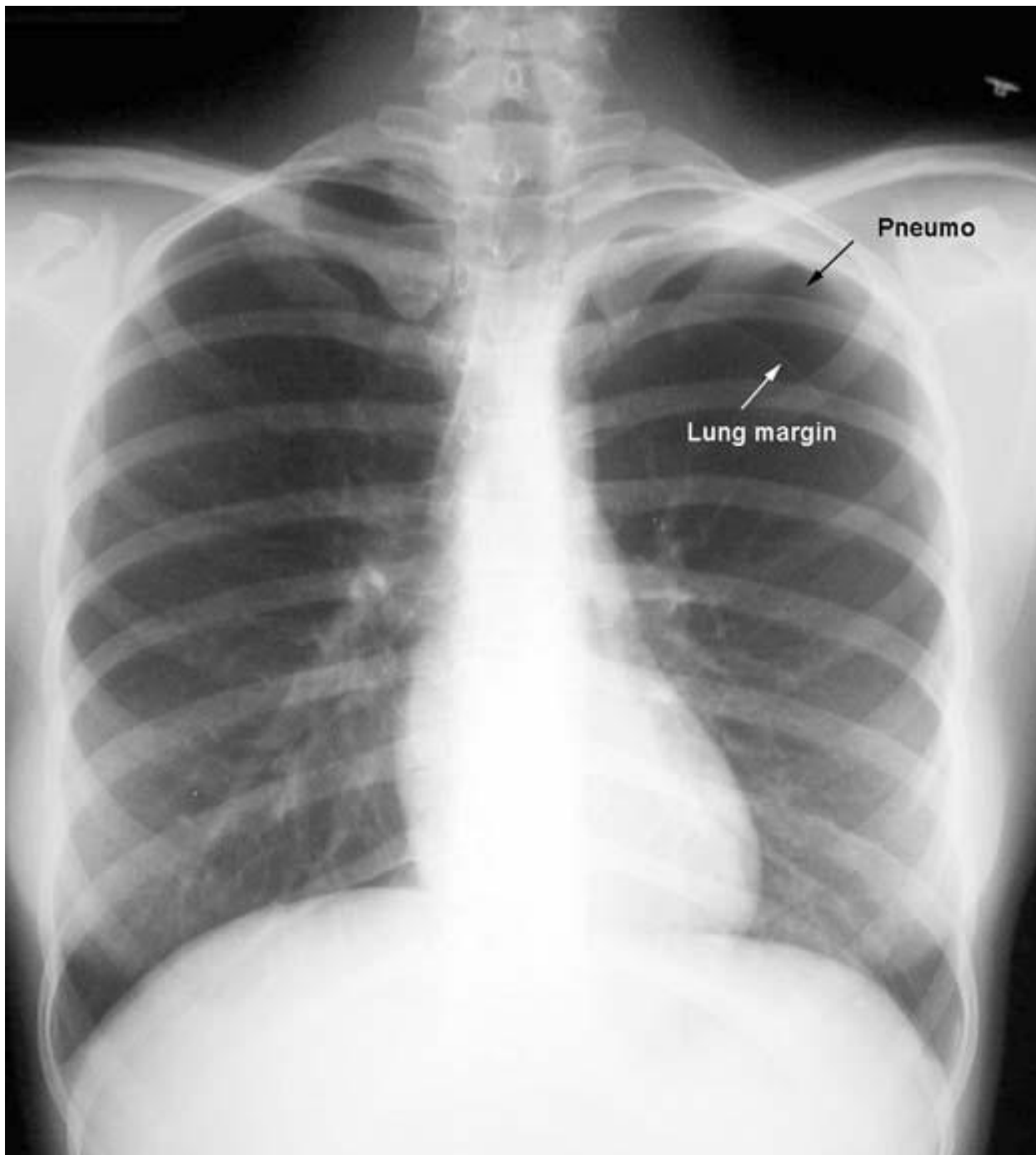


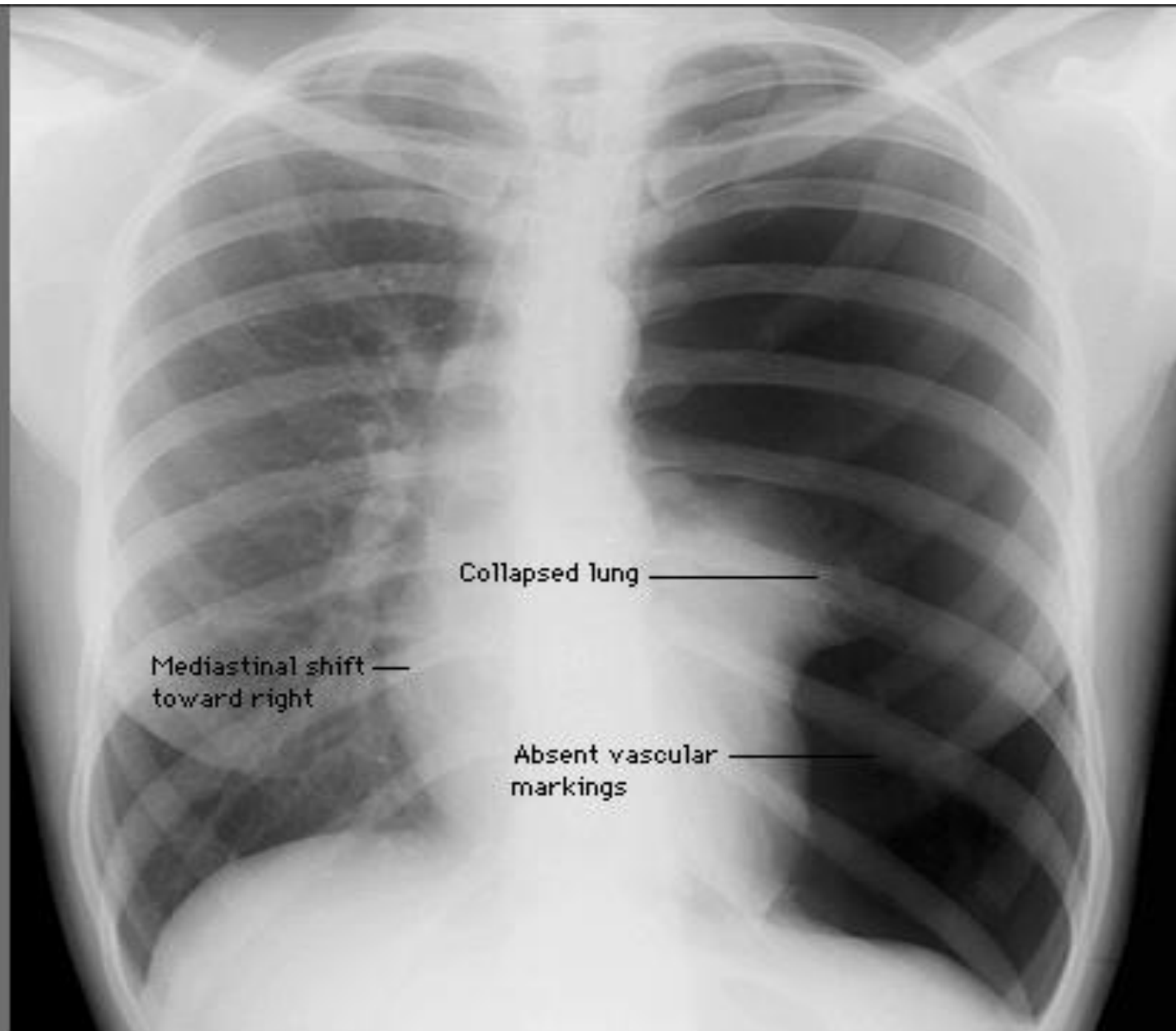




# Pneumothorax

- Appears in the chest radiograph as air without lung markings
- In a PA film it is usually seen in the apices since the air rises to the least dependent part of the chest
- The air is typically found peripheral to the white line of the visceral pleura
- Best demonstrated by an expiration film





Collapsed lung

Mediastinal shift  
toward right

Absent vascular  
markings

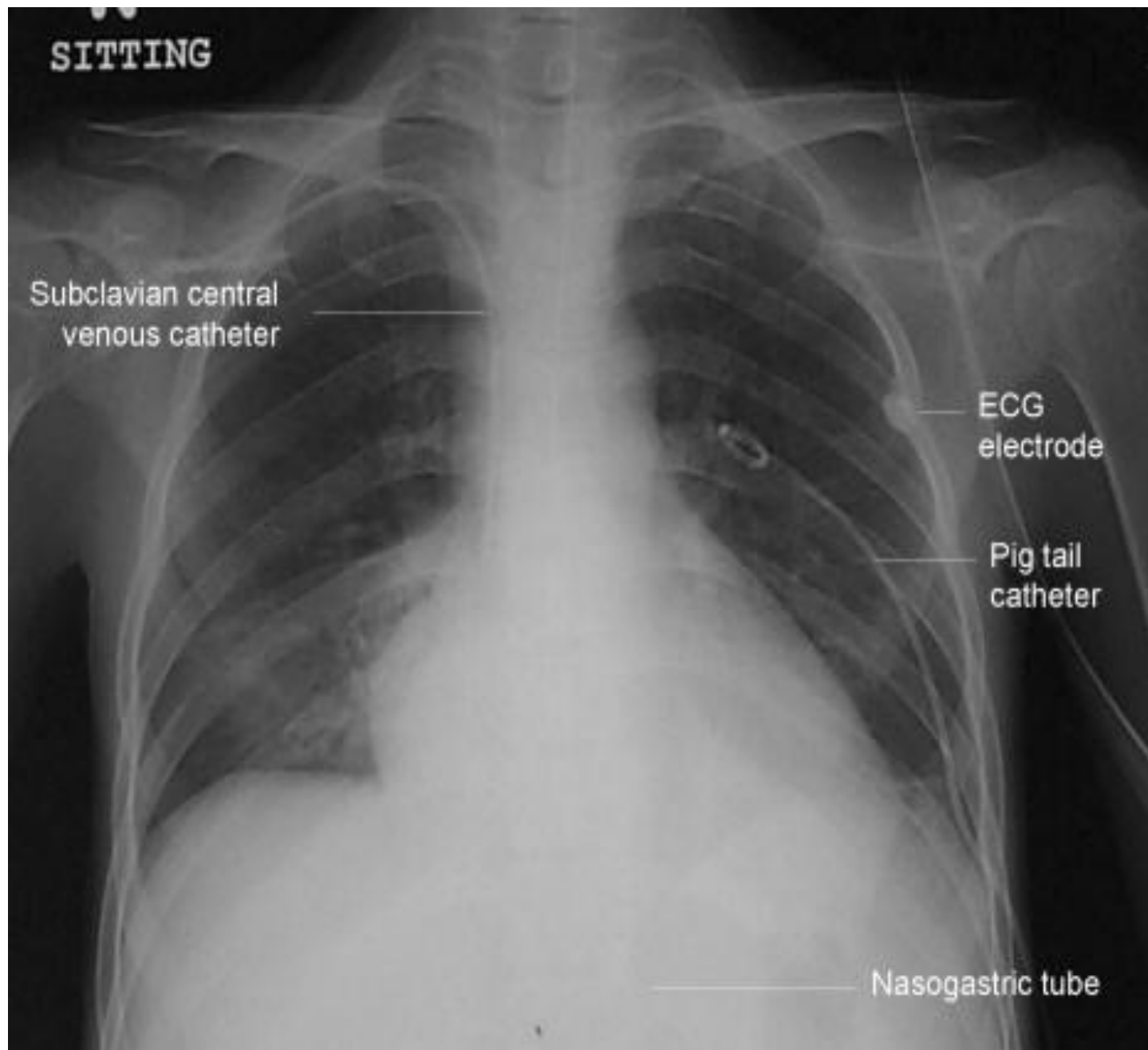
**SITTING**

Subclavian central  
venous catheter

ECG  
electrode

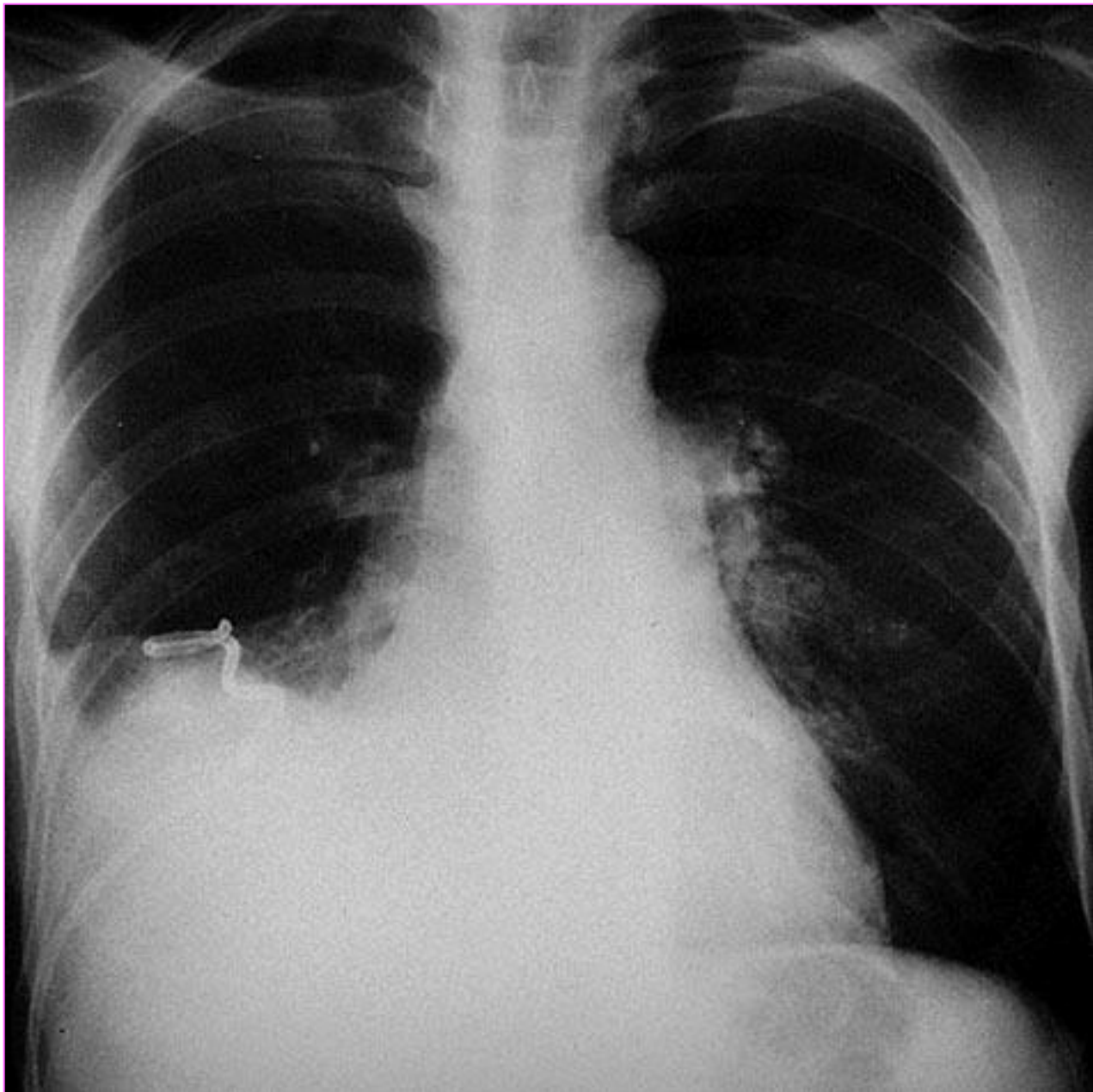
Pig tail  
catheter

Nasogastric tube





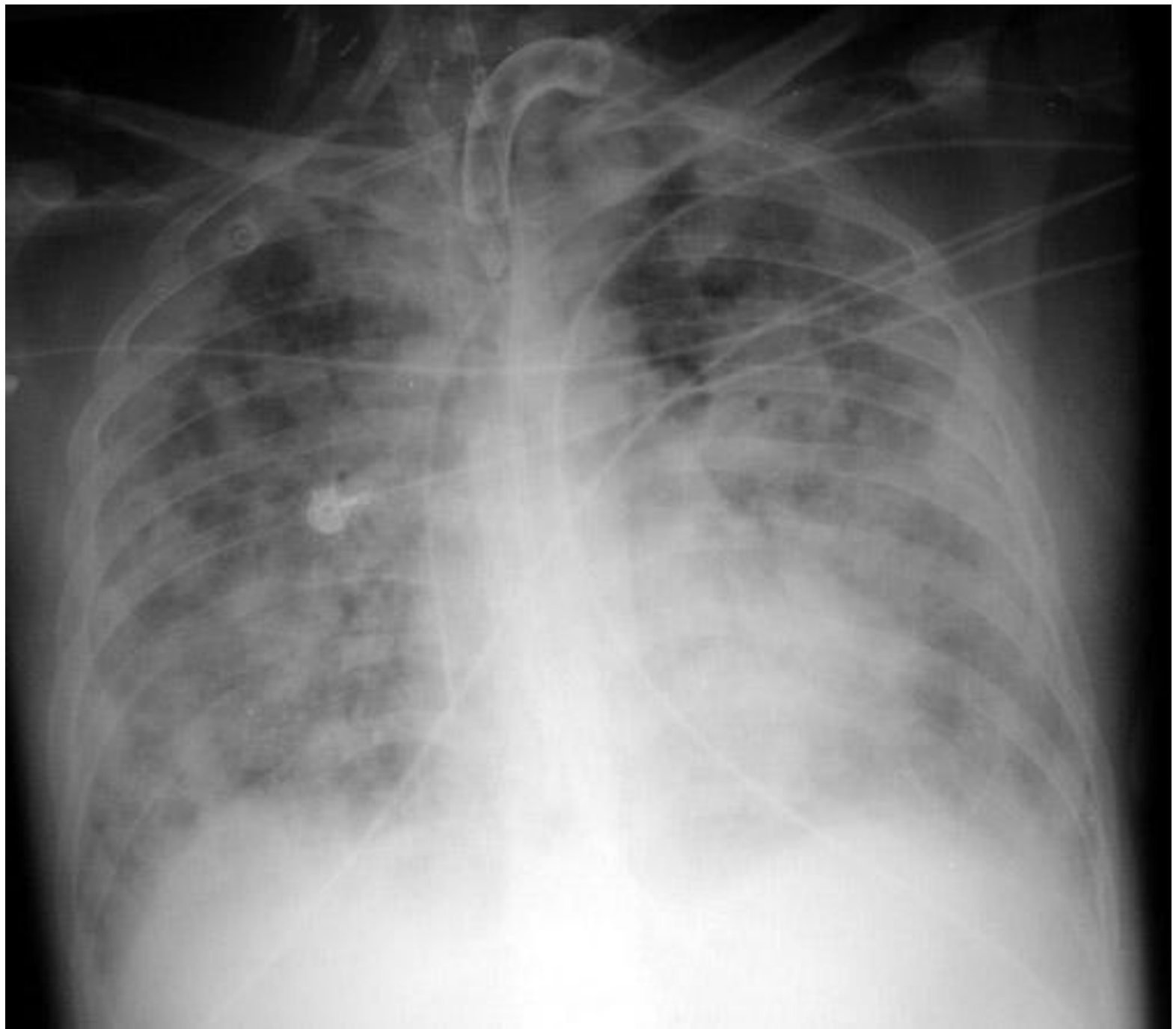




# Pulmonary Edema

There are two basic types of pulmonary edema:

