

Imaging of the chest

Katarzyna Wypych
Zbigniew Serafin

Examination methods:

- Chest X-ray in P-A and lateral projection
- Fluoroscopy
- Ultrasonography
- CT, CTA, HRCT
- MRI
- Angiography
- Bronchoscopy
- Scintigraphy
- PET, PET-CT, PET-MR

Chest X-ray (CXR)

- Standard: standing position, anteroposterior (AP) projection, 2-m distance from a tube, facing the photographic plate, deep inspiration,
- Additional projections: lateral, oblique, focused, on deep expiration (pneumothorax)
- Image summation: middle shade (spine, sternum, mediastinum organs) + 2 lung fields (limited by ribs, diaphragm, mediastinum)

PLAIN RADIOGRAPHY OF THE CHEST

- **Indications:**

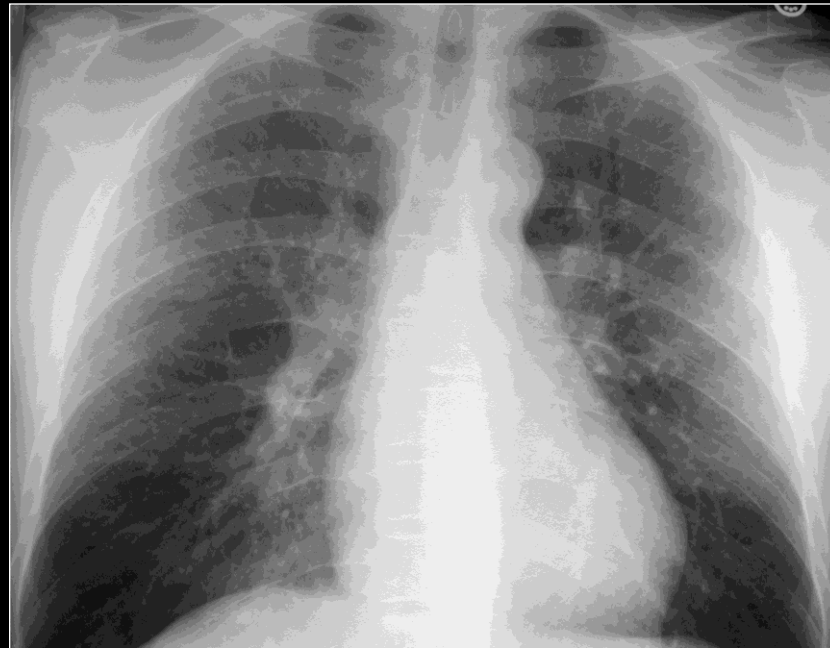
- Diagnosis & follow up of chest & heart diseases.
- Routine pre-employment examination.
- Routine preoperative examination
- Follow up of malignancy
- Medical checkup.

What is a Chest Radiograph?

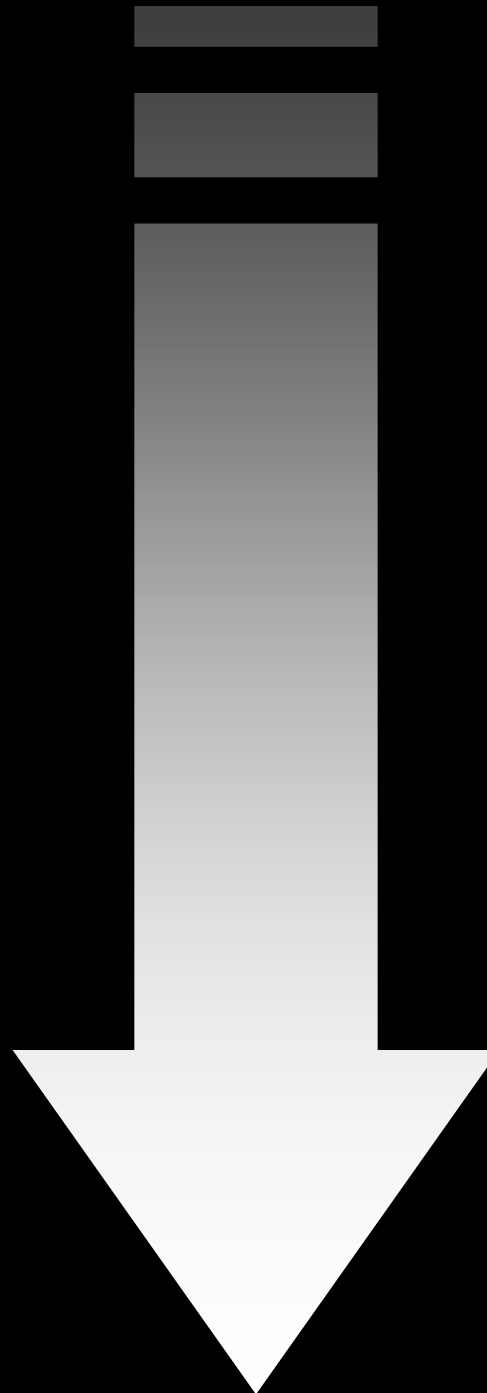
SHADOW

Chest Radiography: Basic Principles

- A structure is rendered visible on a radiograph by the juxtaposition of two different densities



**Maximum x-ray
Transmission
(least dense tissue)**



Blackest

air

fat

soft tissue

calcium

bone

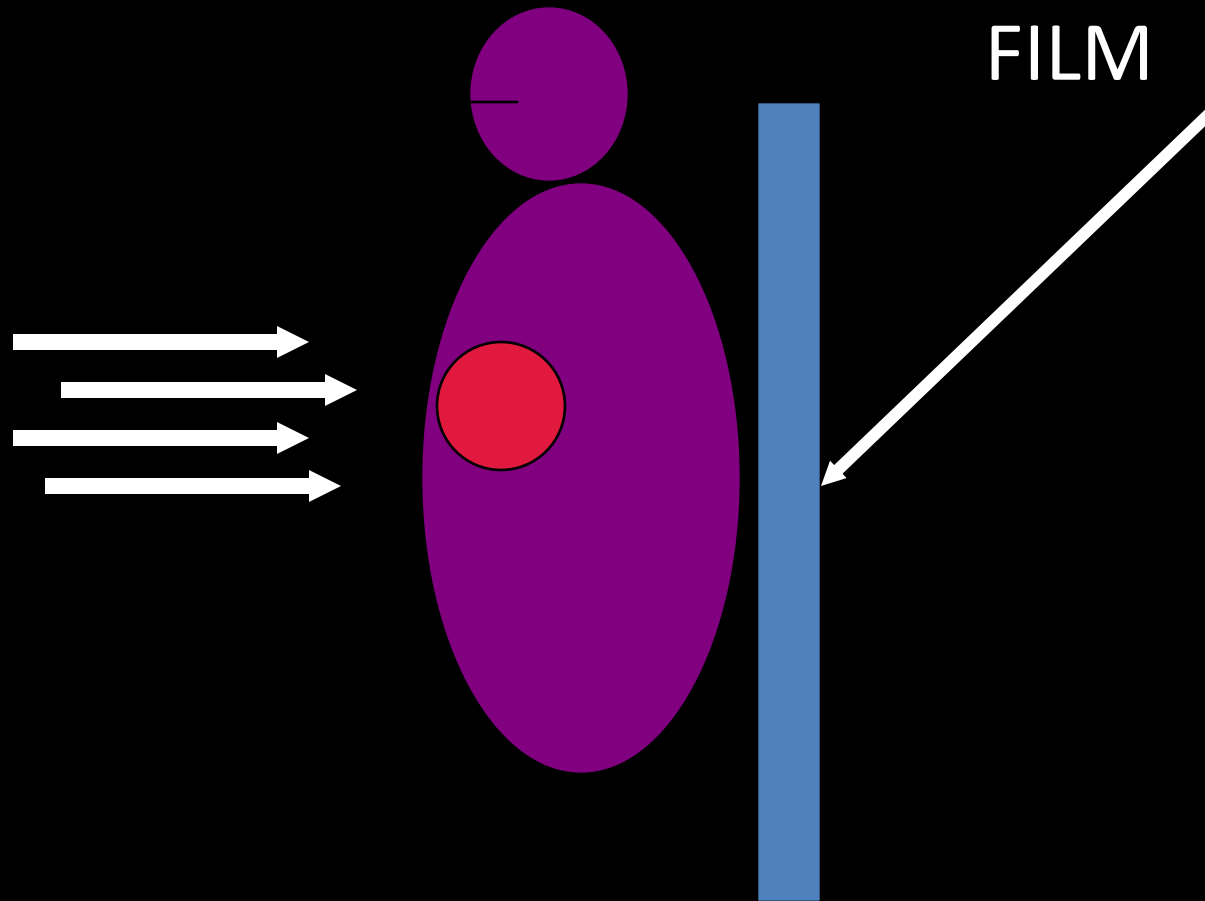
x-ray contrast

metal

Whitest

**Maximum x-ray
Absorption
(densest tissue)**

Portable (**AP** or Antero-posterior)