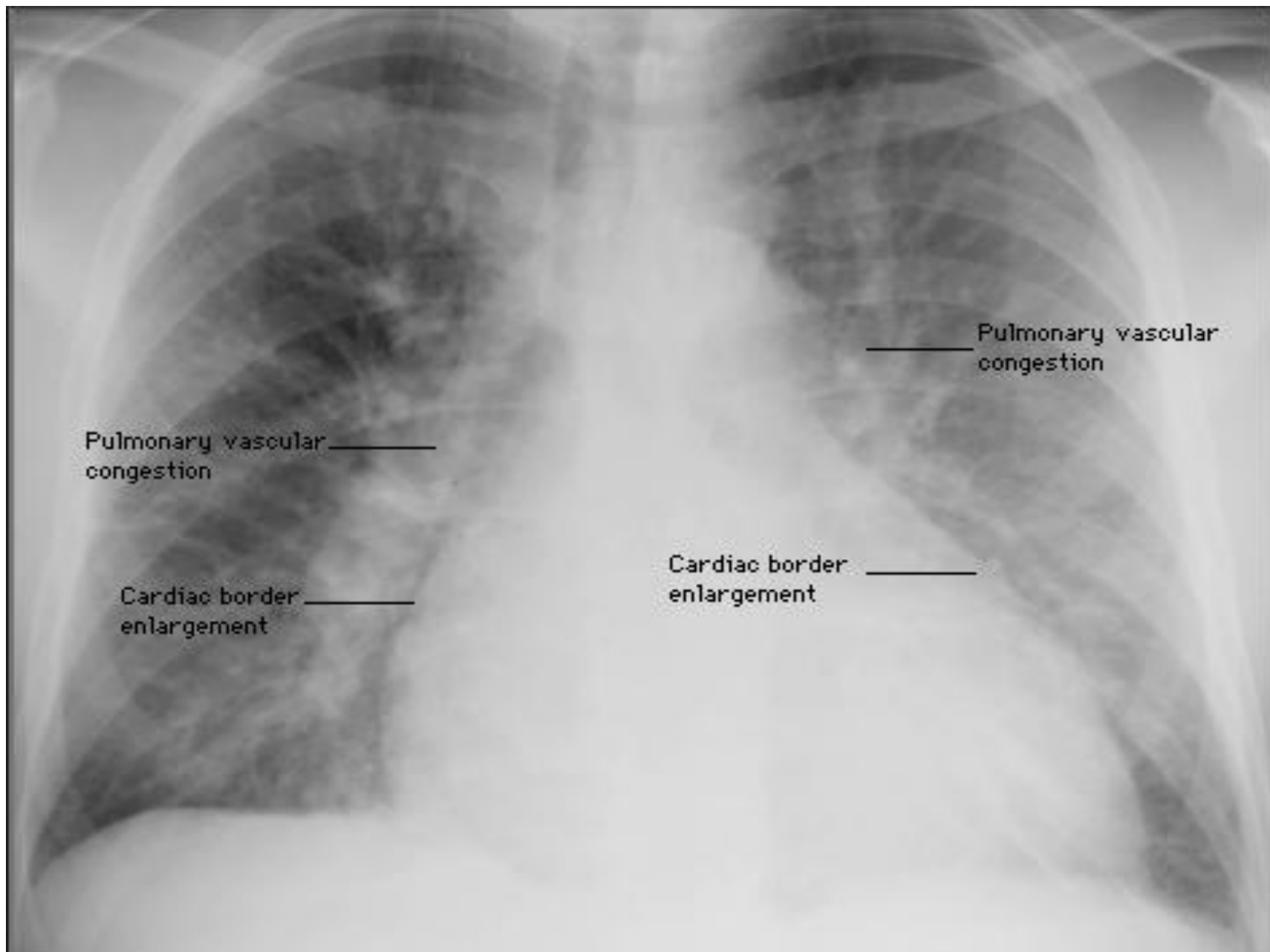
- Cardiogenic pulmonary edema caused by increased hydrostatic pulmonary capillary pressure
- Noncardiogenic pulmonary edema caused by either altered capillary membrane permeability or decreased plasma oncotic pressure

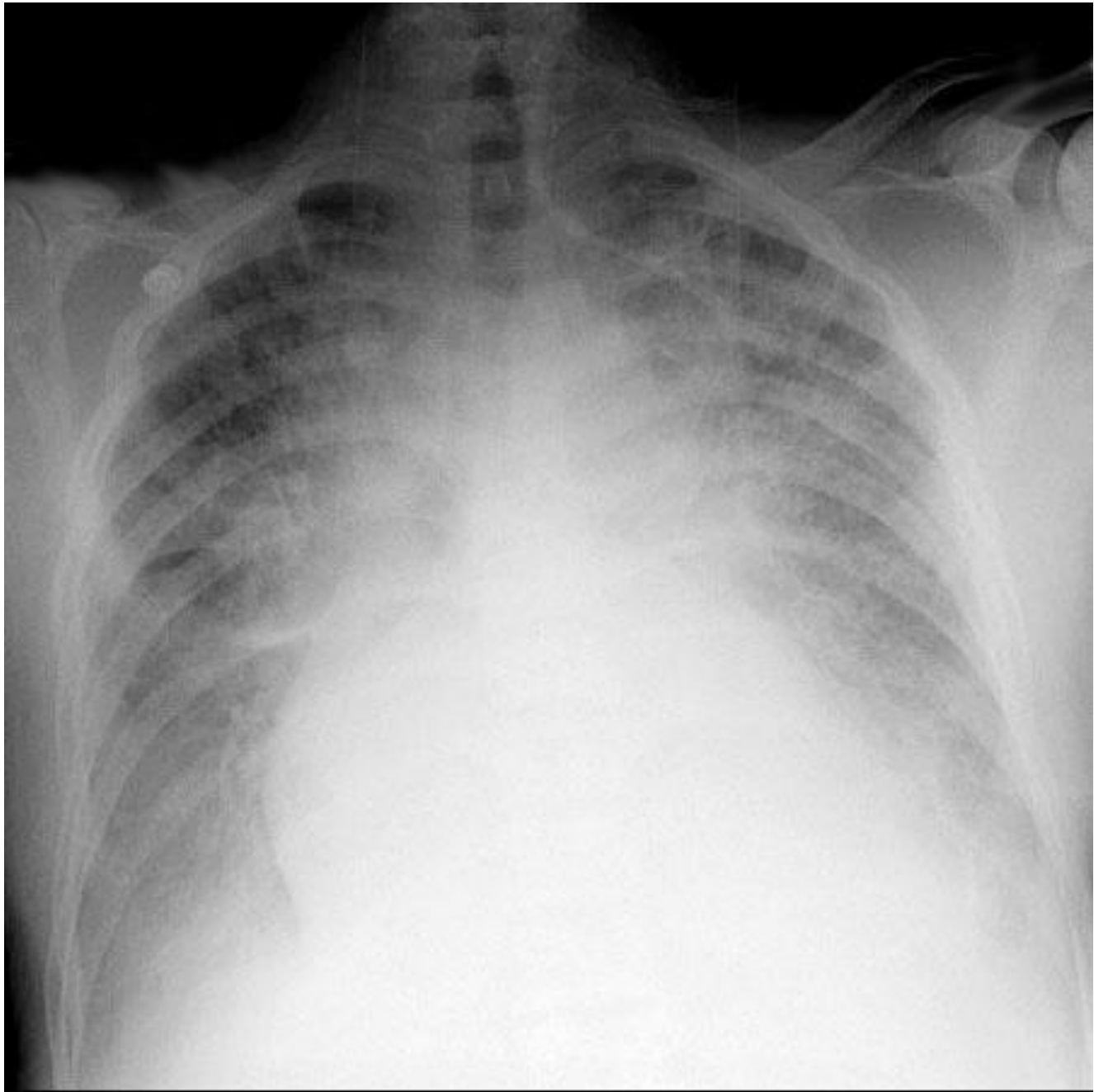


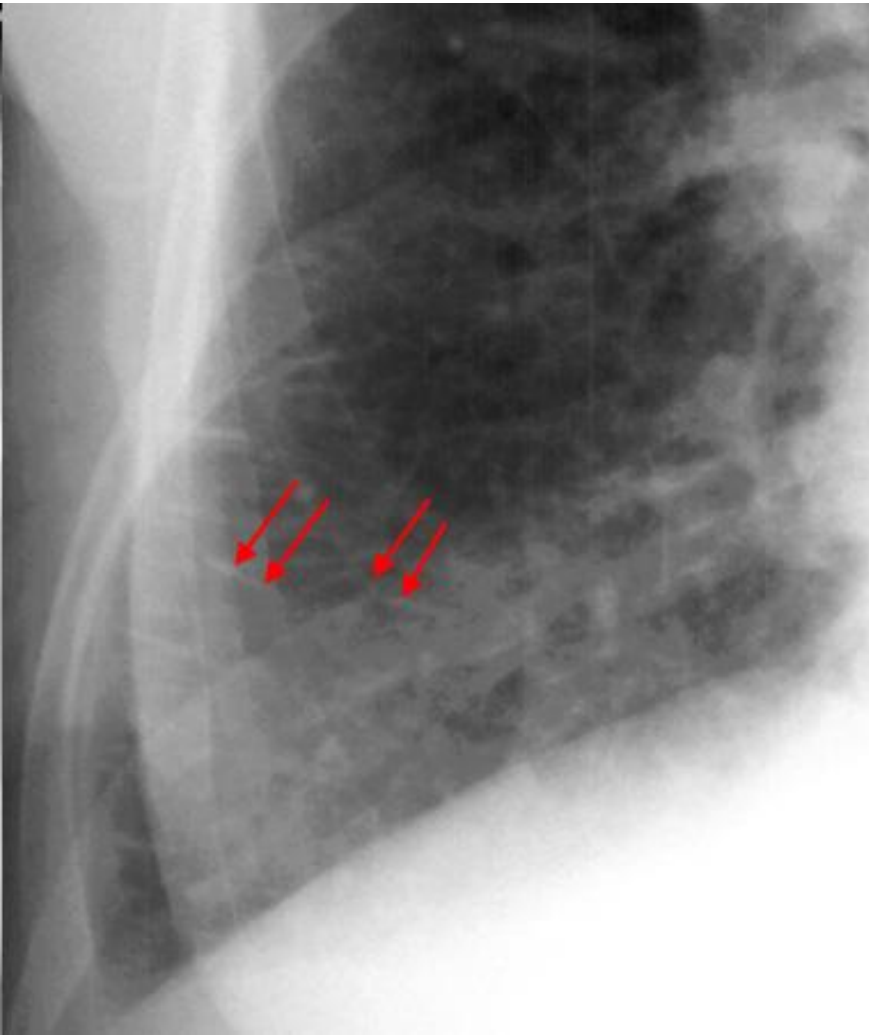
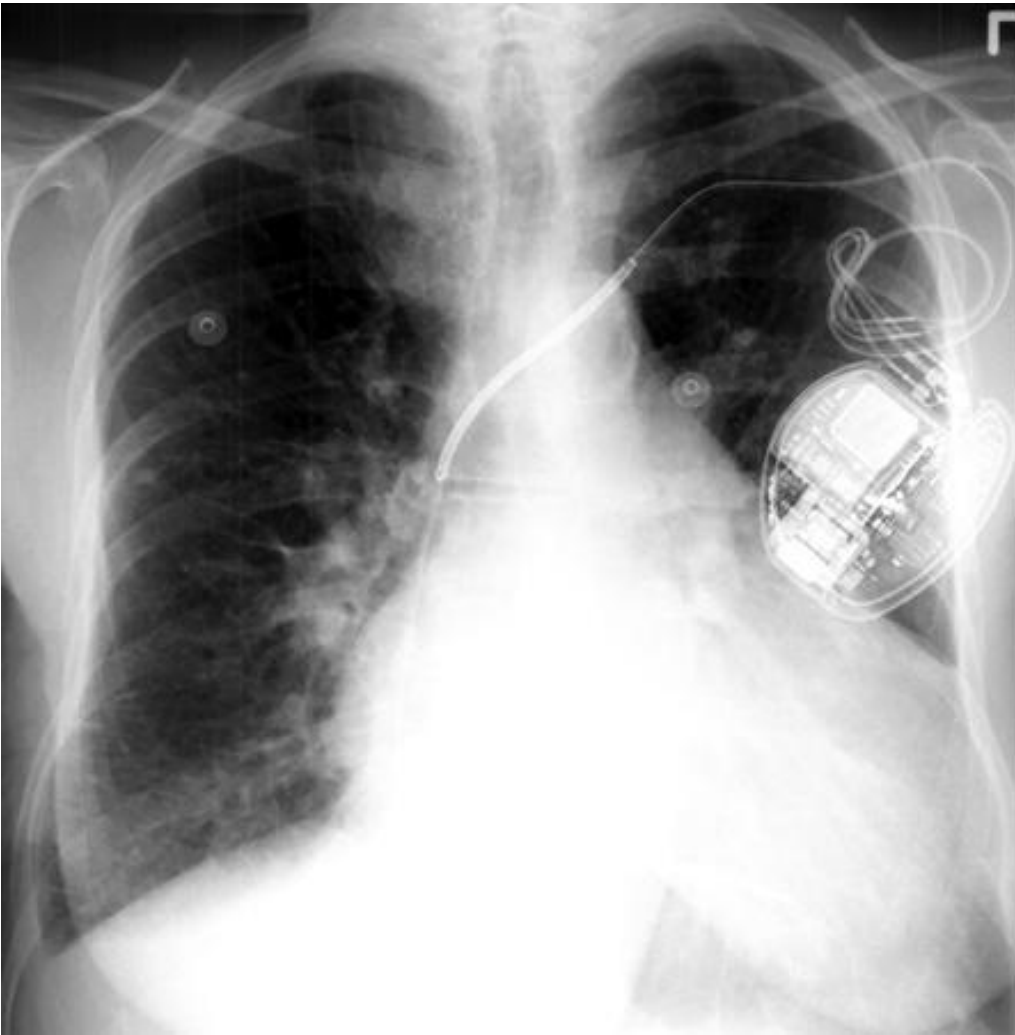
# Congestive Heart Failure

Common features observed on the chest radiograph of a CHF patient include:

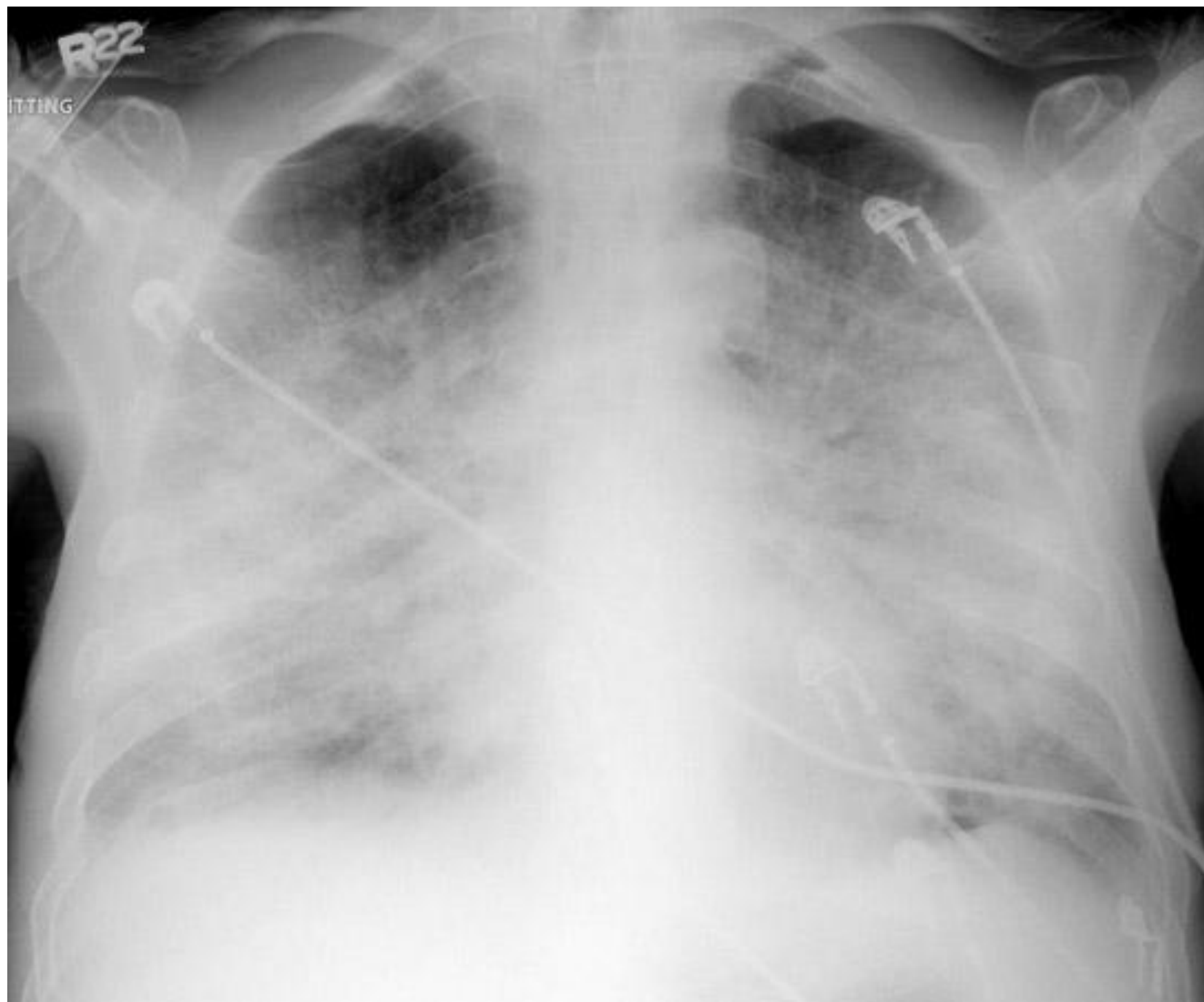
- Cardiomegaly (cardiothoracic ratio  $> 50\%$ )
- Cephalization of the pulmonary veins
- Appearance of Kerley B lines
- Alveolar edema often present in a classis perihilar bat wing pattern of density











# Emphysema

Common features seen on the chest radiograph include:

- Hyperinflation with flattening of the diaphragms
- Increased retrosternal space
- Bullae
- Enlargement of PA/RV (cor pulmonale)



# Lung Mass

A lung mass will typically present as a lesion with sharp margins and a homogenous appearance, in contrast to the diffuse appearance of an infiltrate.



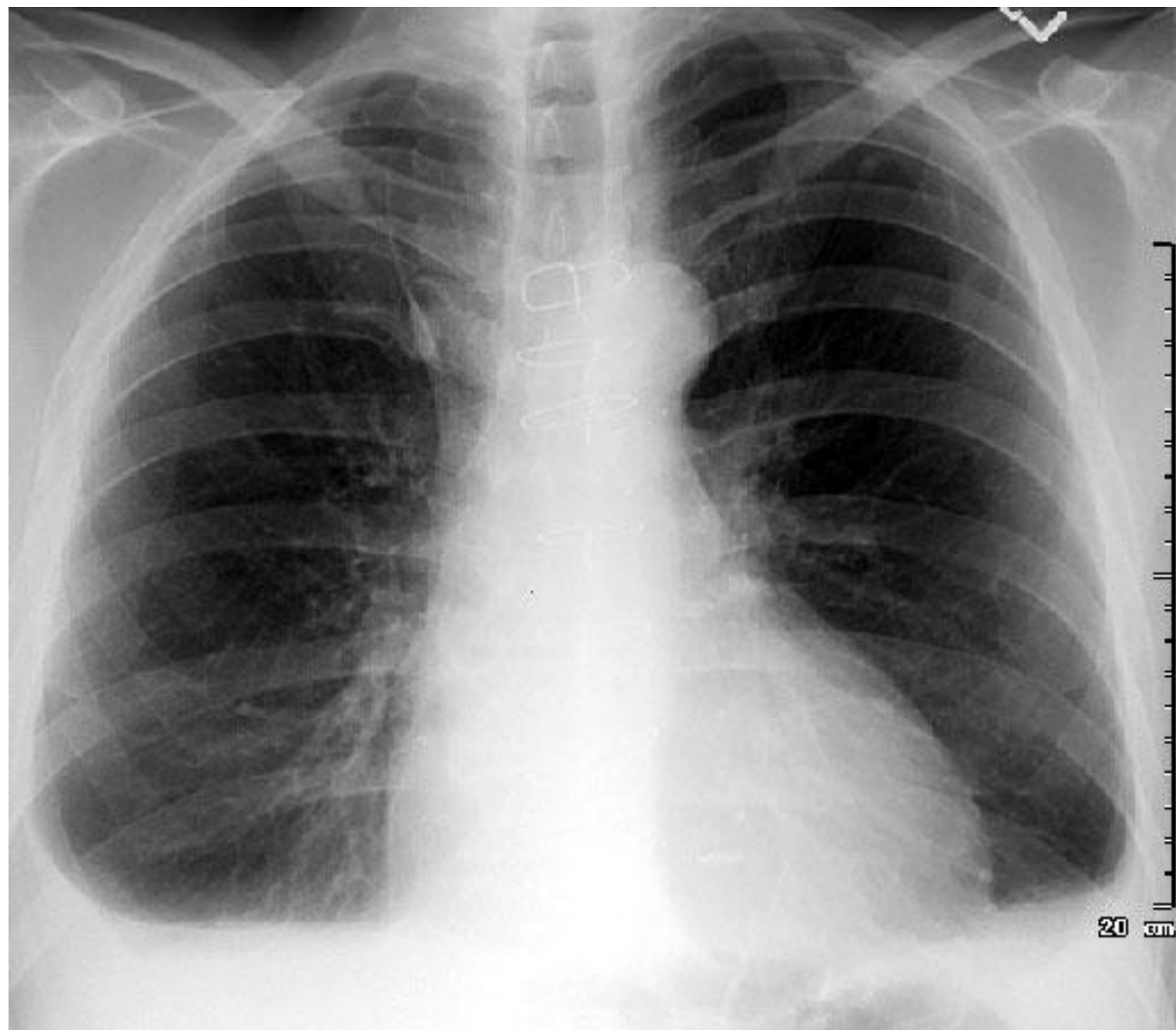
# Pleural Effusion

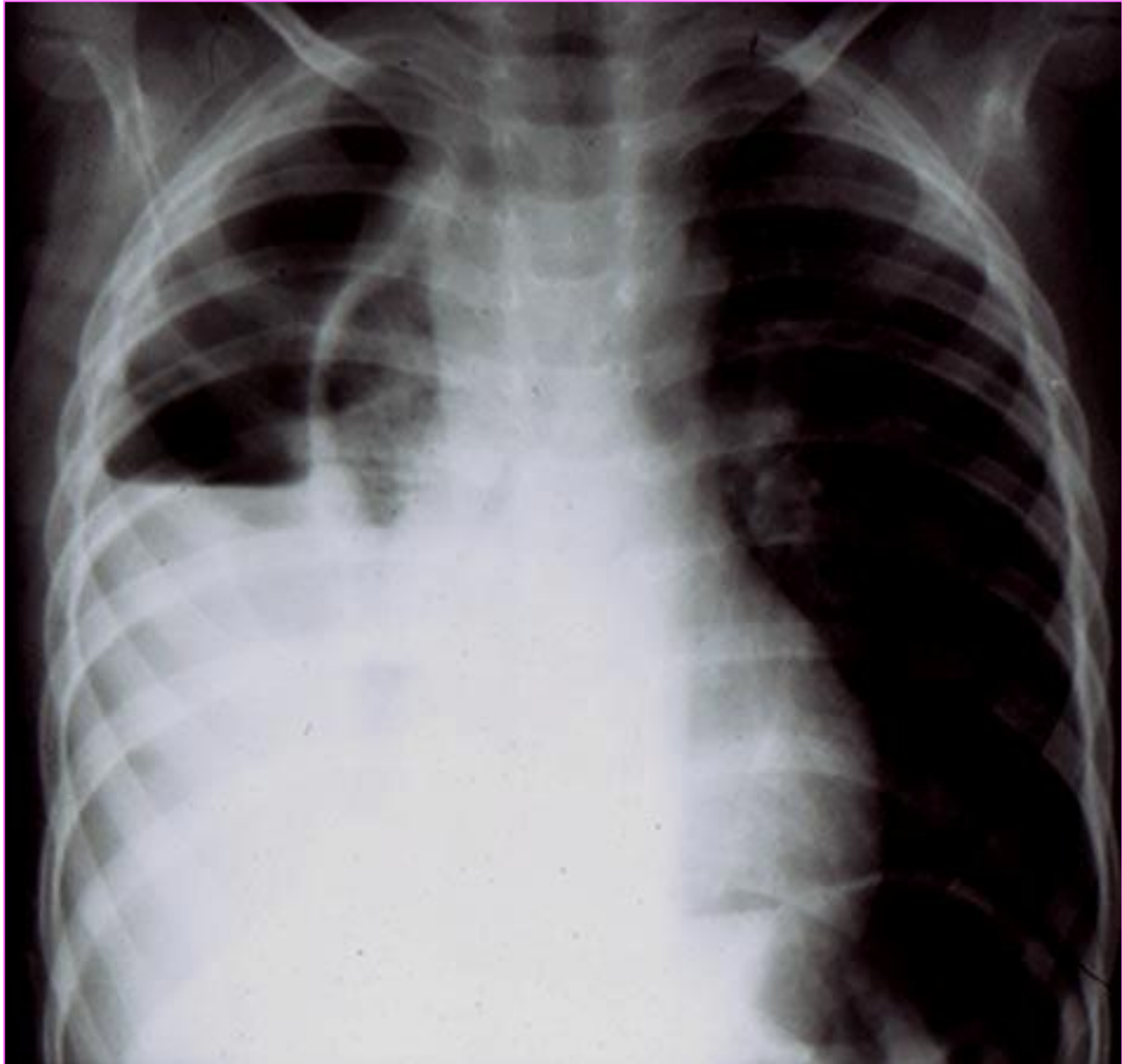
On an upright film, an effusion will cause blunting on the lateral costophrenic sulcus and, if large enough, on the posterior costophrenic sulcus.

- Approximately 200 ml of fluid are needed to detect an effusion in a PA film, while approximately 75 ml of fluid would be visible in the lateral view

In the AP film, an effusion will appear as a graded haze that is denser at the base

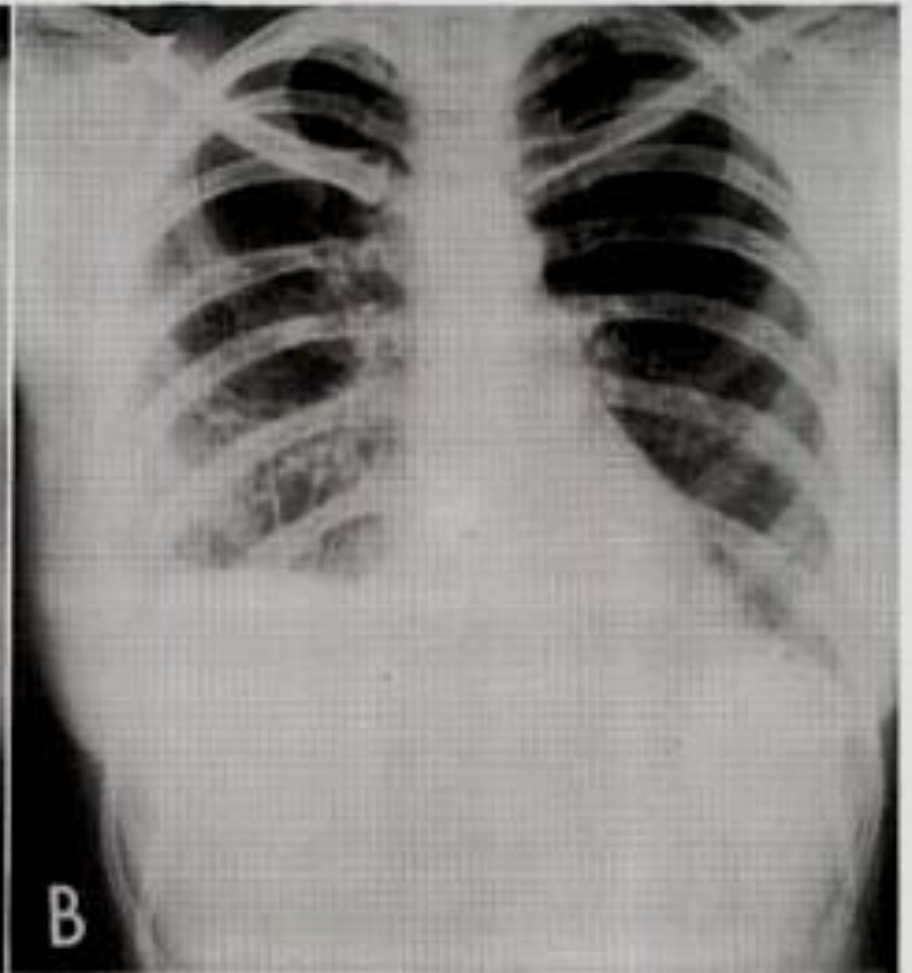
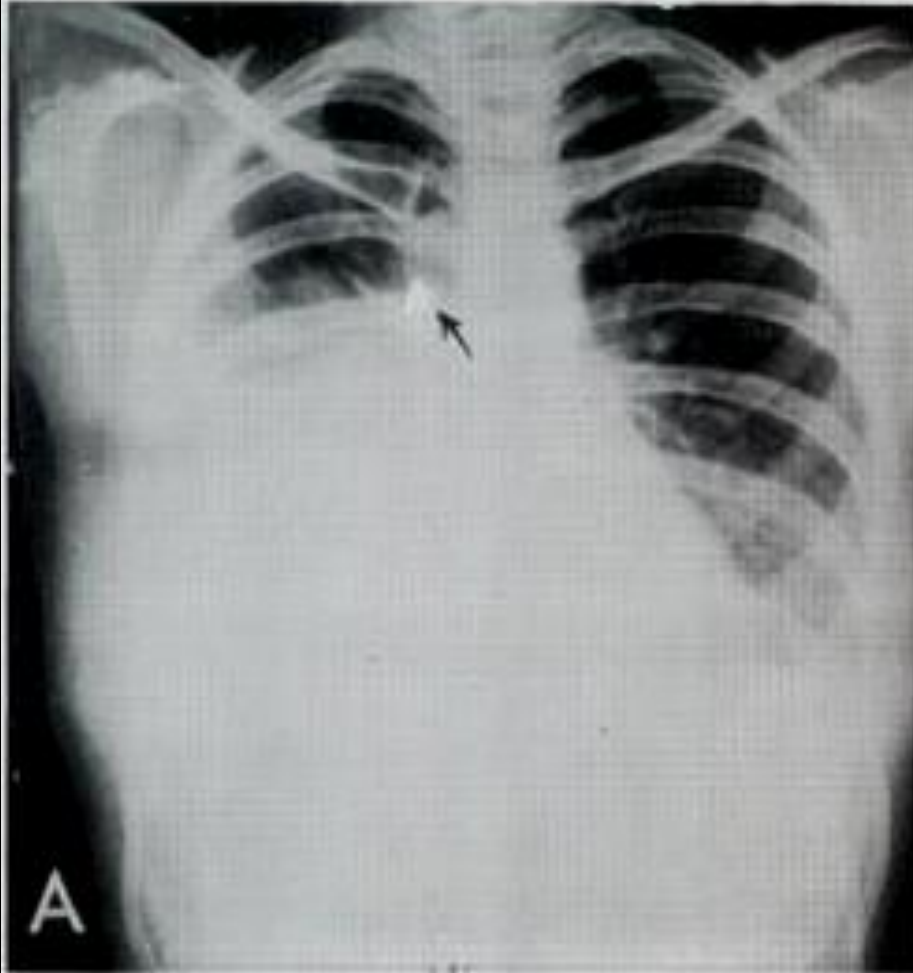
A lateral decubitus film is helpful in confirming an effusion as the fluid will collect on the dependent side