PLAIN RADIOGRAPHY OF THE CHEST (CXR)



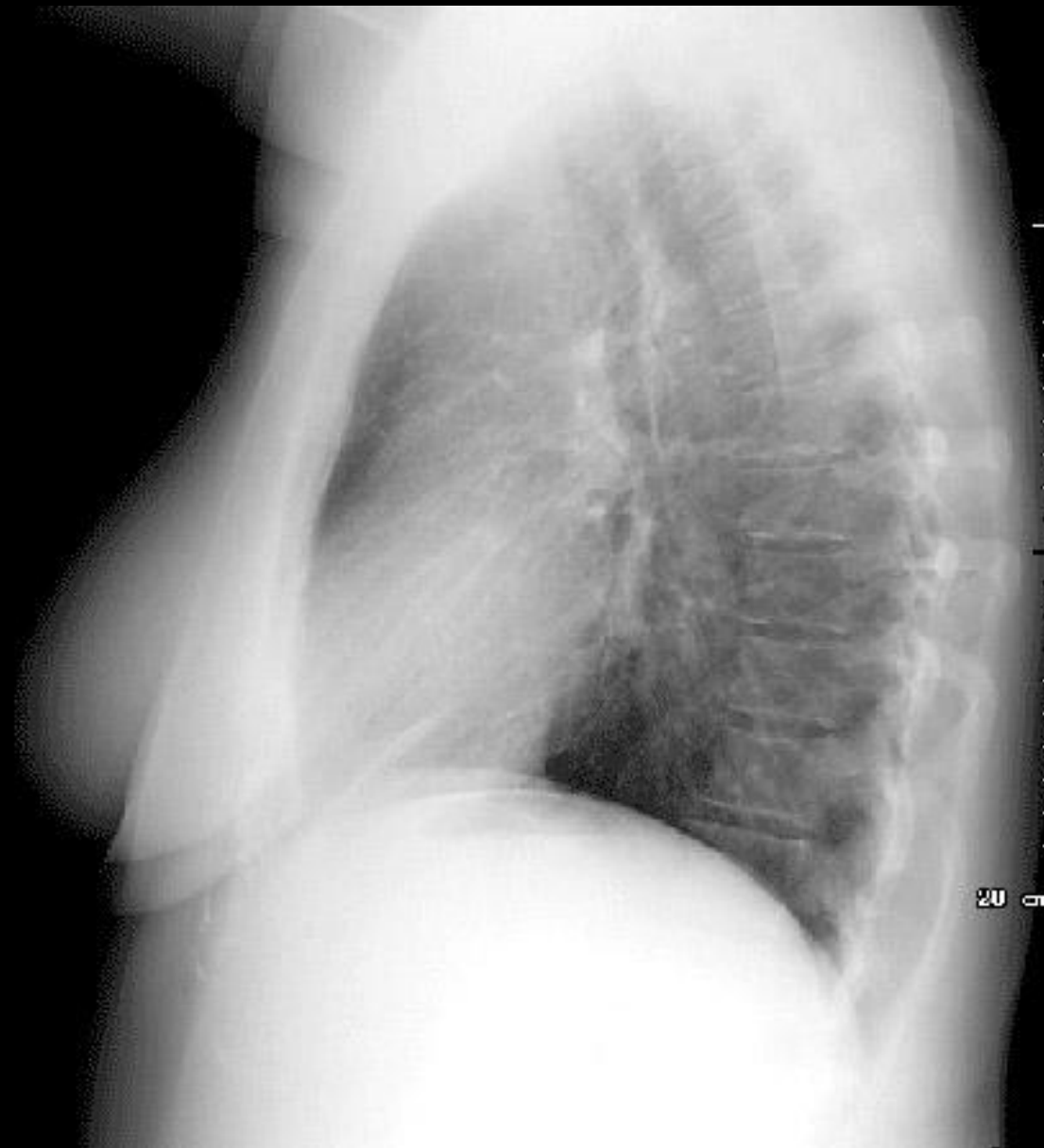
Normal PA View of the chest



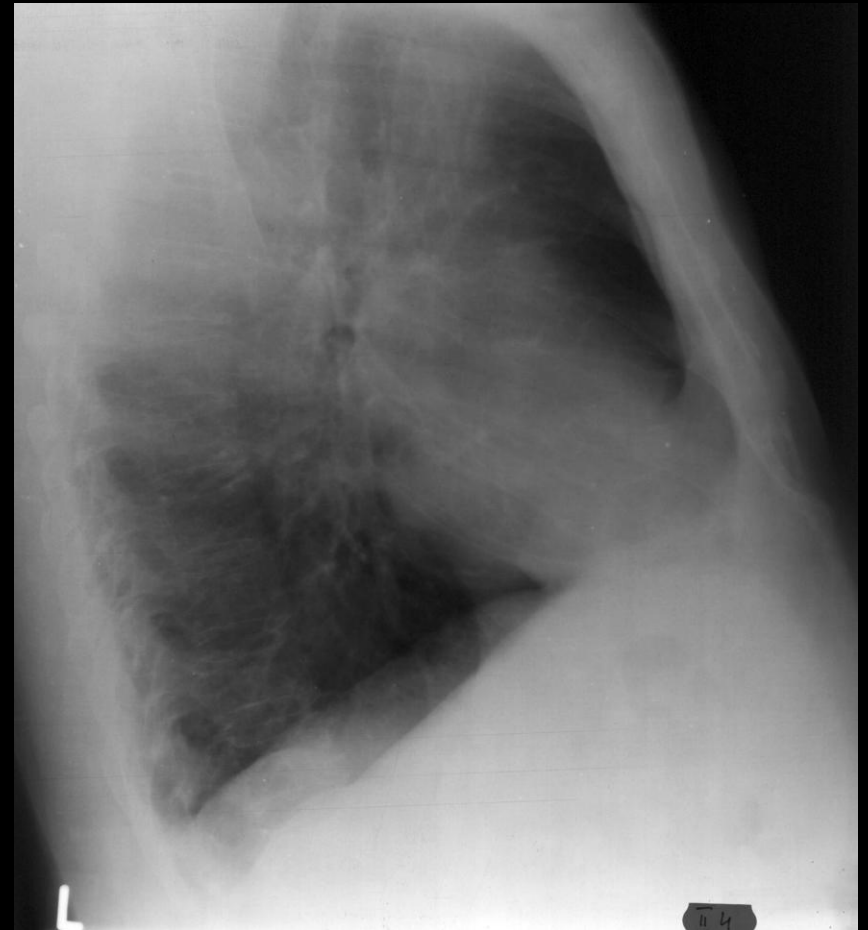
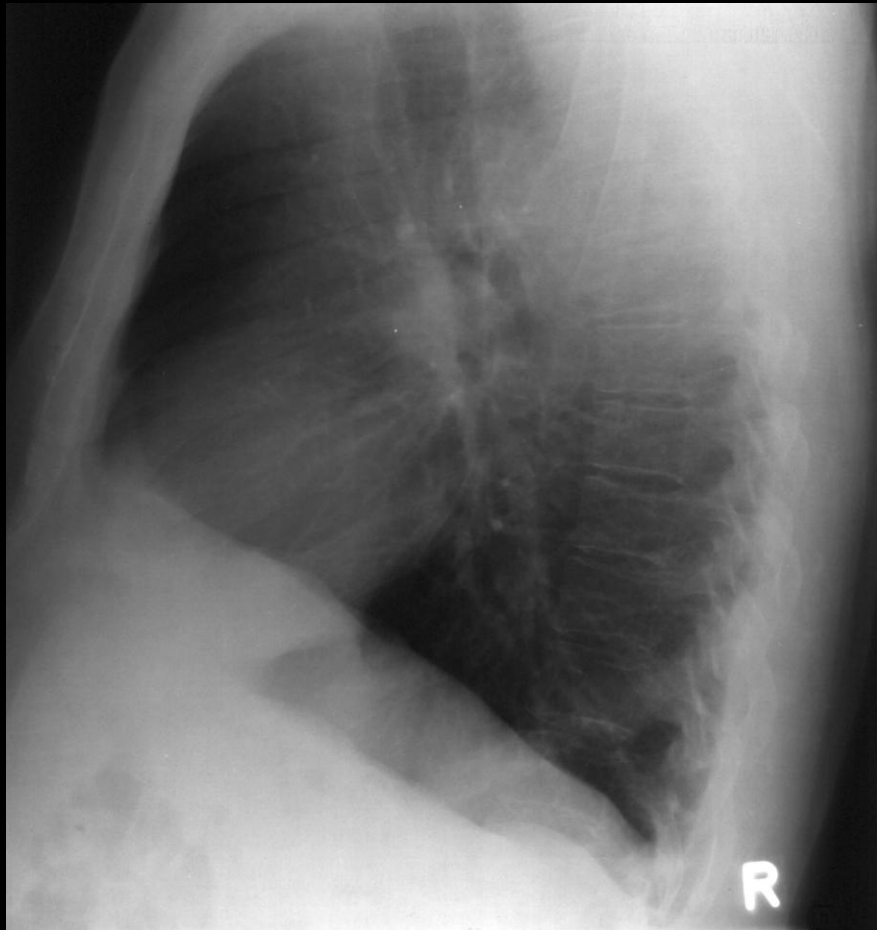
PLAIN RADIOGRAPHY OF THE CHEST (CXR)