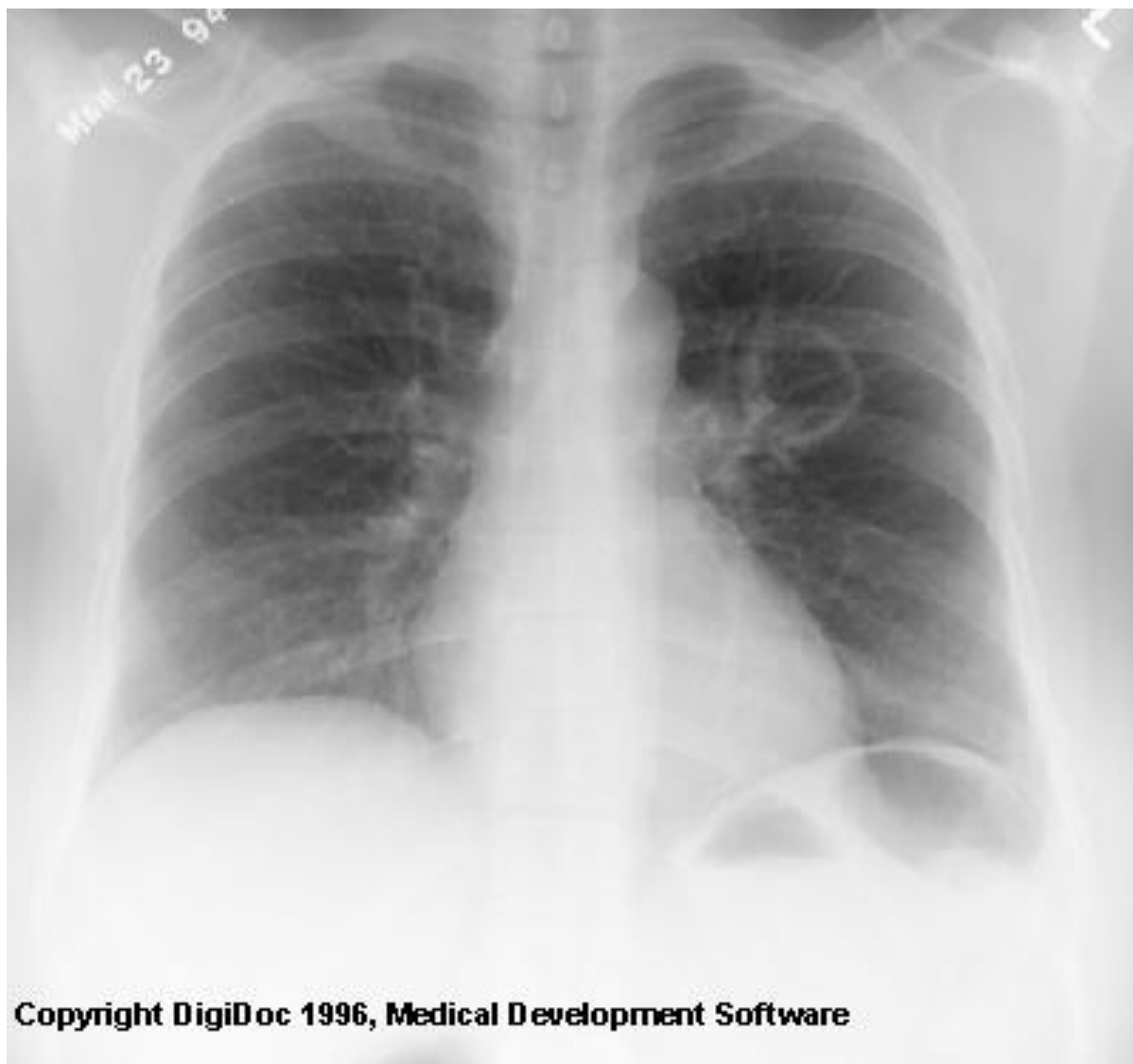


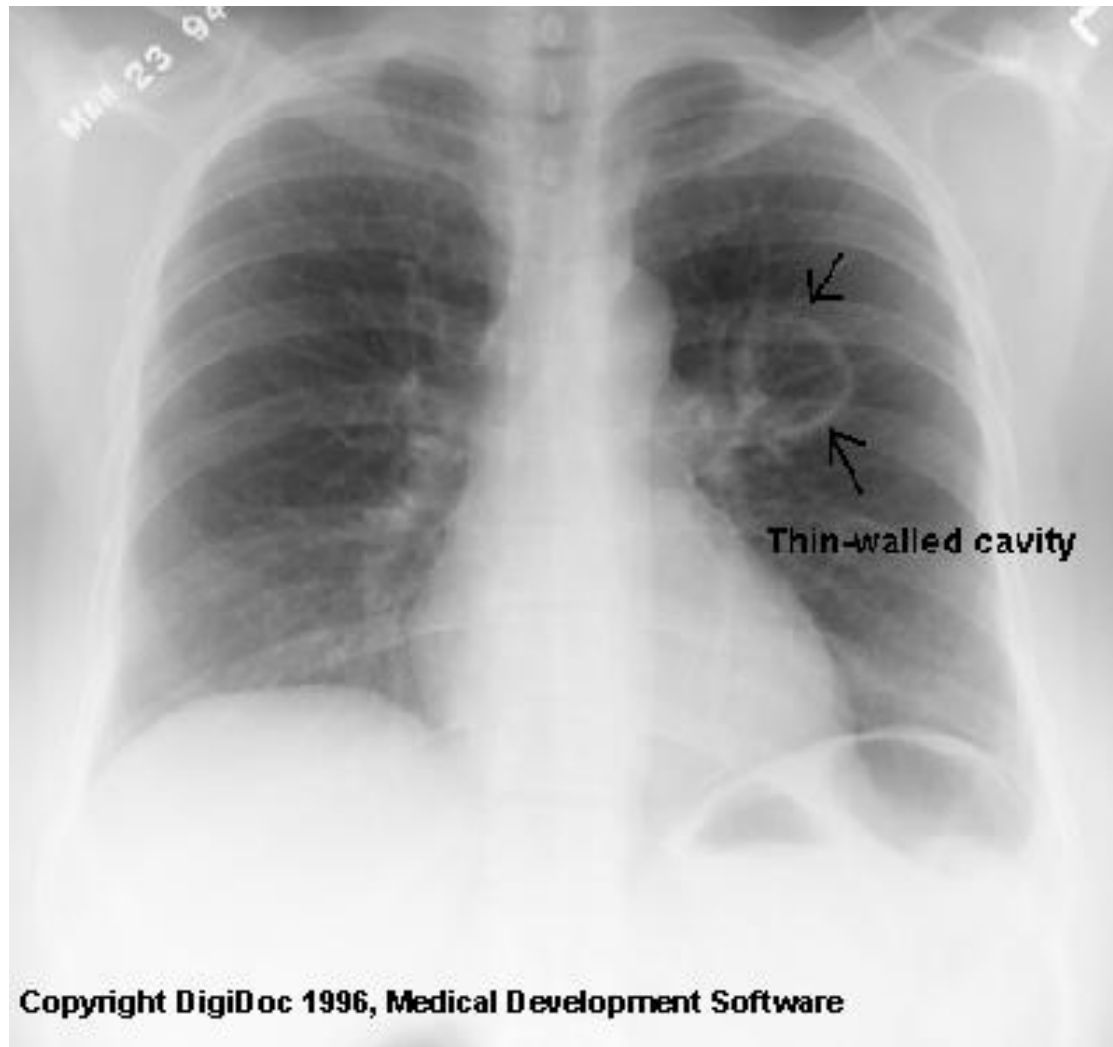
# Hemothorax



# Putting It Into Practice

# Case 1

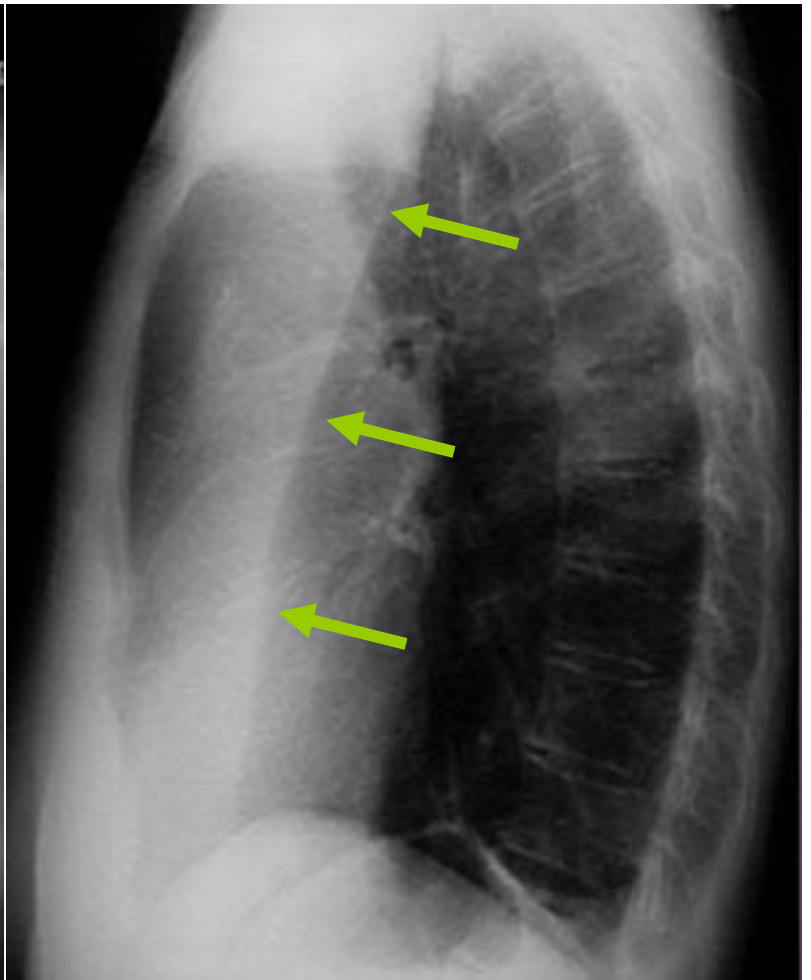
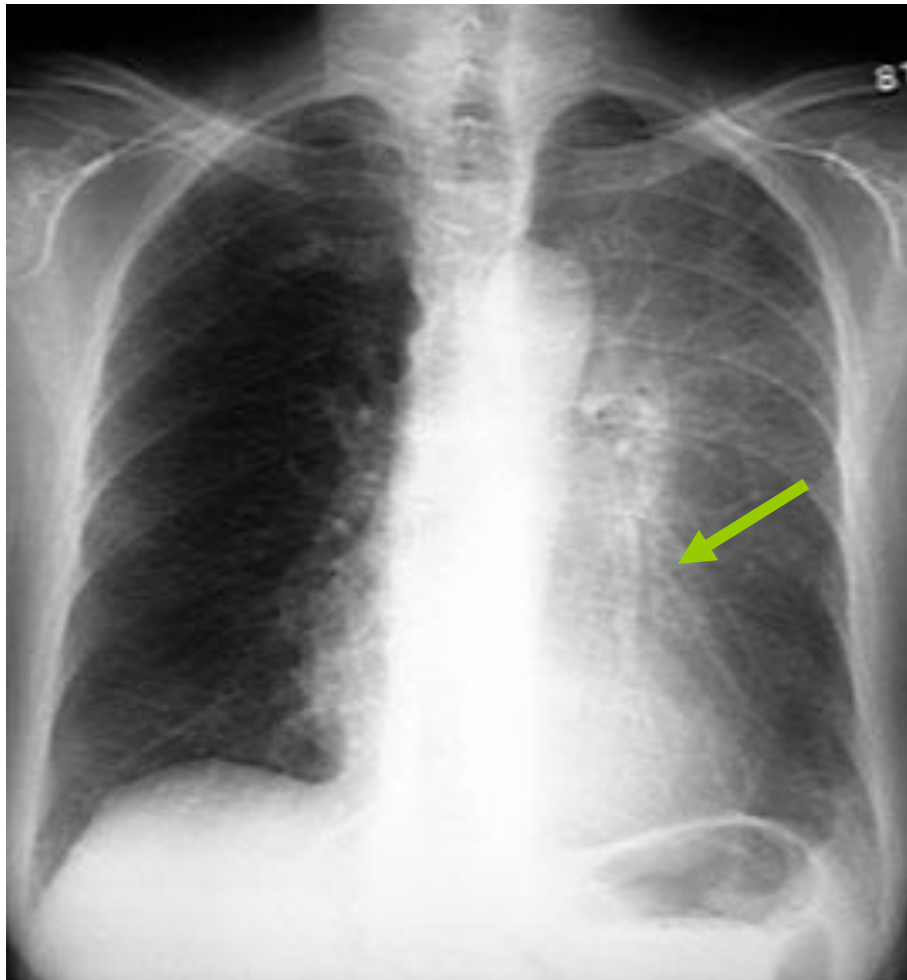




A single, 3cm relatively thin-walled cavity is noted in the left midlung. This finding is most typical of squamous cell carcinoma (SCC). One-third of SCC masses show cavitation

# Case 2



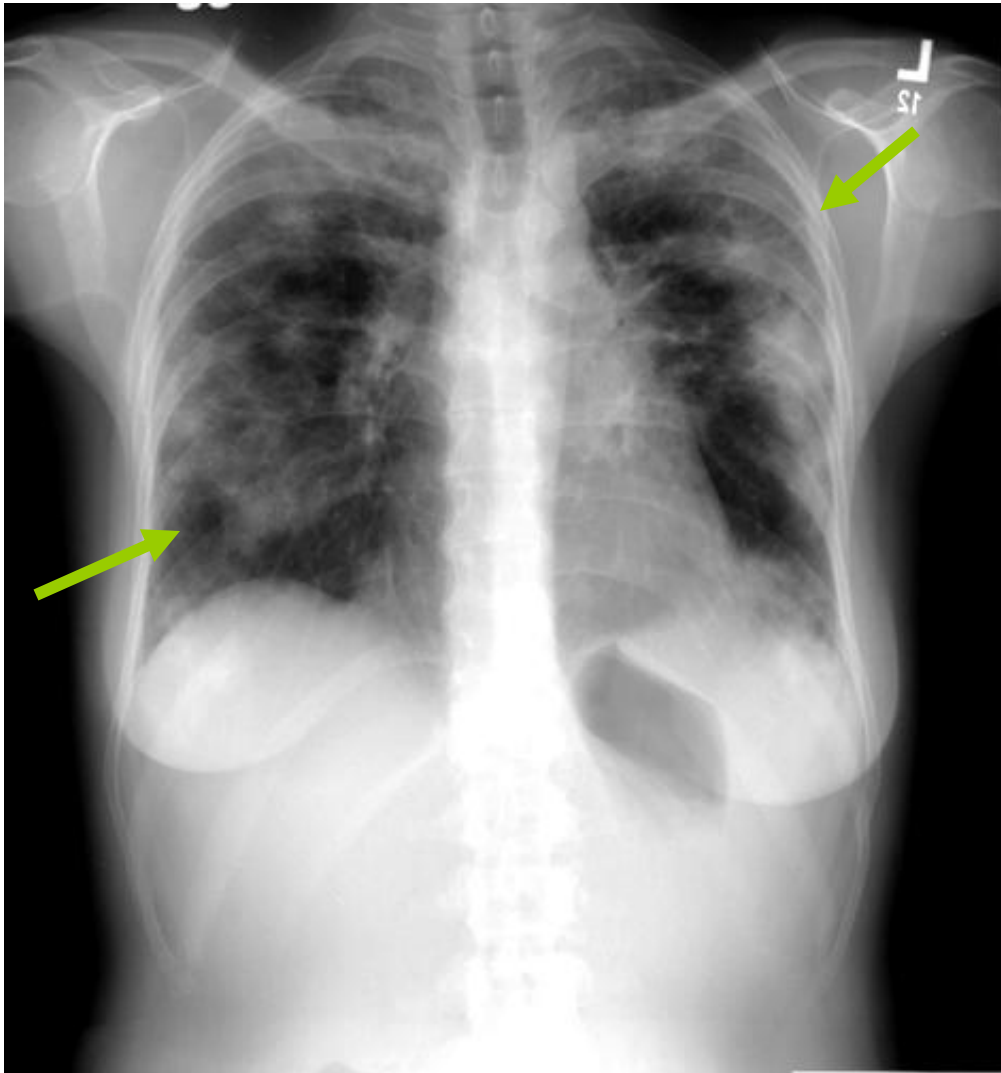


LUL Atelectasis: Loss of heart borders/silhouetting. Notice over inflation on unaffected lung



# Case 3

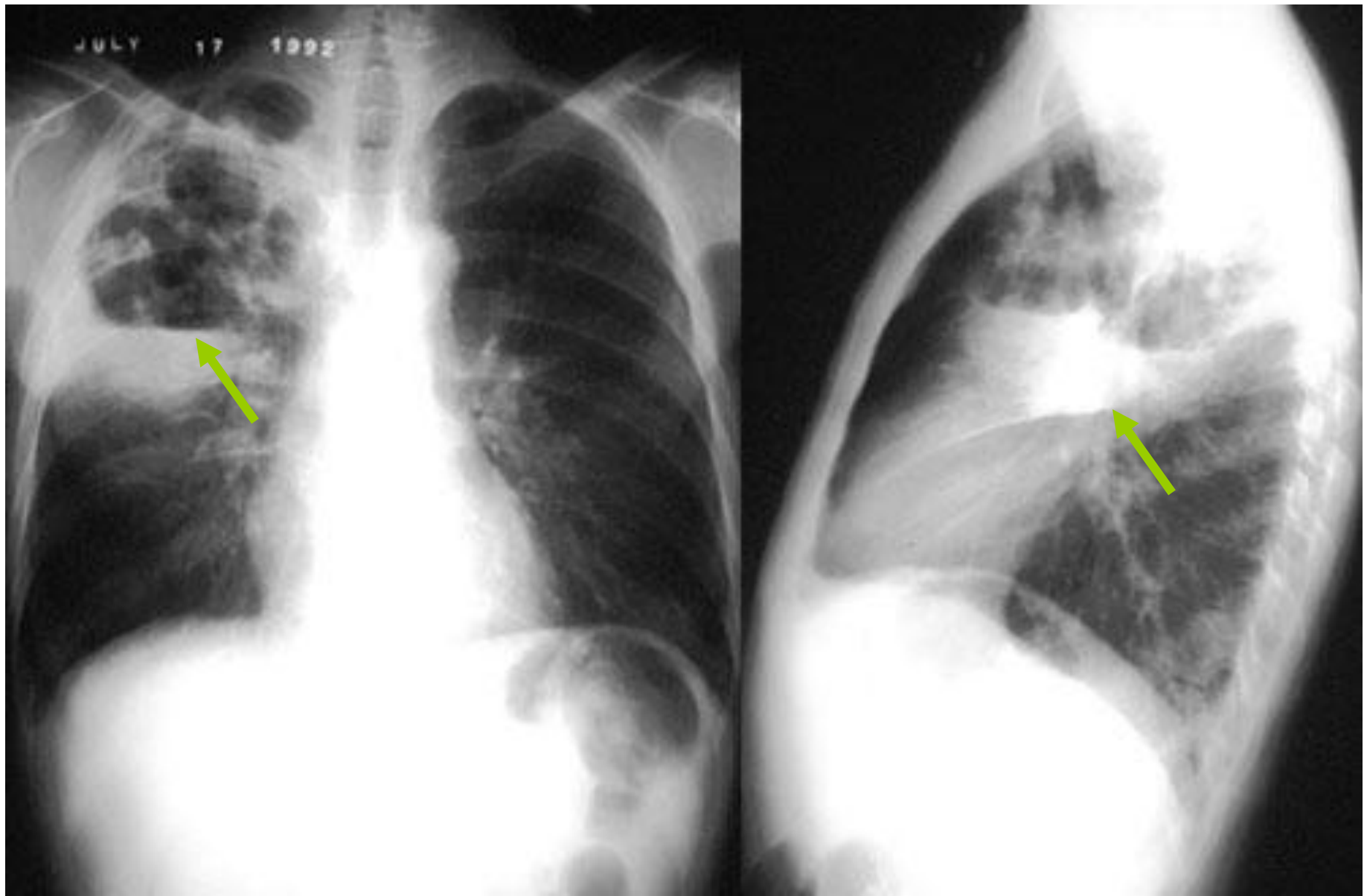




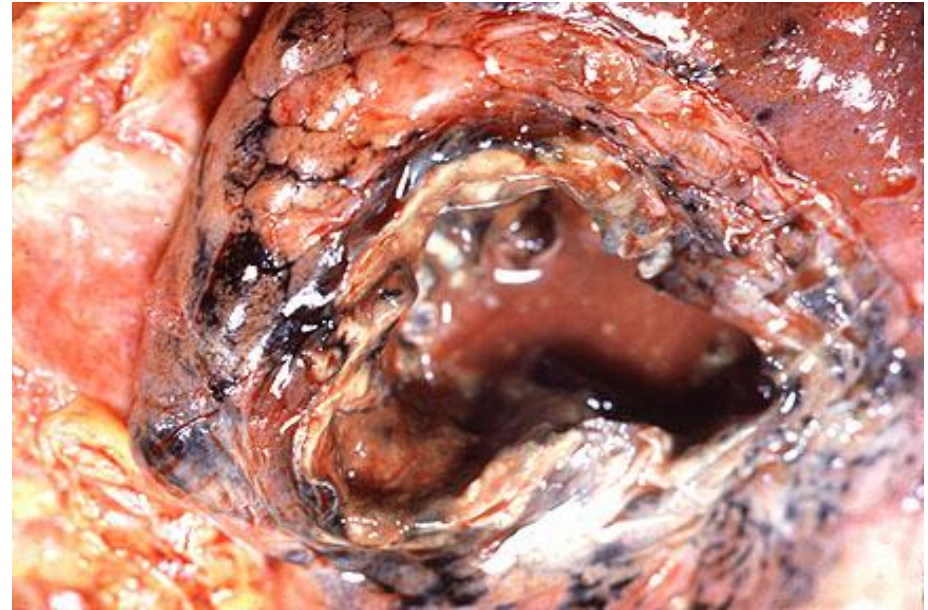
Right Middle and Left Upper Lobe Pneumonia

# Case 4





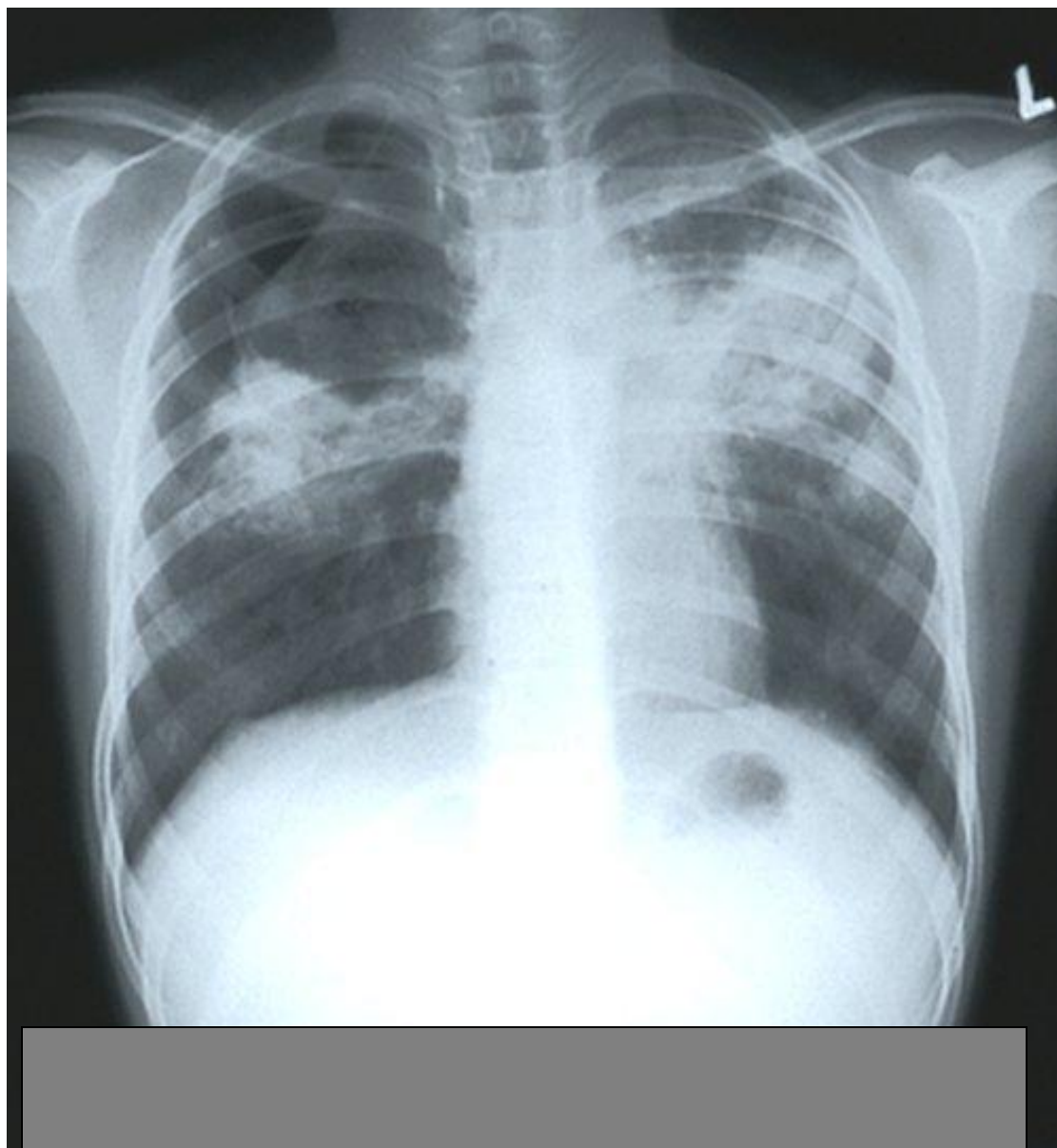
Cavitation: cystic changes in the area of consolidation due to the bacterial destruction of lung tissue. Notice air fluid level.

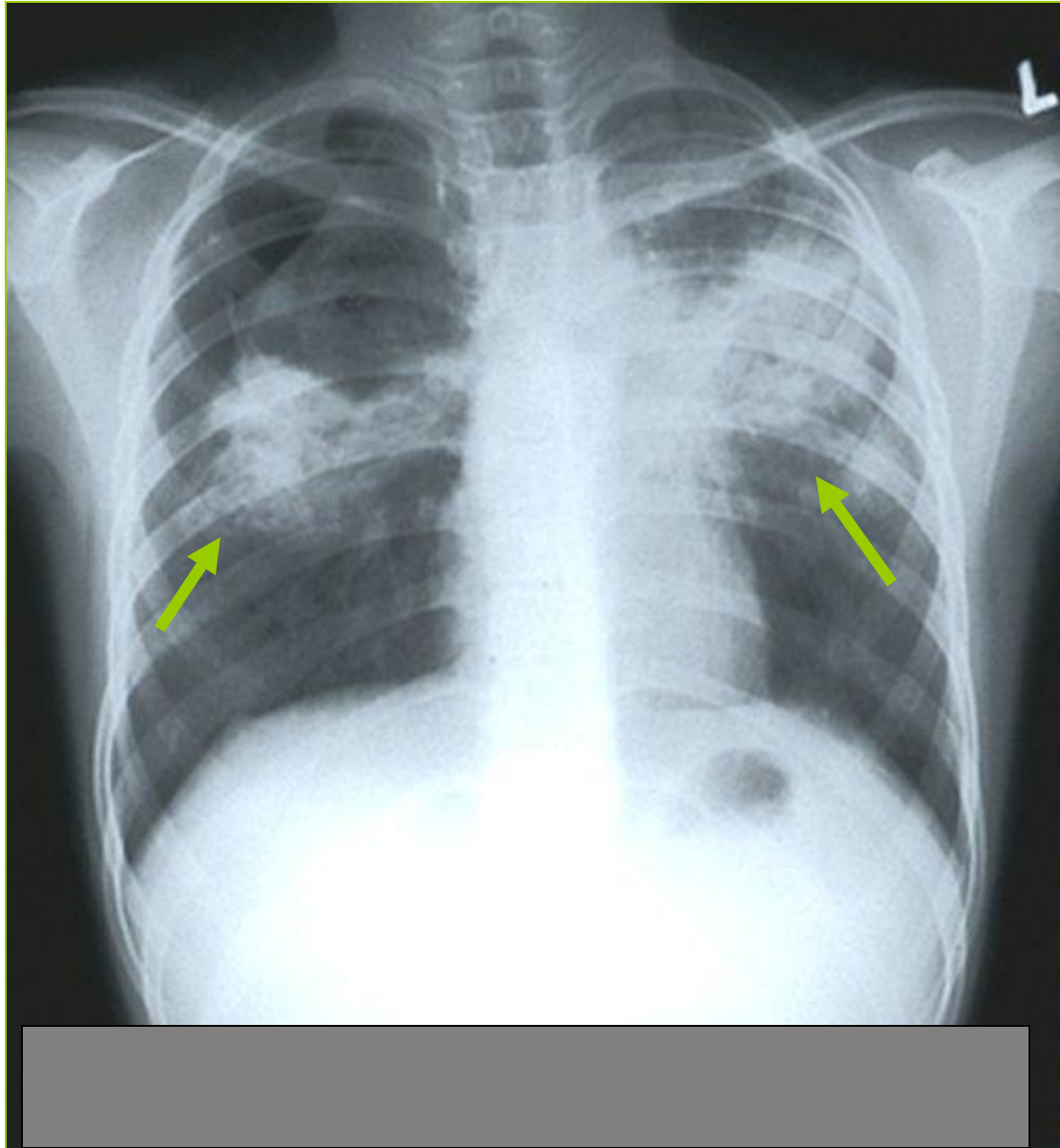


Cavitation

# Case 5



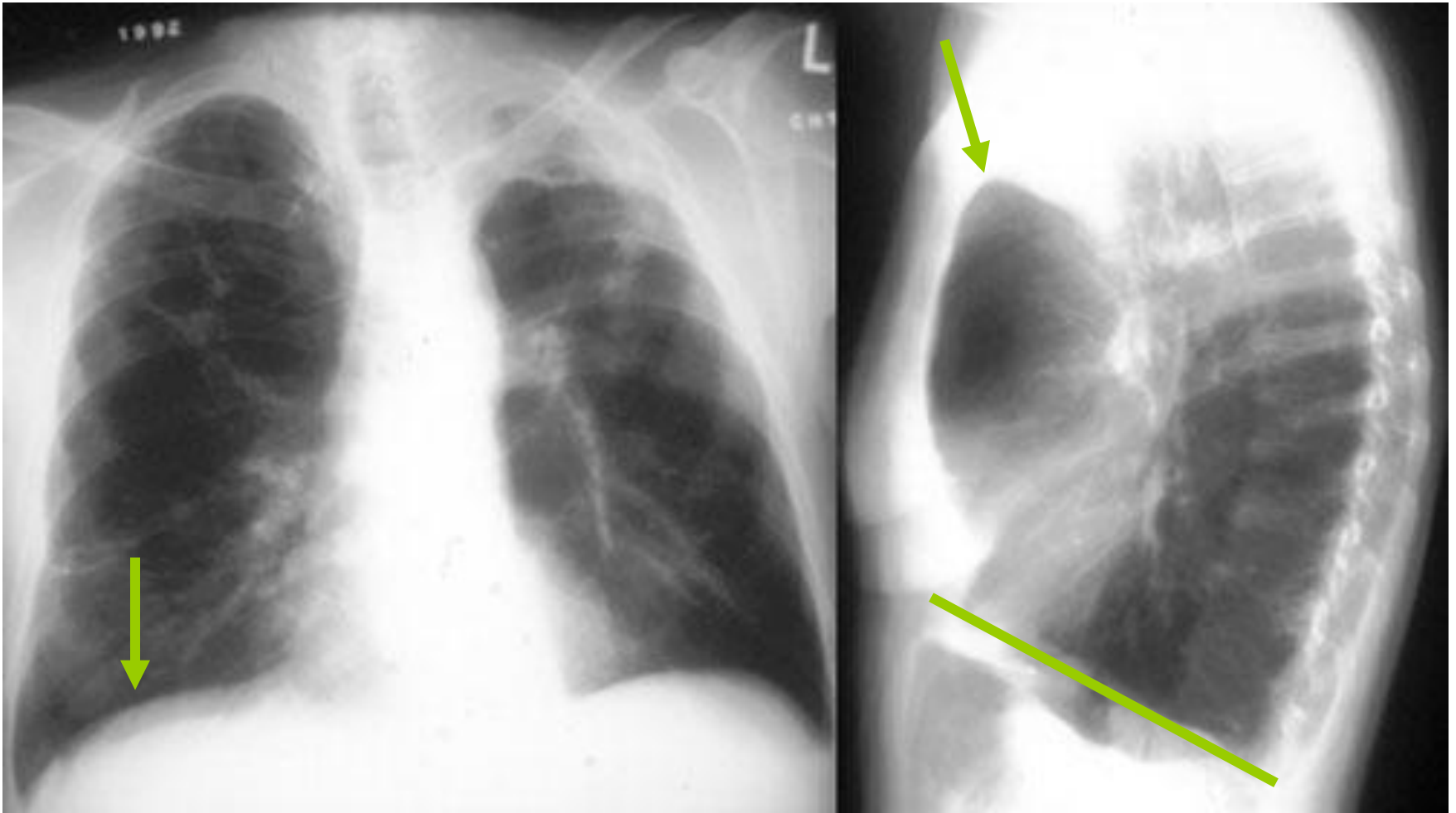




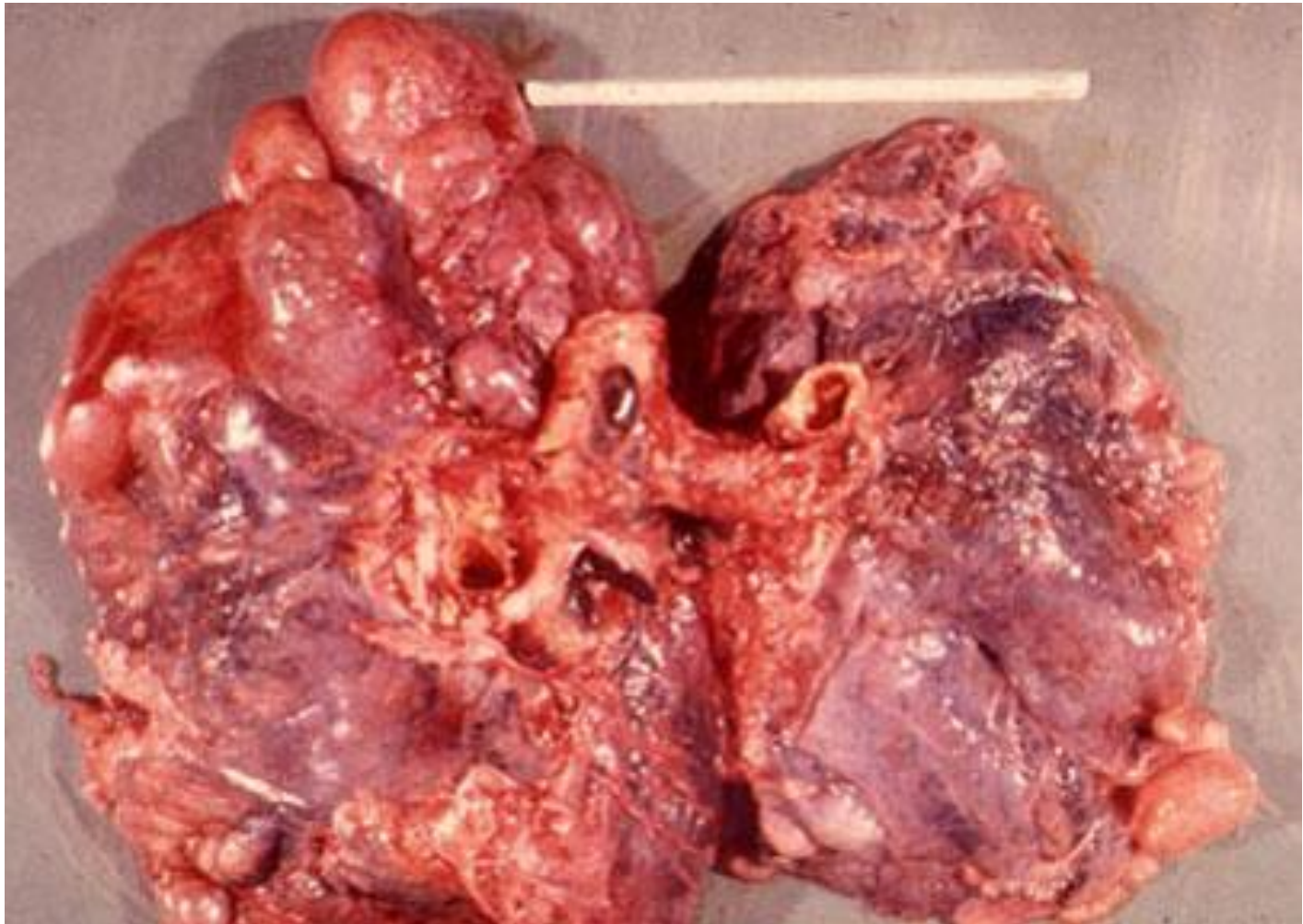
Tuberculosis

# Case 6



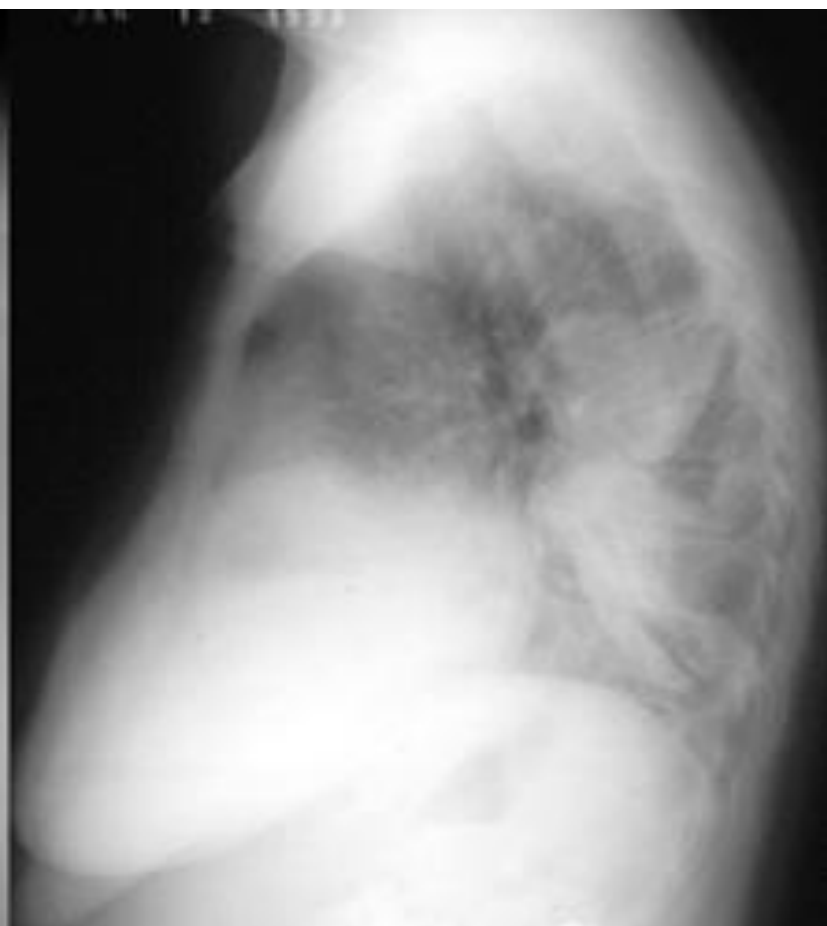


COPD: increase in heart diameter, flattening of the diaphragm, and increase in the size of the retrosternal air space. In addition the upper lobes will become hyperlucent due to destruction of the lung tissue.