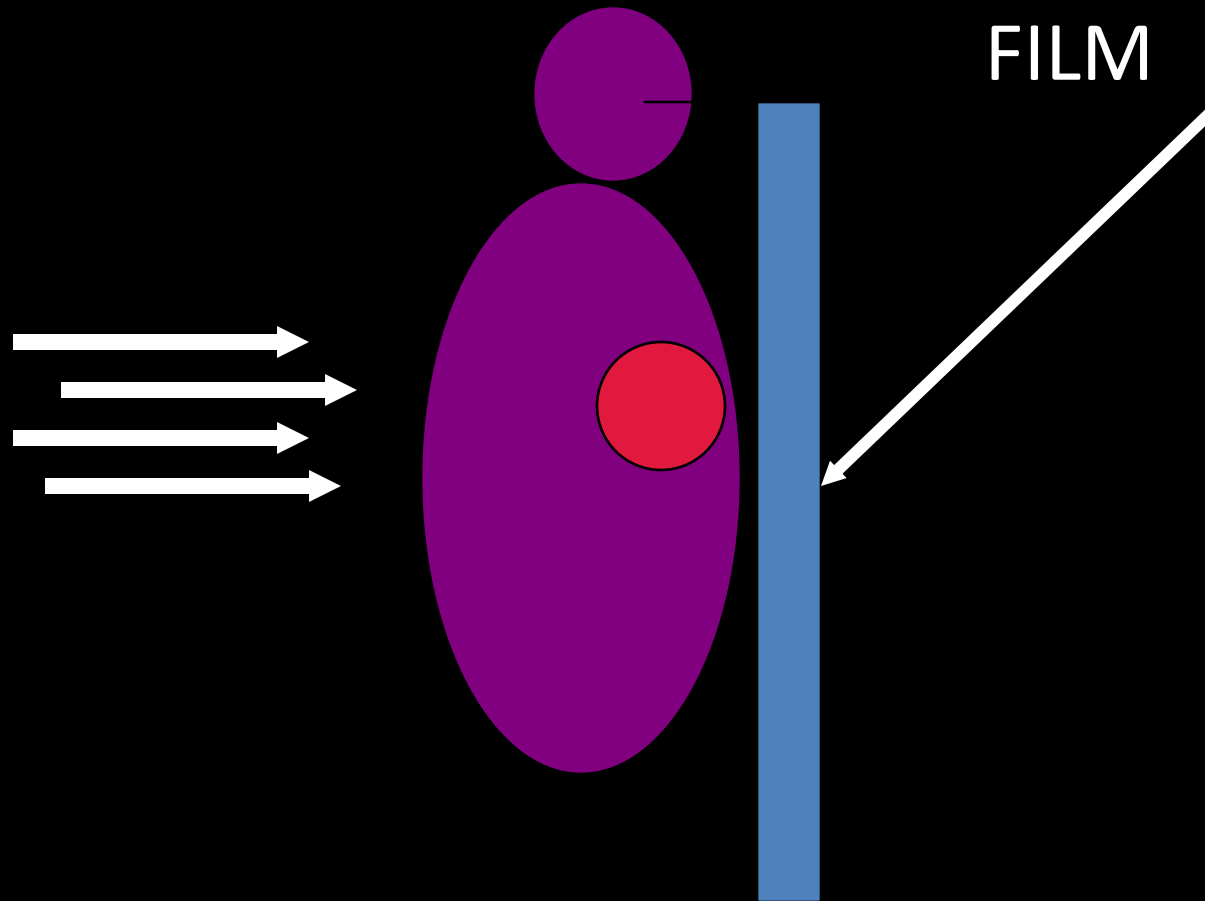
Normal Lateral View of the chest



The chest X-ray - lateral



PA (Postero-anterior)



PLAIN RADIOGRAPHY OF THE CHEST (CXR)