Chronic emphysema effect on the lungs

# Case 7



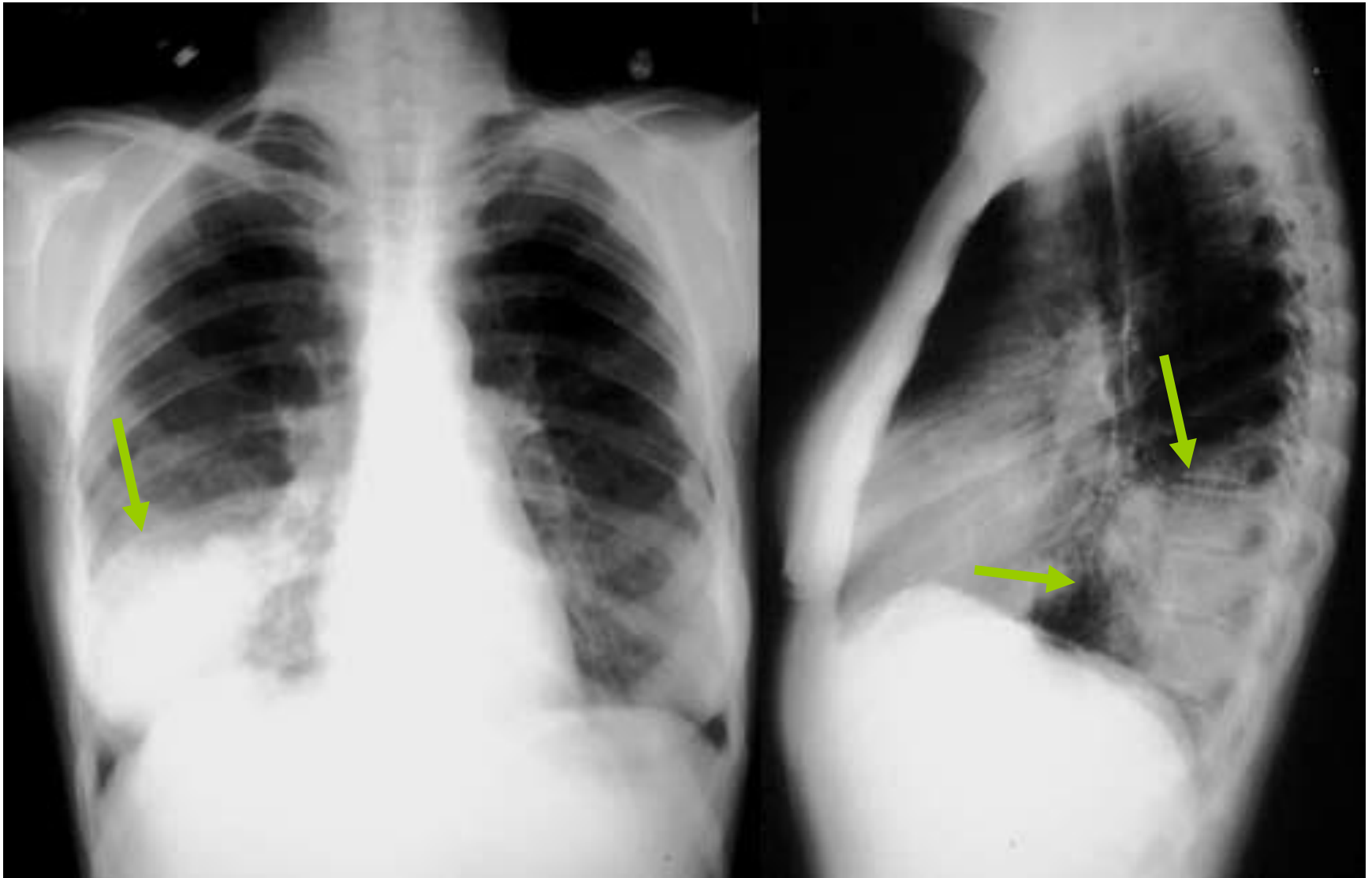




Pseudotumor: fluid has filled the minor fissure creating a density that resembles a tumor (arrow). Recall that fluid and soft tissue are indistinguishable on plain film. Further analysis, however, reveals a classic pleural effusion in the right pleura. Note the right lateral gutter is blunted and the right diaphragm is obscured.

# Case 8

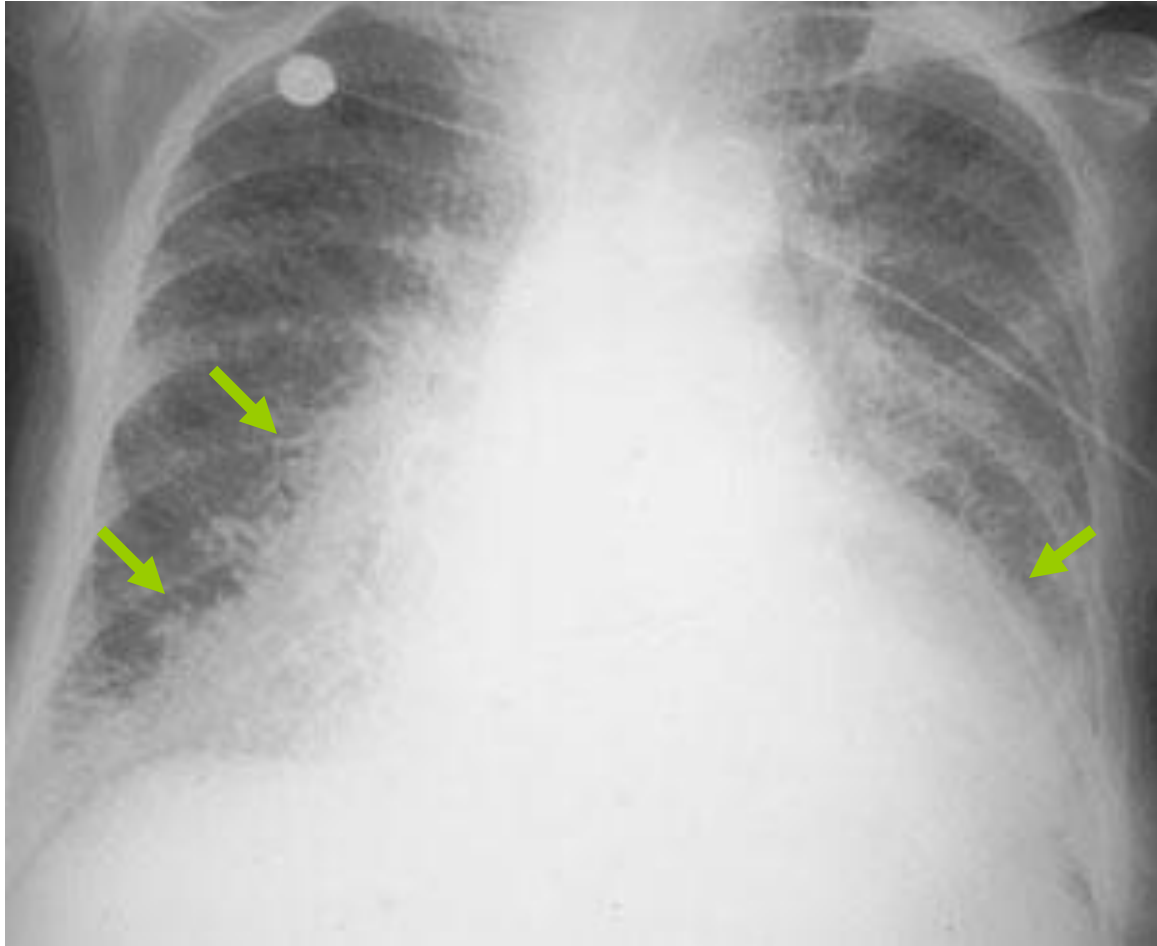




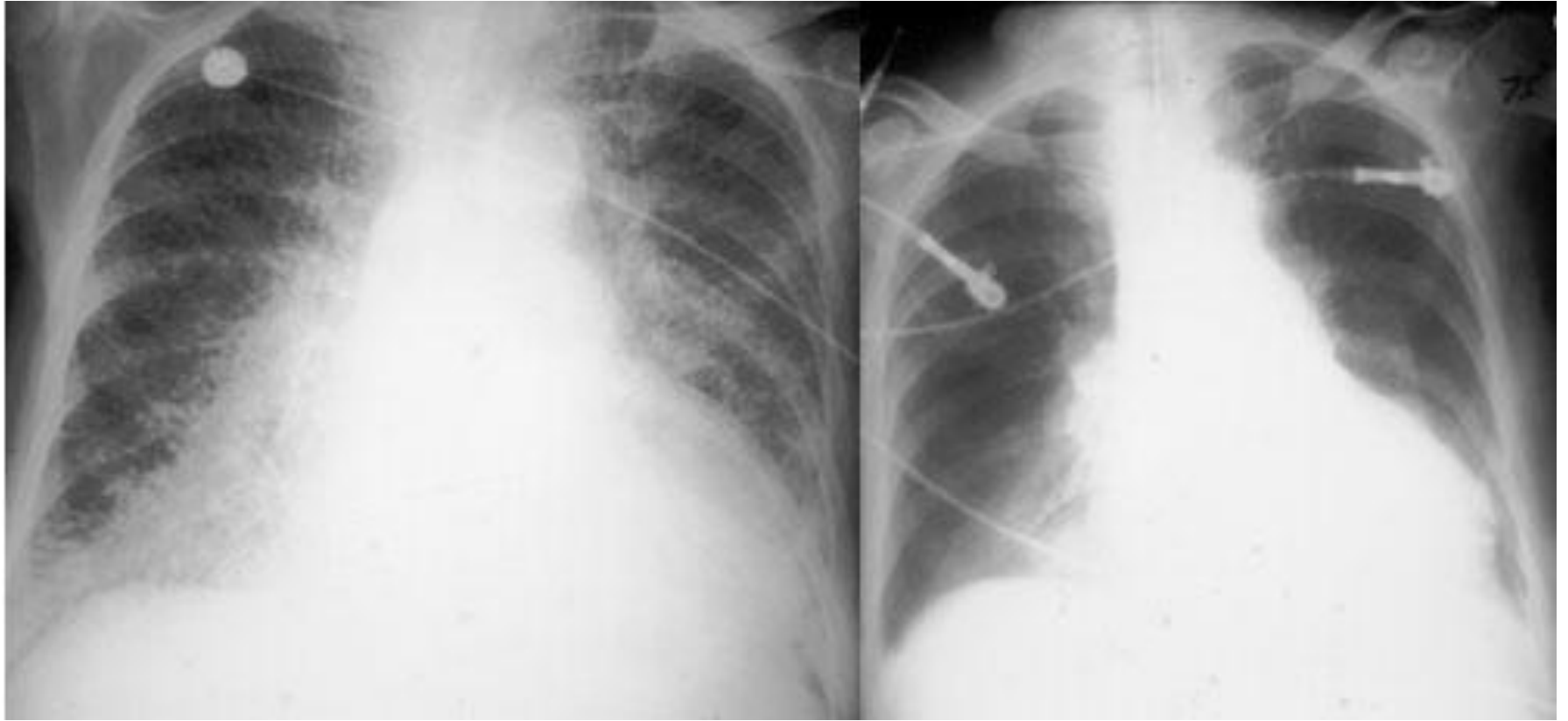
Pneumonia: a large pneumonia consolidation in the right lower lobe. Knowledge of lobar and segmental anatomy is important in identifying the location of the infection

# Case 9





CHF: a great deal of accentuated interstitial markings, Curly lines, and an enlarged heart. Normally indistinct upper lobe vessels are prominent but are also masked by interstitial edema.

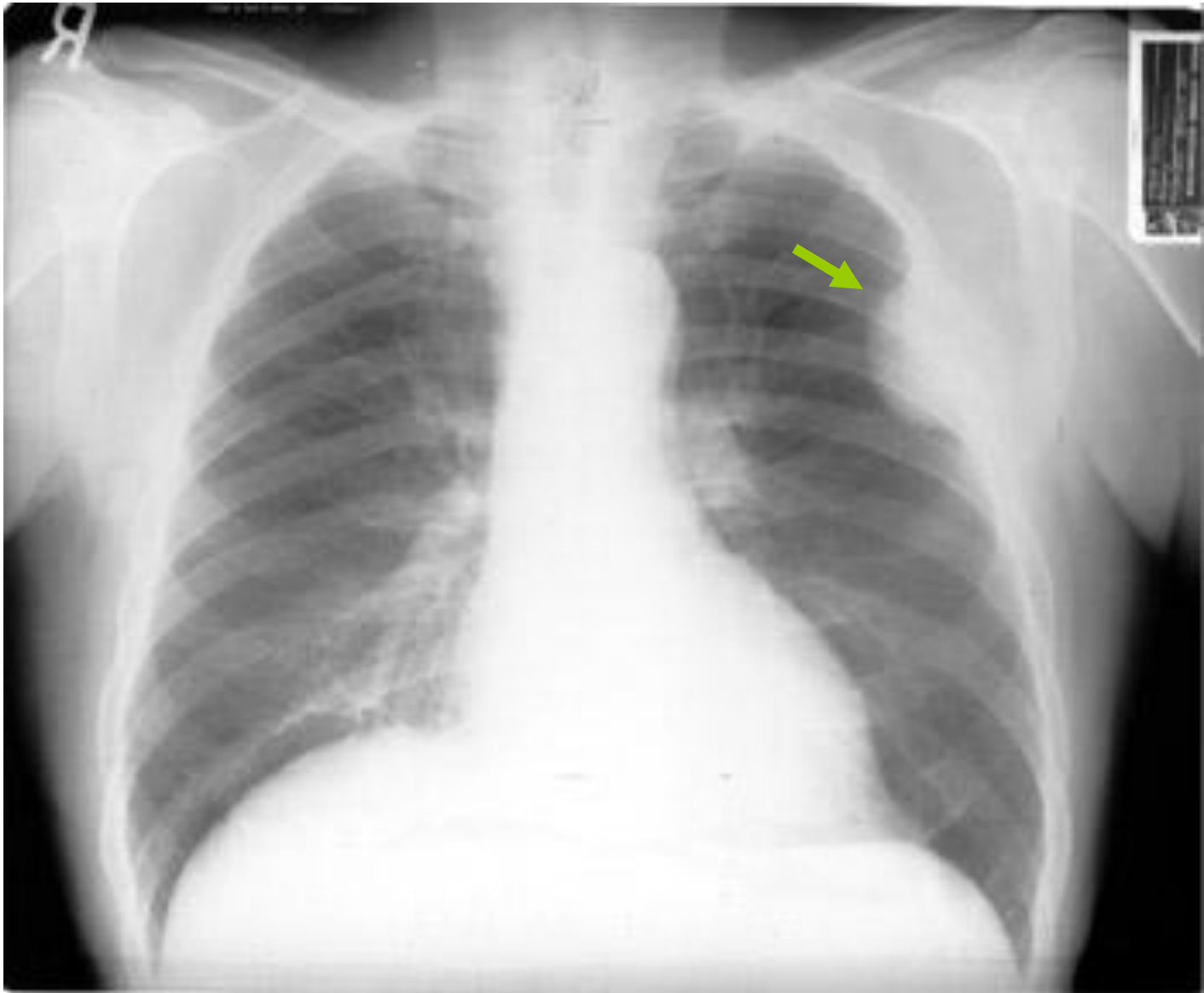


24 hours after diuretic therapy



# Case 10

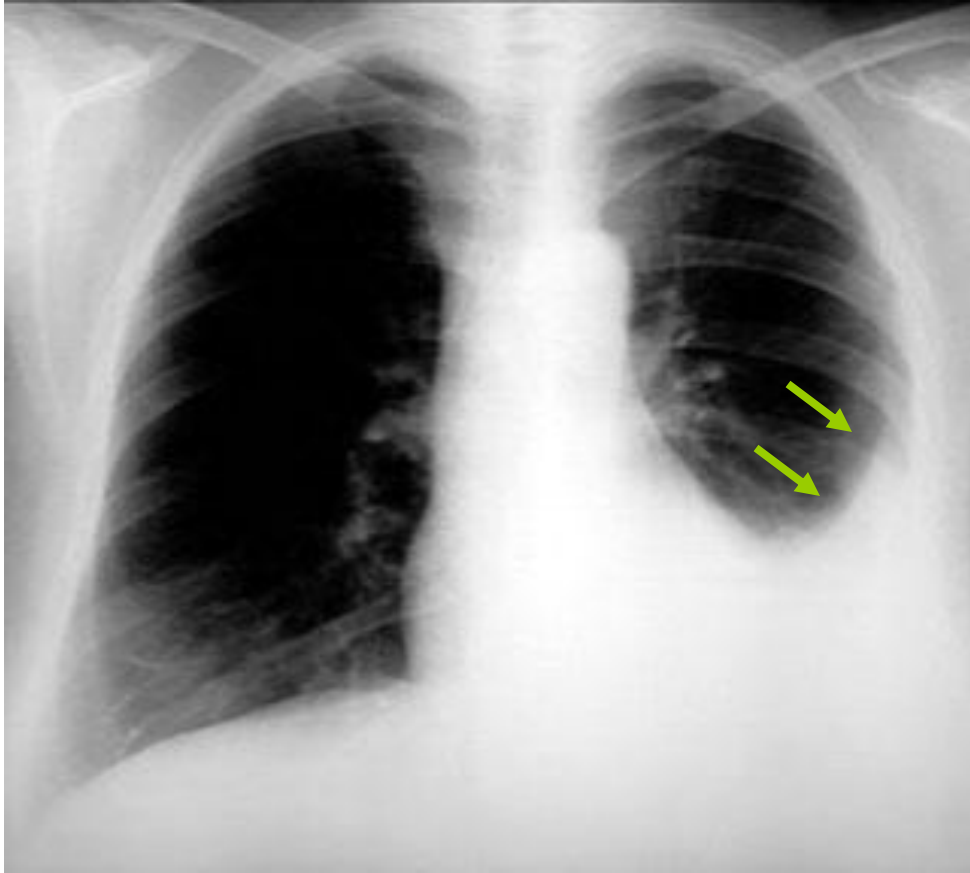




Chest wall lesion: arising off the chest wall and not the lung

# Case 11



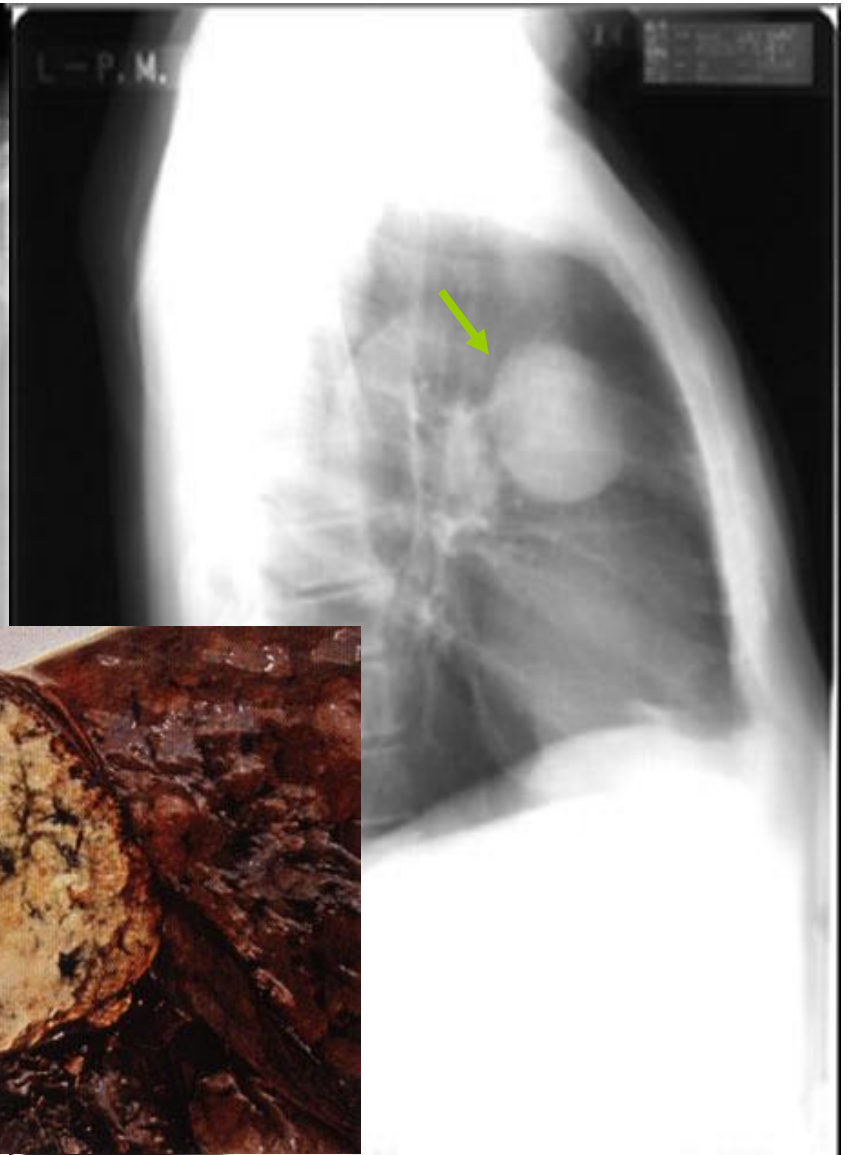


Pleural effusion: Note loss of left hemidiaphragm. Fluid drained via thoracentesis

# Case 12



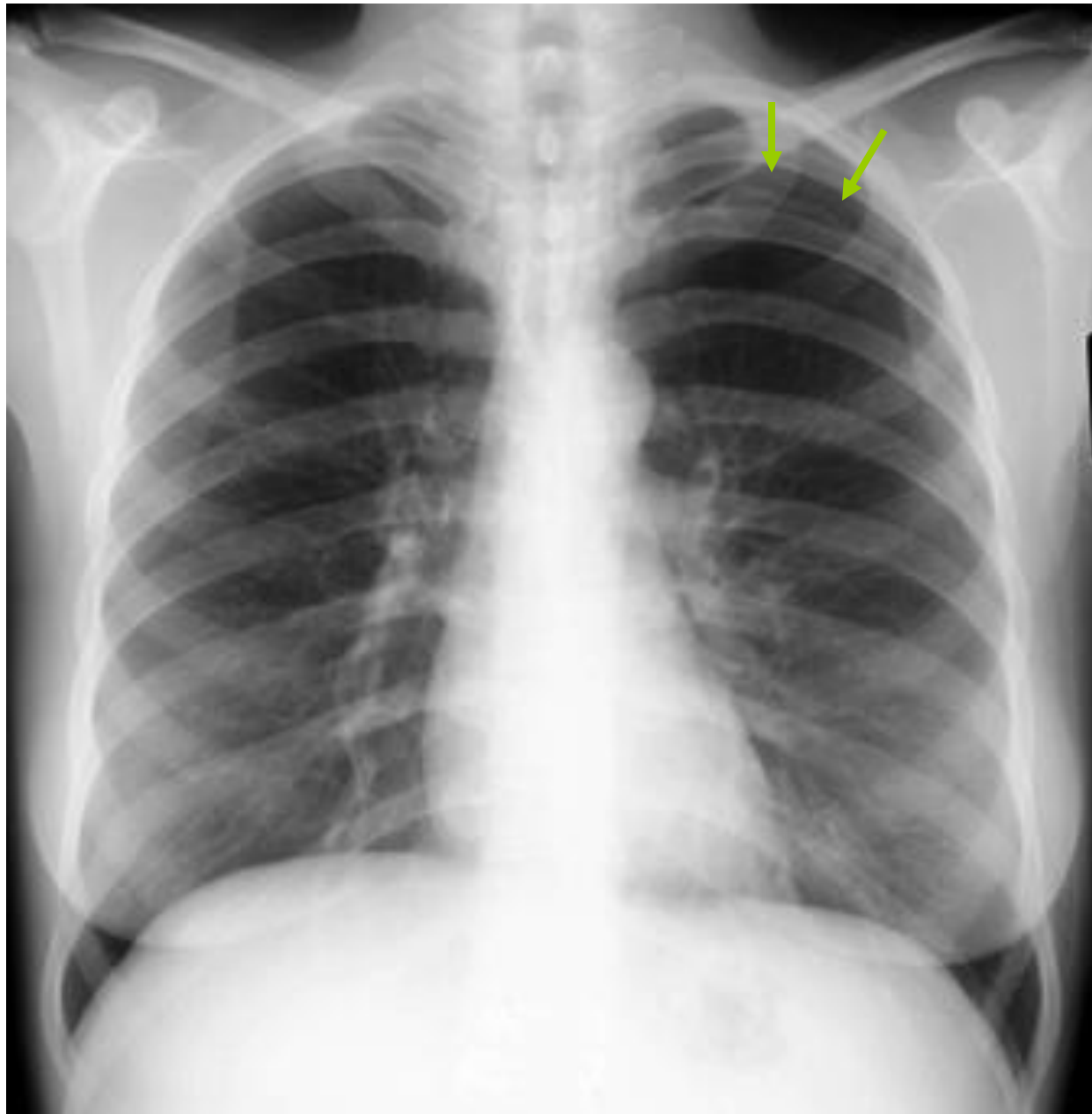




Lung Mass

# Case 13





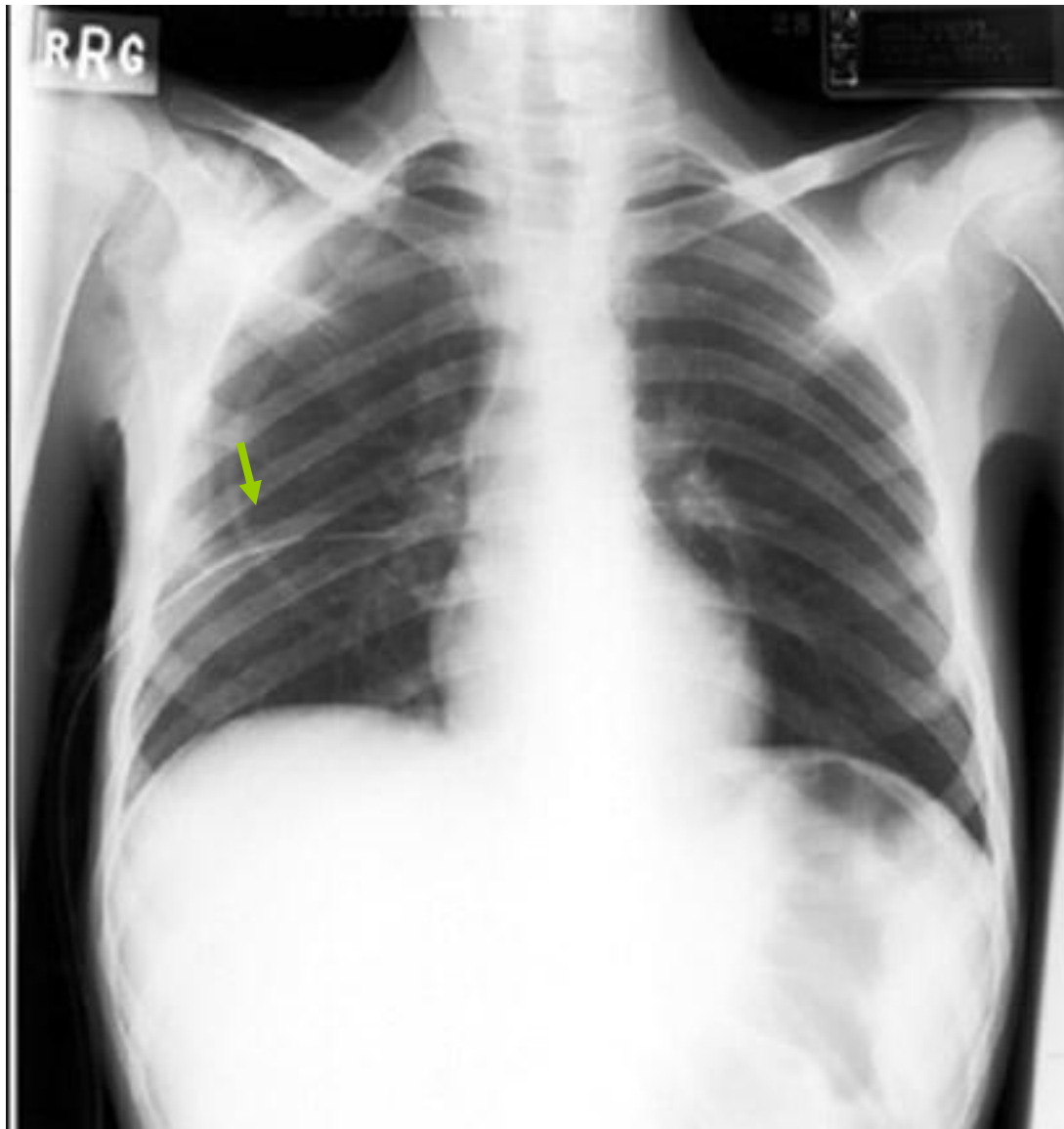
Small Pneumothorax: LUL

# Case 15





Right Middle Lobe Pneumothorax: complete lobar collapse

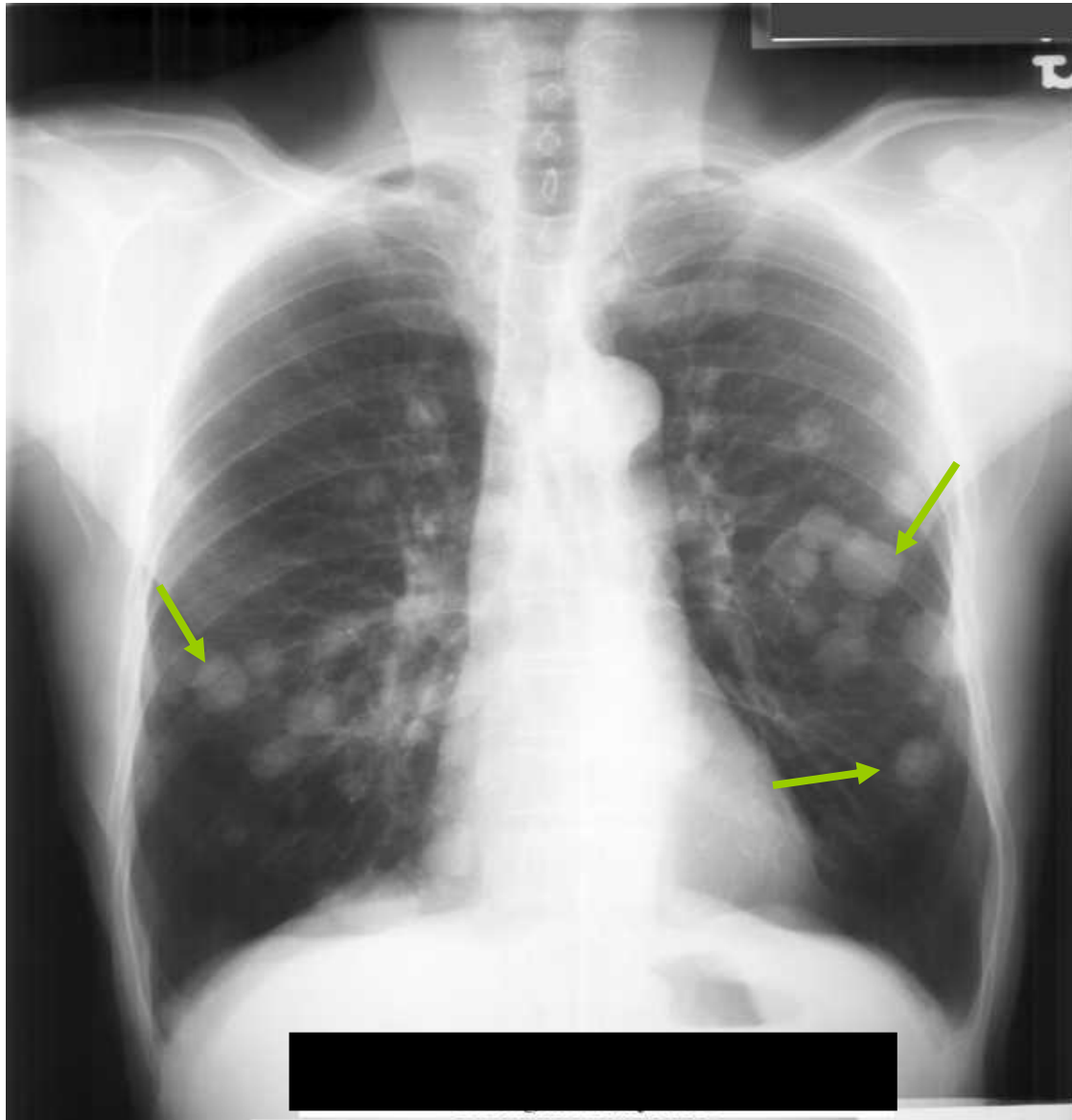


Post chest tube insertion and re-expansion



# Case 16

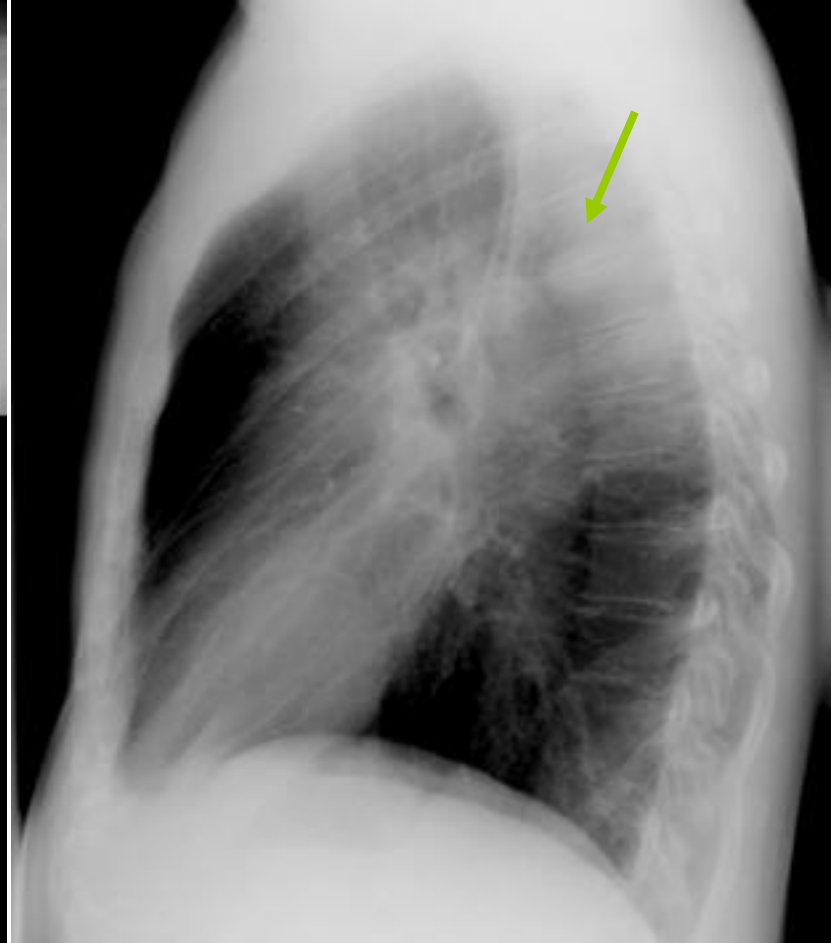
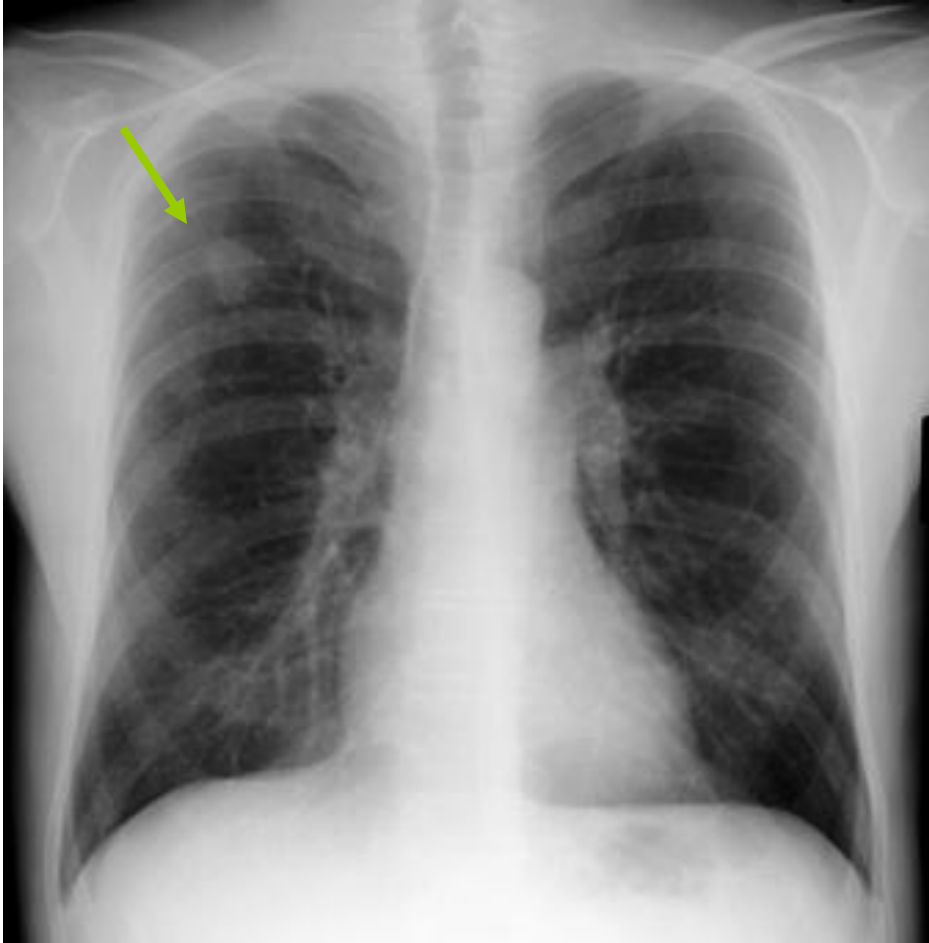