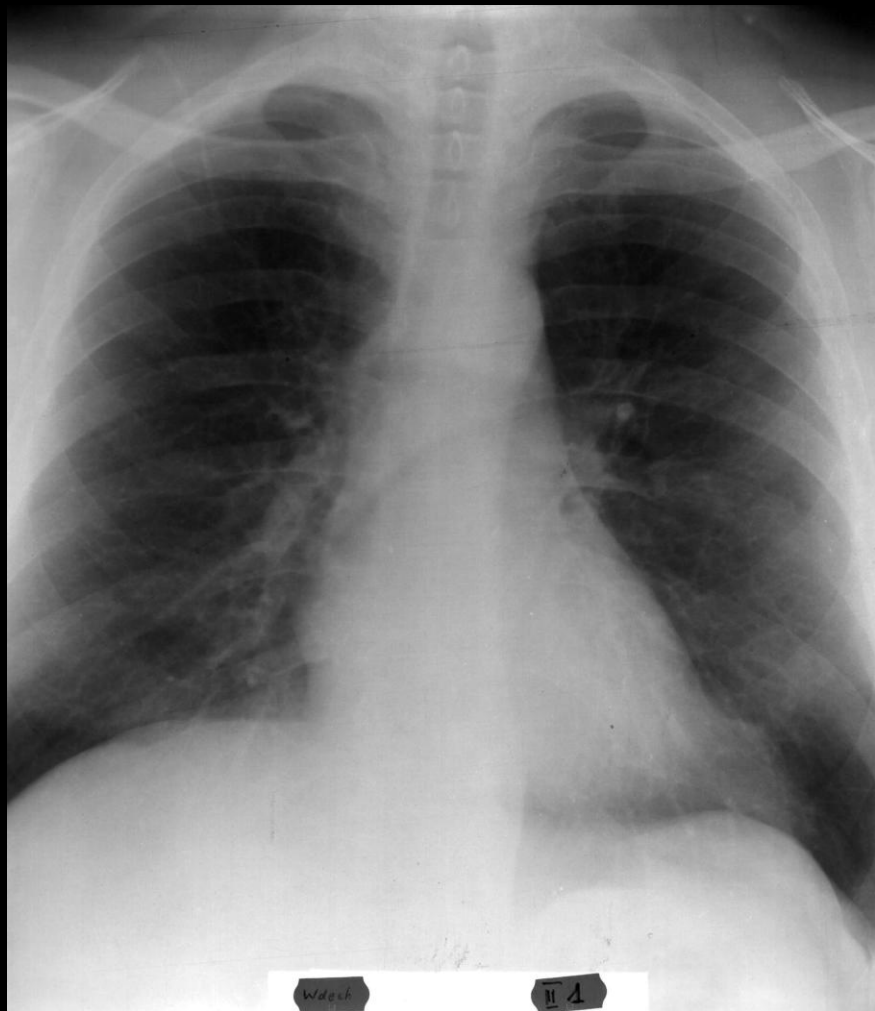




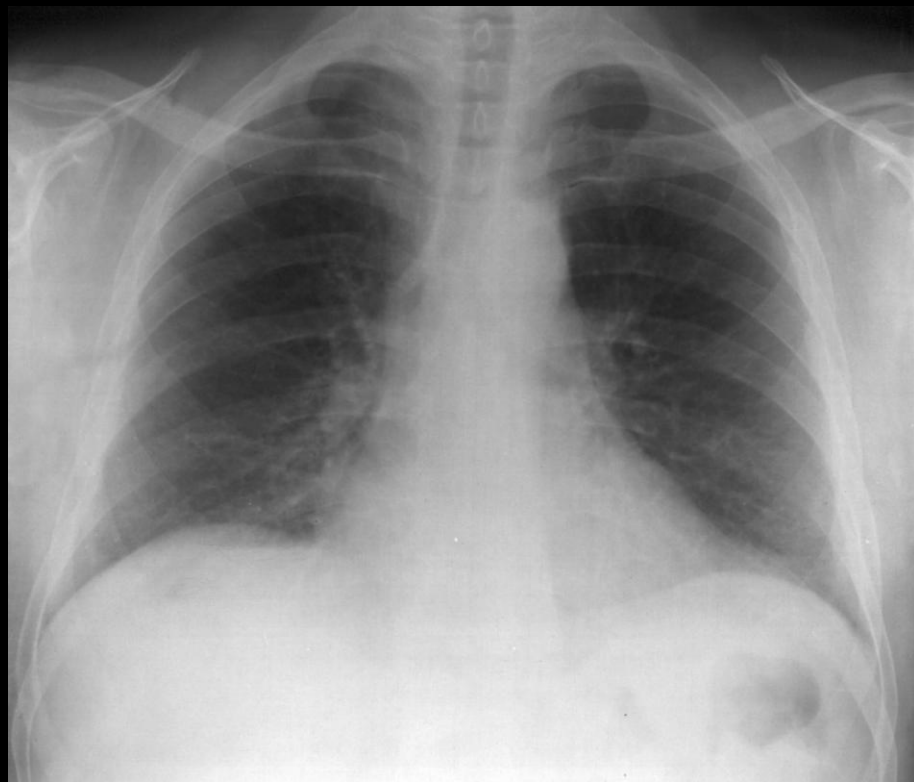
PA



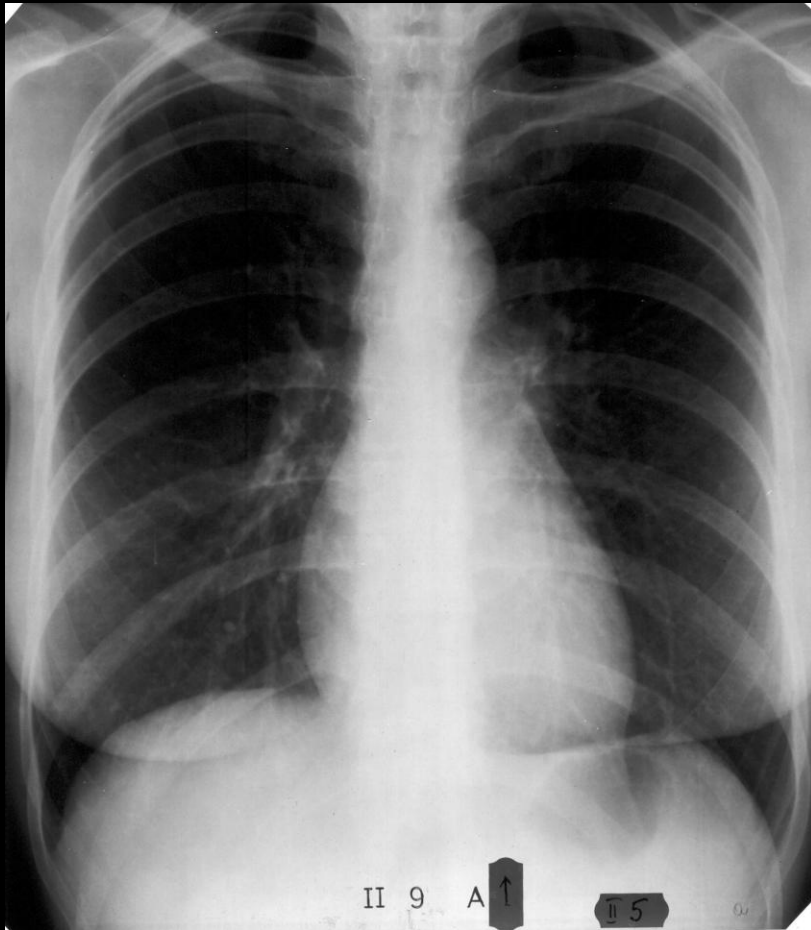
AP



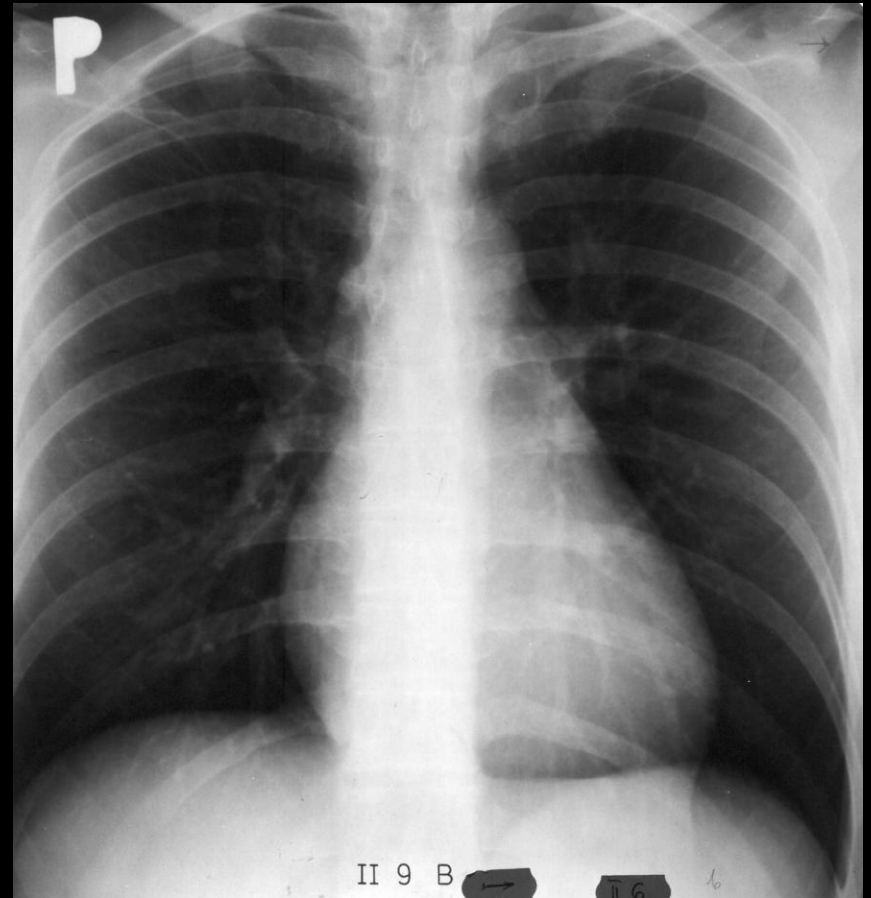
inspiration



expiration



Standing position



Lying position

PLAIN RADIOGRAPHY OF THE CHEST

ANALYSIS OF THE X-RAY OF THE CHEST

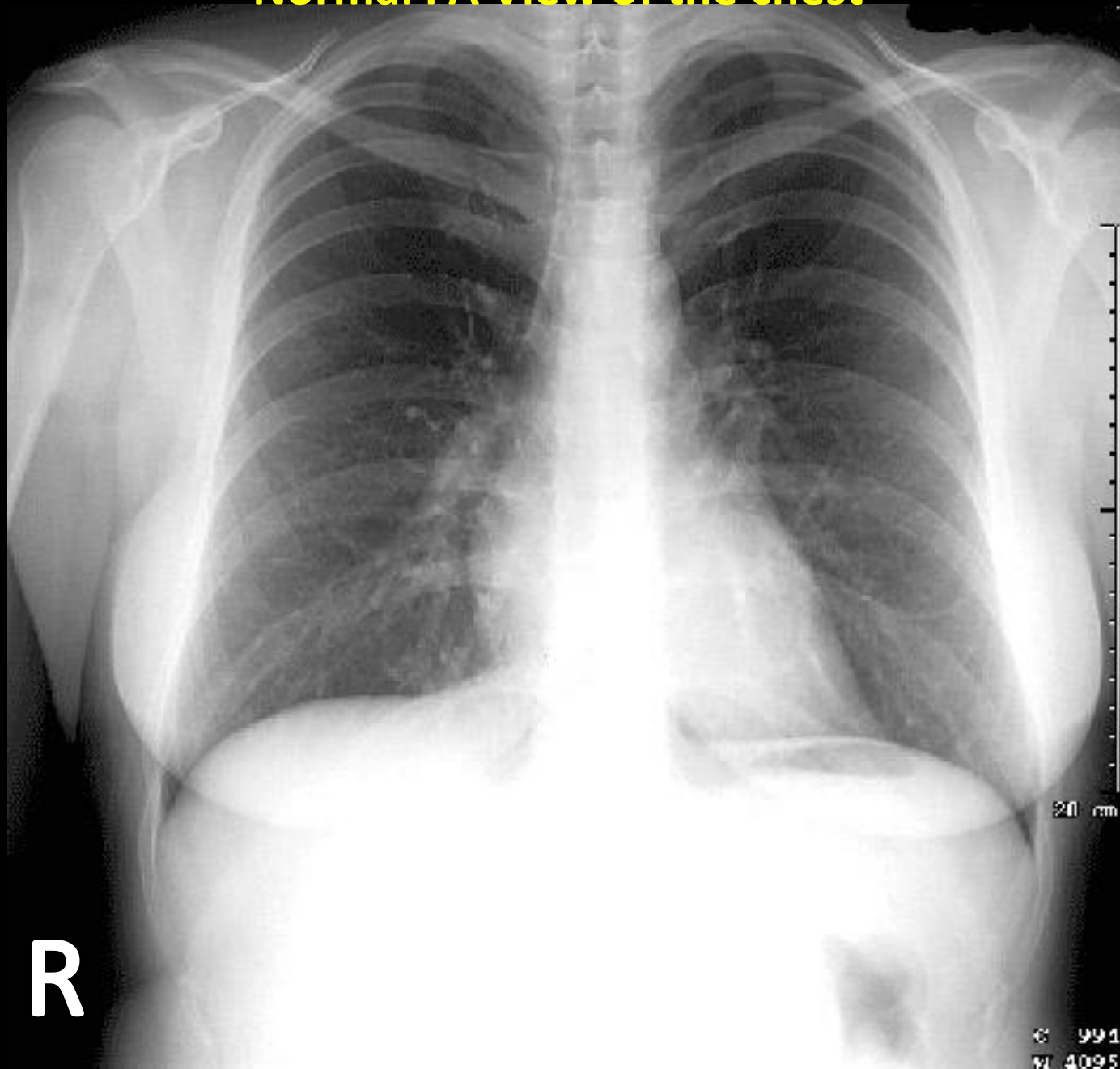
- Does the x-ray belong to the correct patient? Check the patient's name on the film.
- Have the left and right side markers been labeled correctly, or does the patient really have dextrocardia?
- Lastly has the projection of the radiograph (PA vs. AP) been documented?

PLAIN RADIOGRAPHY OF THE CHEST (CXR)

CRITERIA OF A GOOD X-RAY OF THE CHEST

- Patient central
 - a-Sterno-clavicular junction equidistant from midline (spinous process).
 - b-Mediasternum 2/3 to left and 1/3 to right
- Lung apices appear and lower 3 cervical vertebrae.
- The diaphragm should be found at about the level of the 8th - 10th posterior rib or 5th - 6th anterior rib on good inspiration.
- Costo-phrenic and cardio-phrenic are seen
- Scapula away from lung field.
- Vertebral bodies should just be visible through the heart. Intervertebral disc spaces and anterior end of ribs not seen through cardiac shadow
 - Non visualized vertebral bodies & 'whiter' film → Underexposure
 - If the film appears too 'black' → Overexposure