Metastatic Lung Cancer: multiple nodules seen

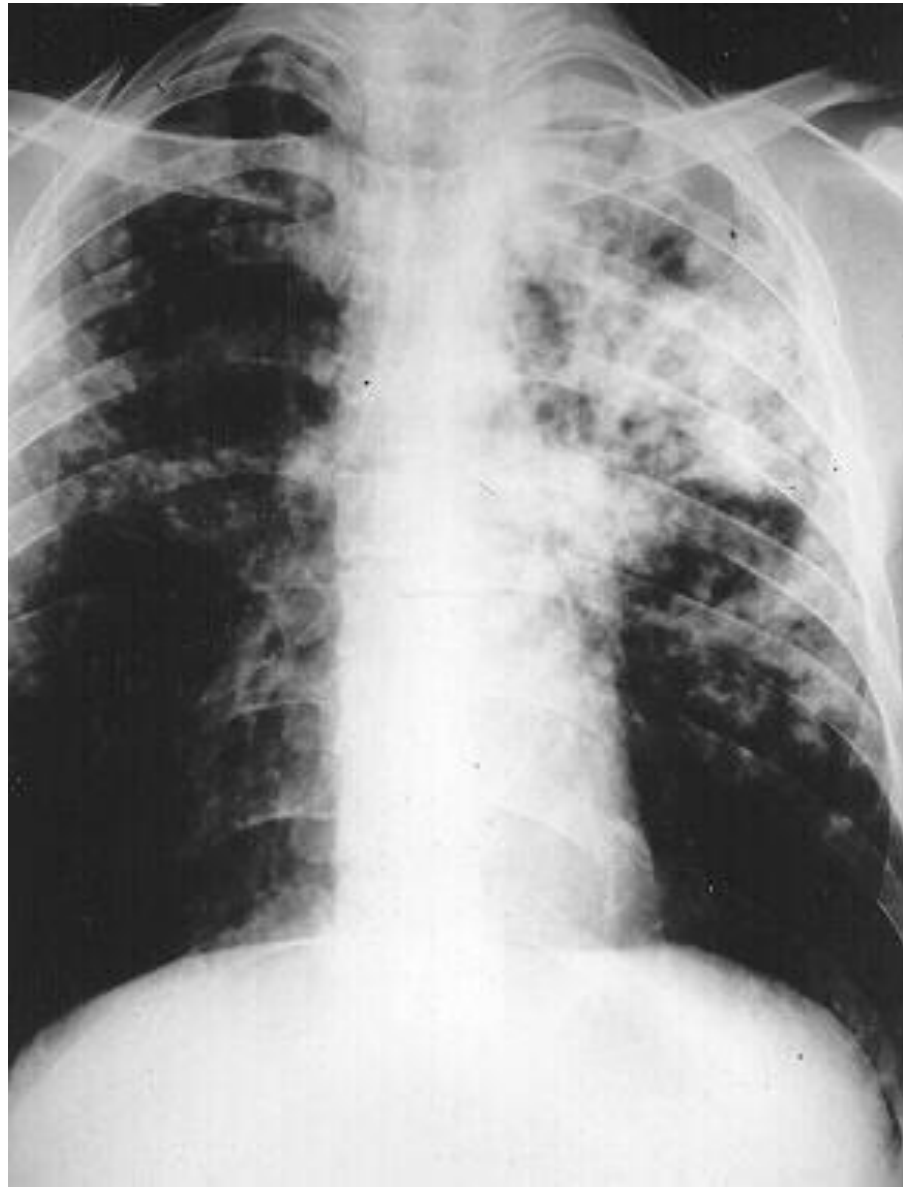
# Case 17



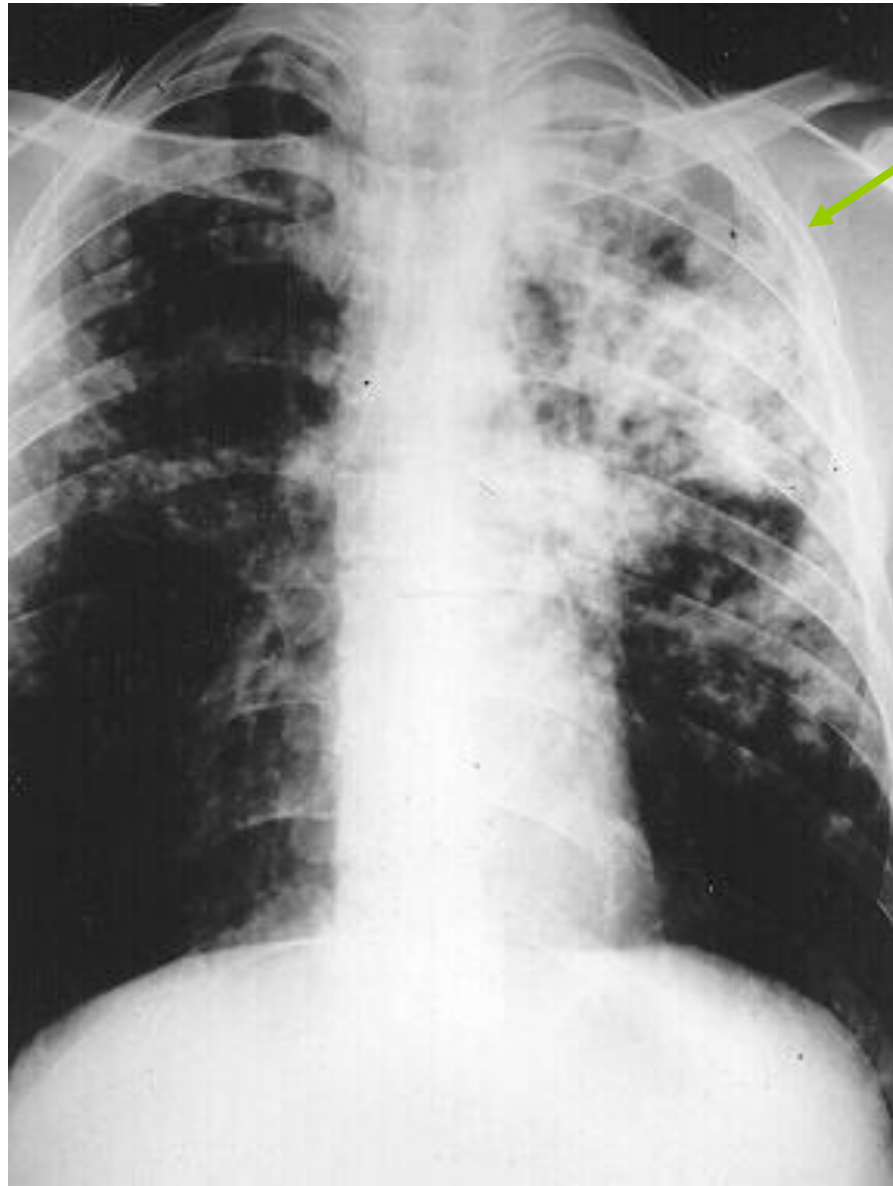


Right upper lower lobe pulmonary nodule

# Case 18

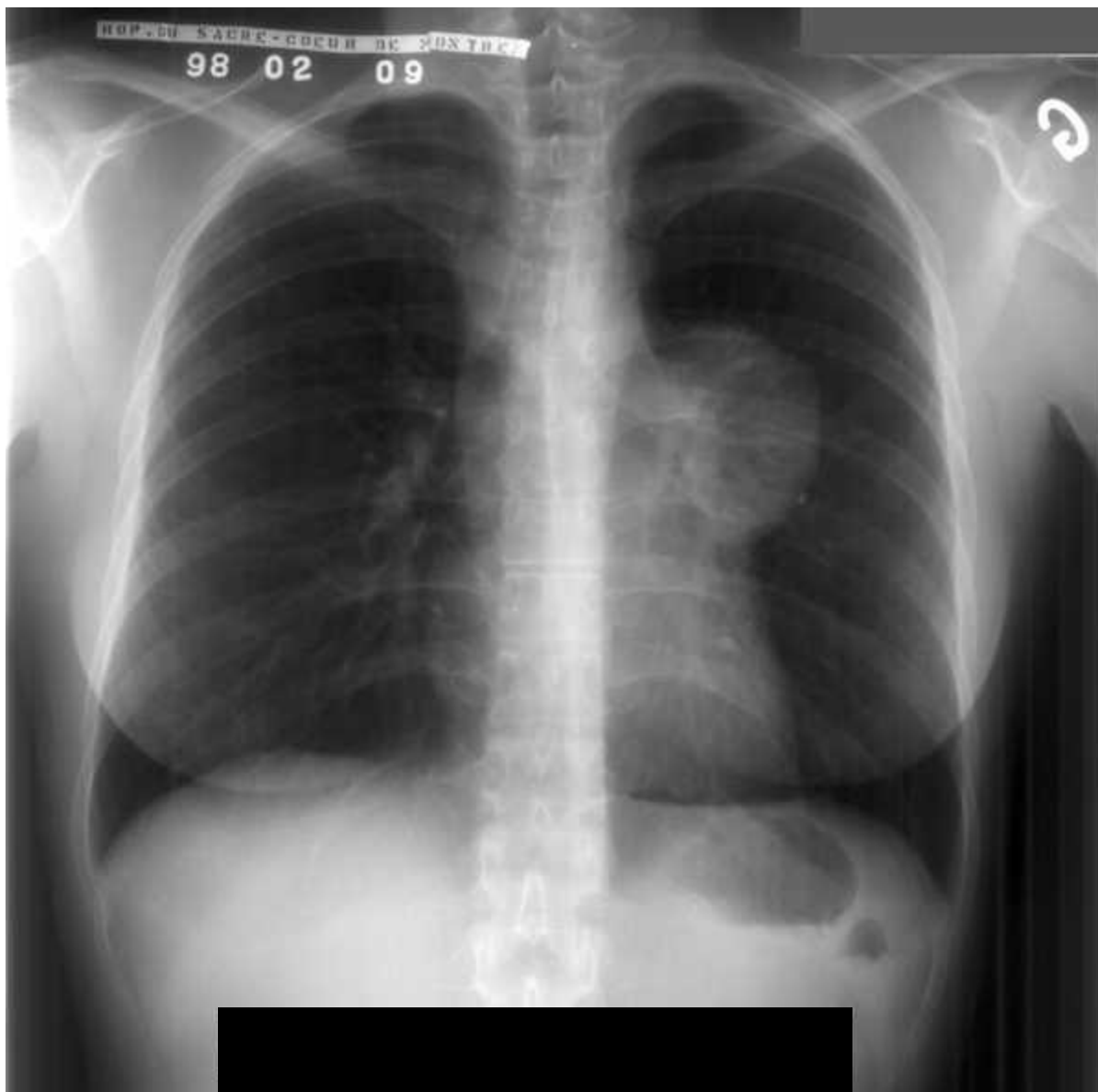


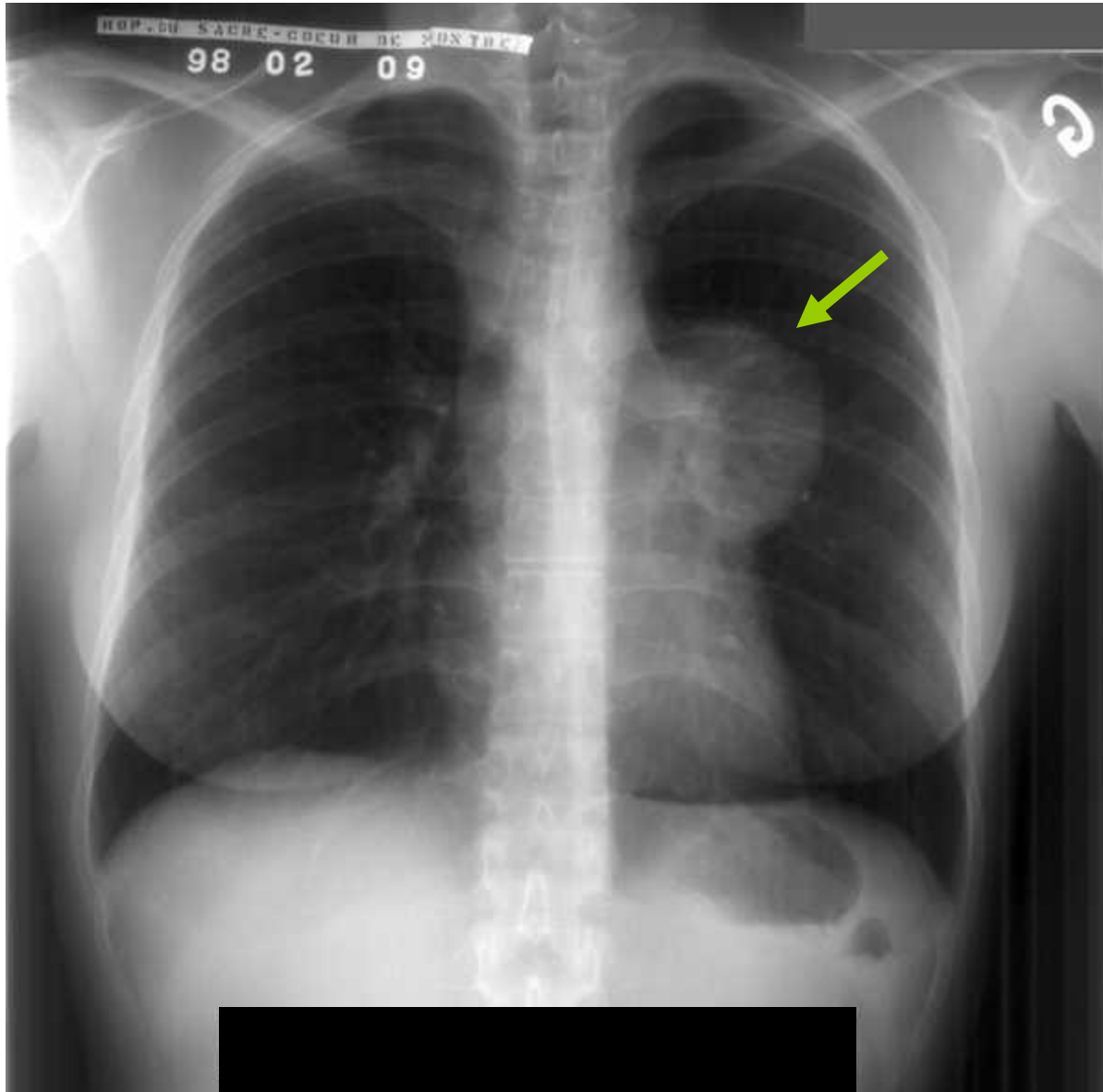




Tuberculosis

# Case 19

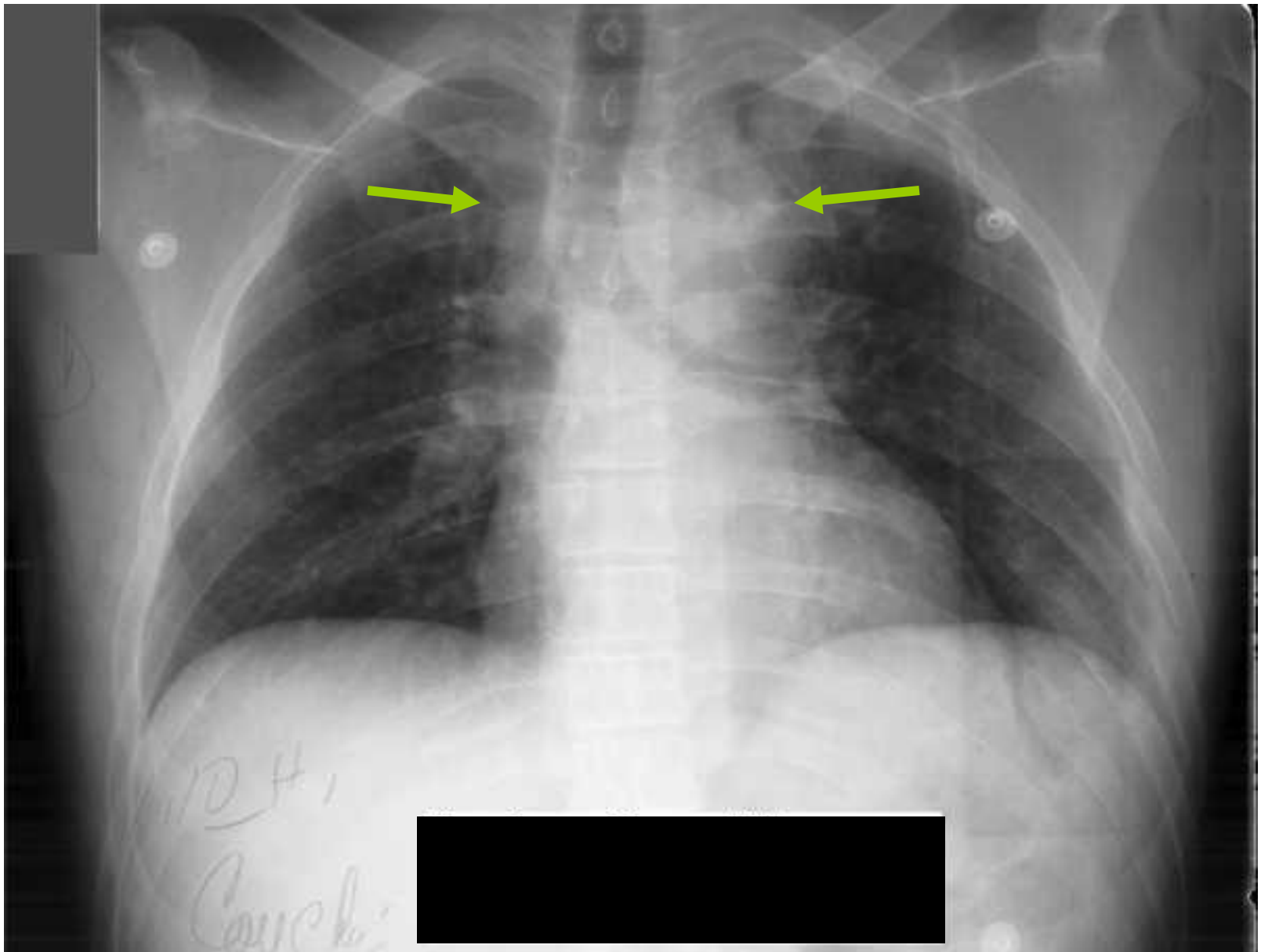




Perihilar mass: Hodgkin's disease

# Case 20





Widened Mediastinum: Aortic Dissection