Normal PA View of the chest

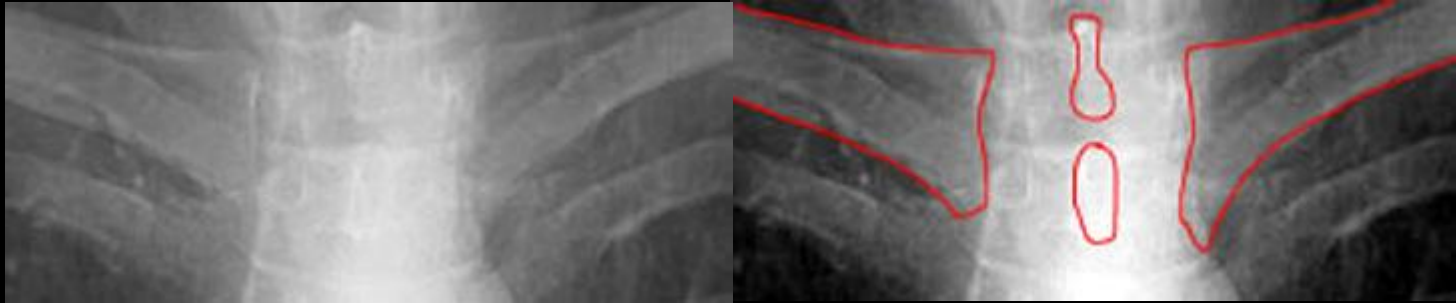


R

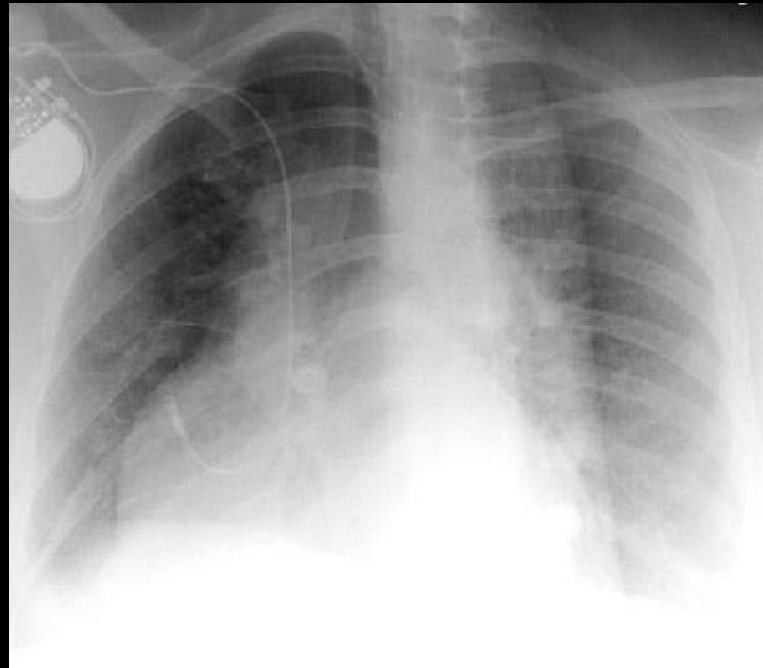
20 cm

© 991
4095

Centrally Positioned Film



Rotated Film



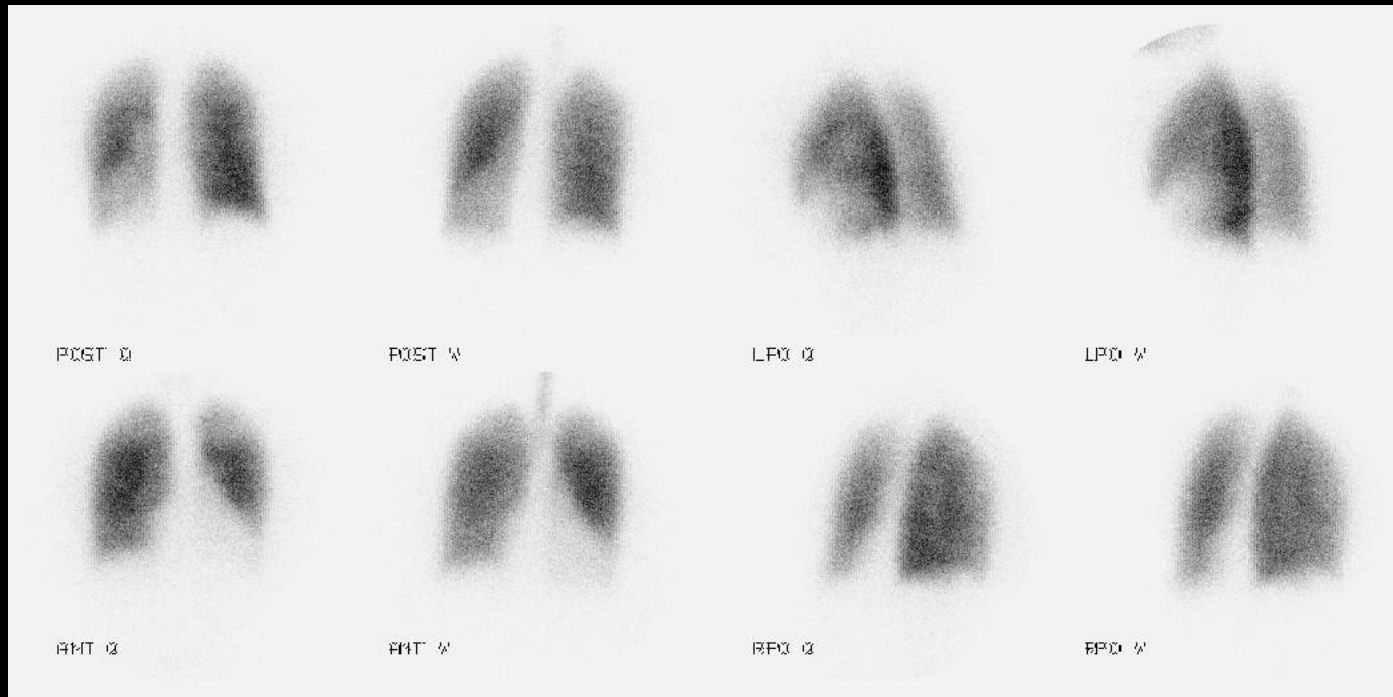
Penetration (Exposure)



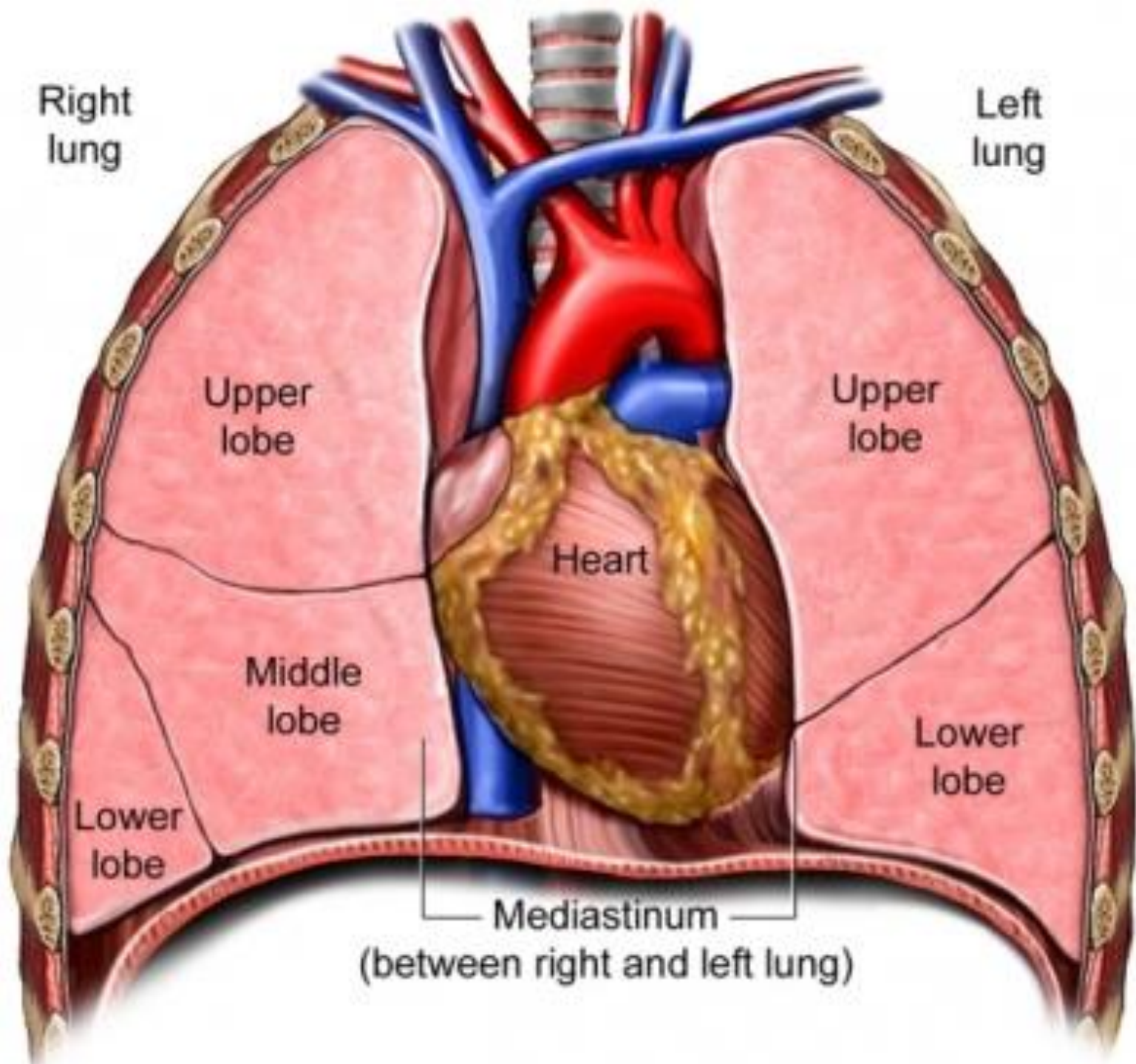
Under Exposed (Soft)



Over Exposed (hard)



Isotope Studies



Right lung

Left lung

Upper lobe

Upper lobe

Middle lobe

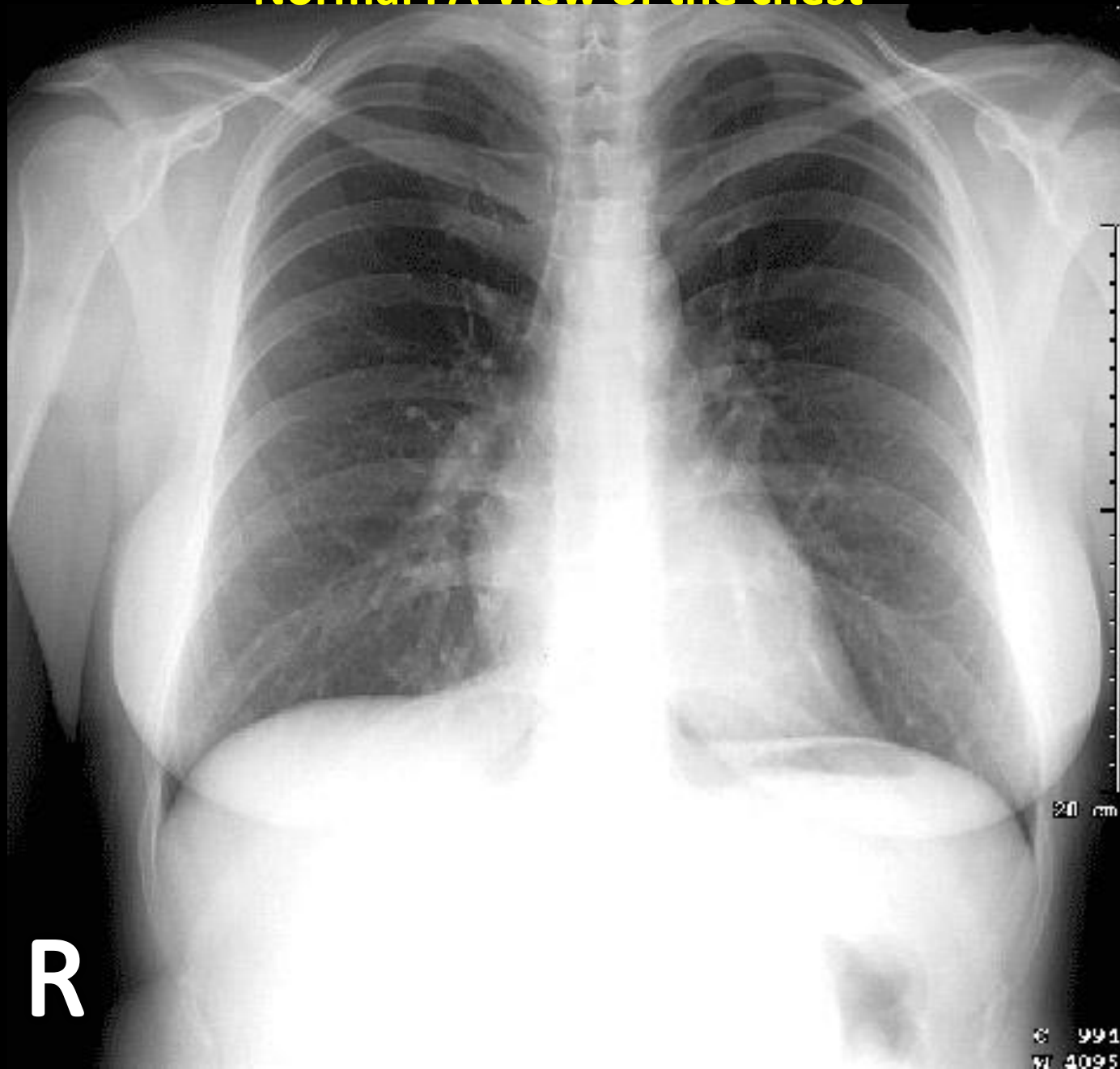
Lower lobe

Heart

Lower lobe

Mediastinum
(between right and left lung)

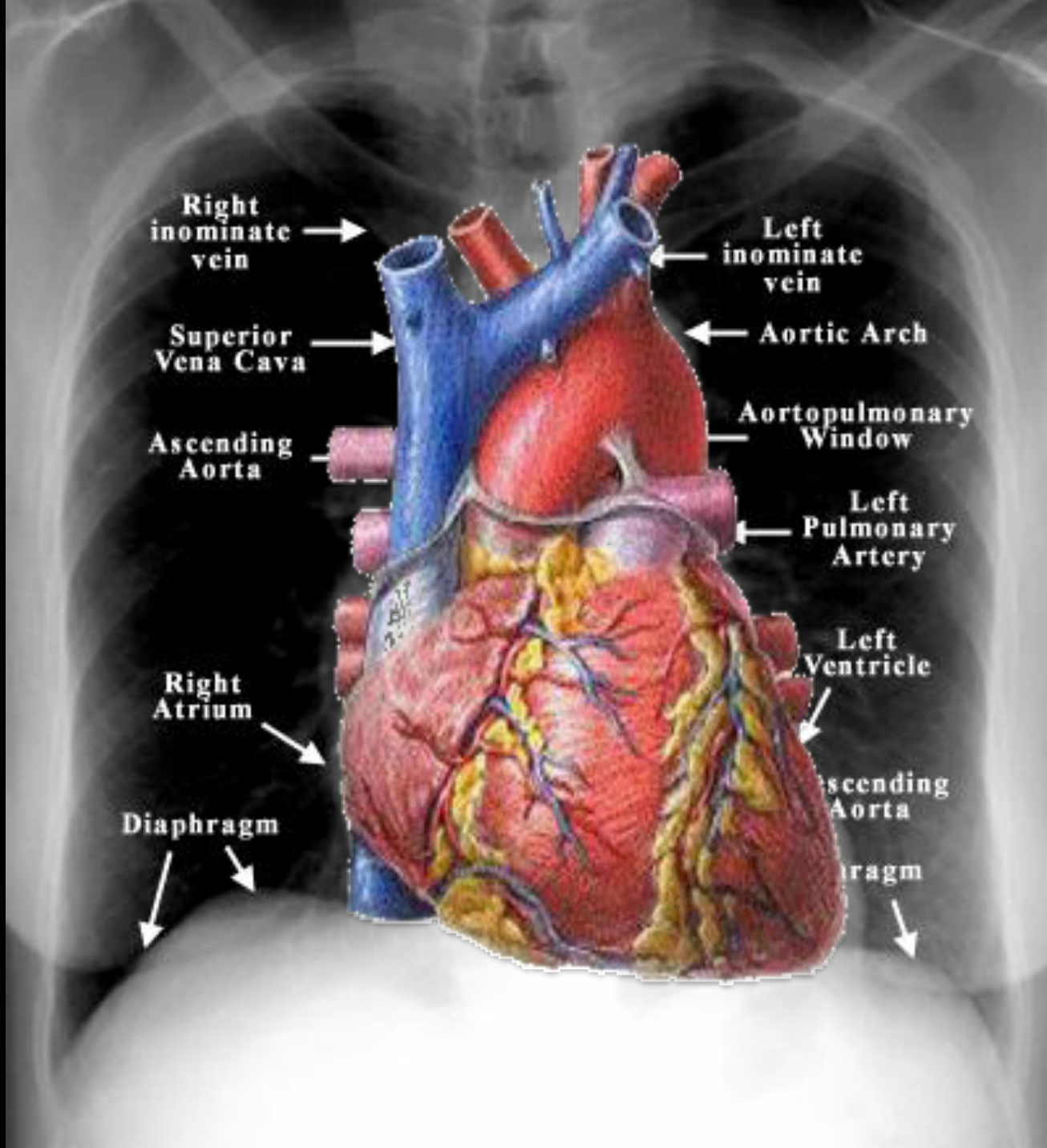
Normal PA View of the chest

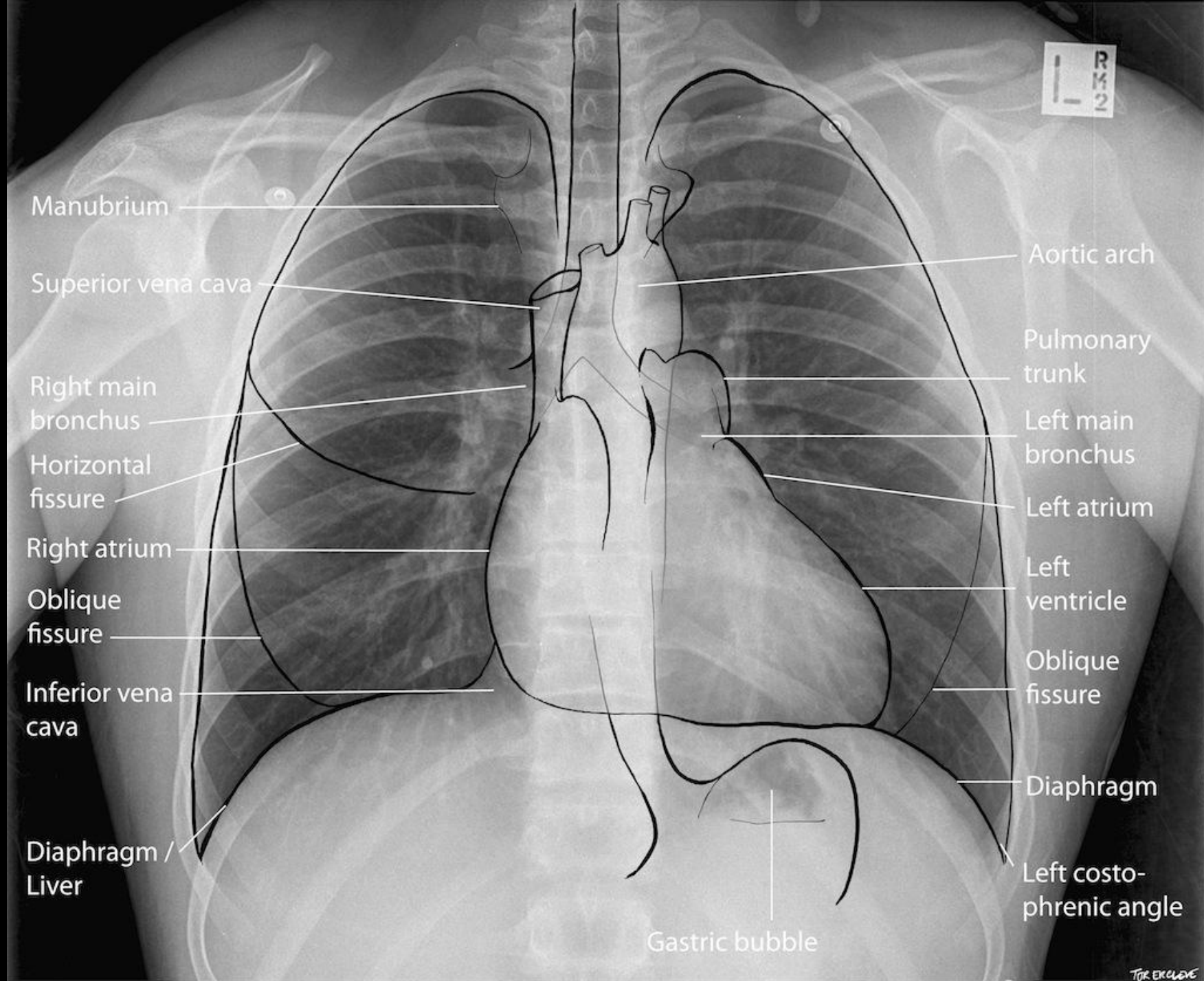


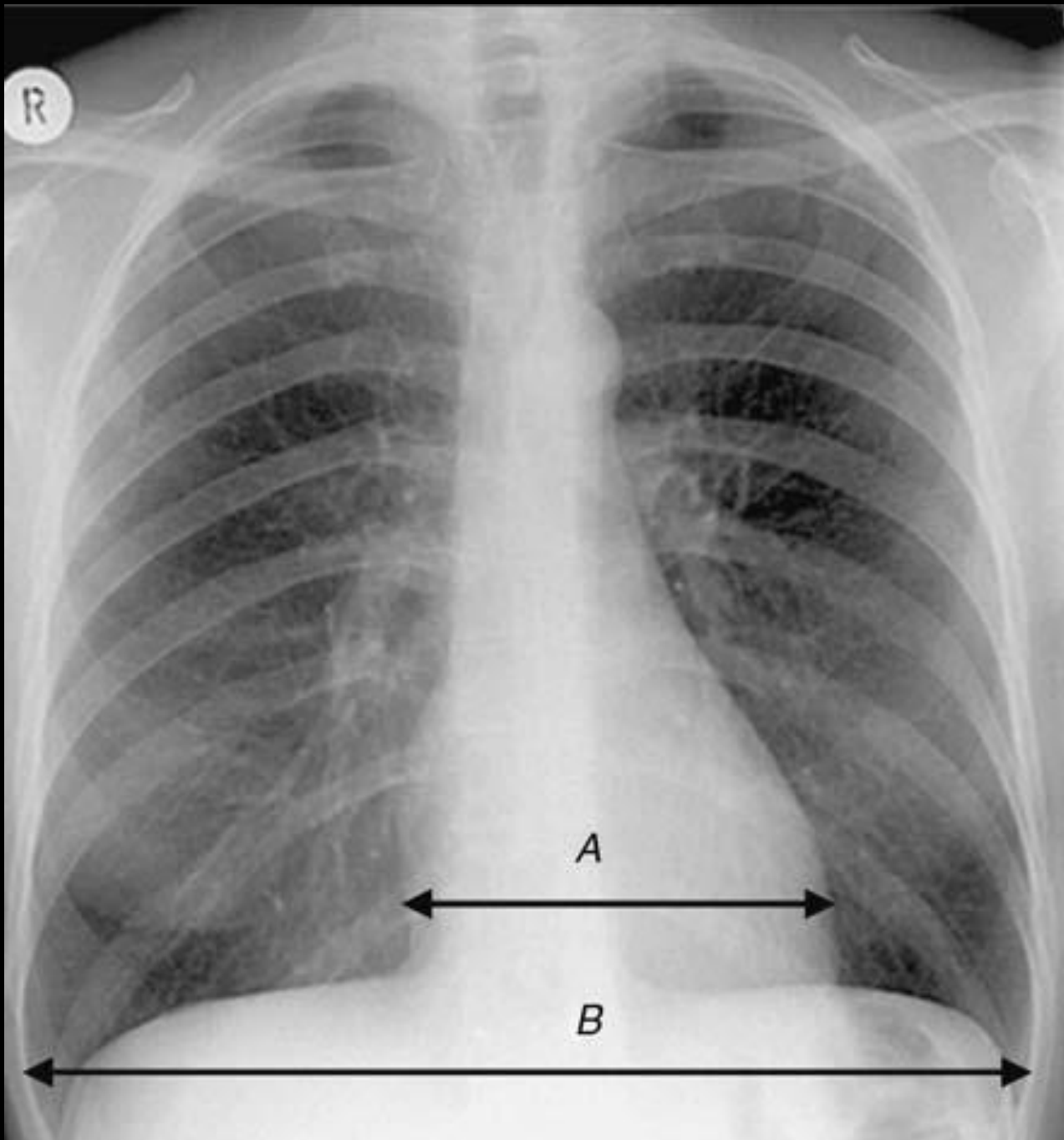
R

20 cm

© 991
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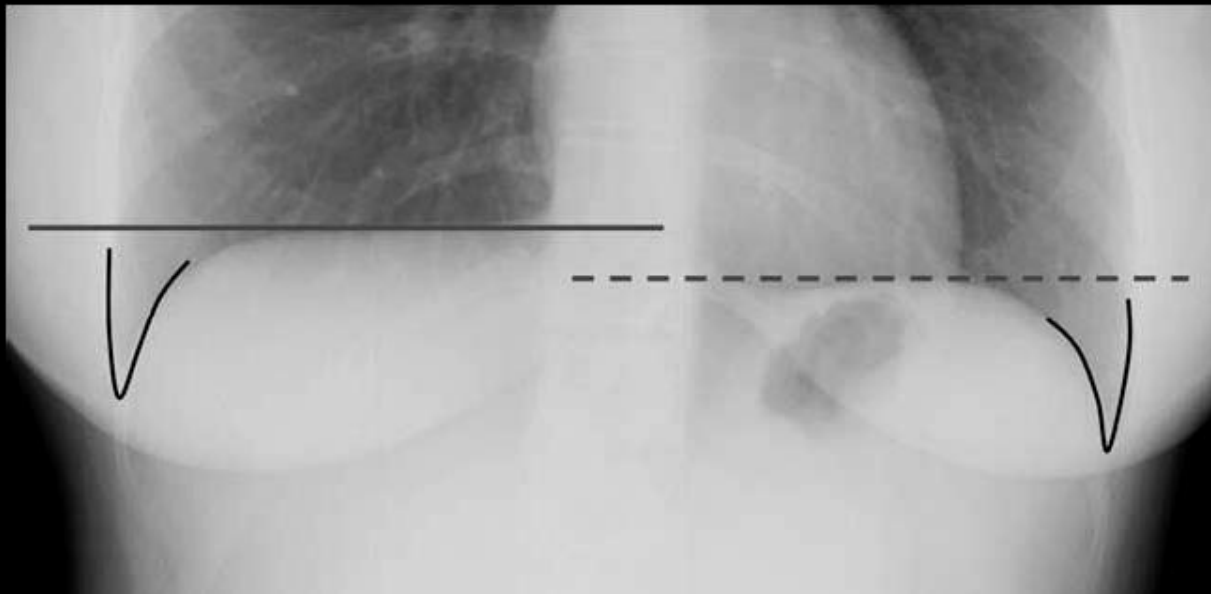






Pleura and Diaphragm:

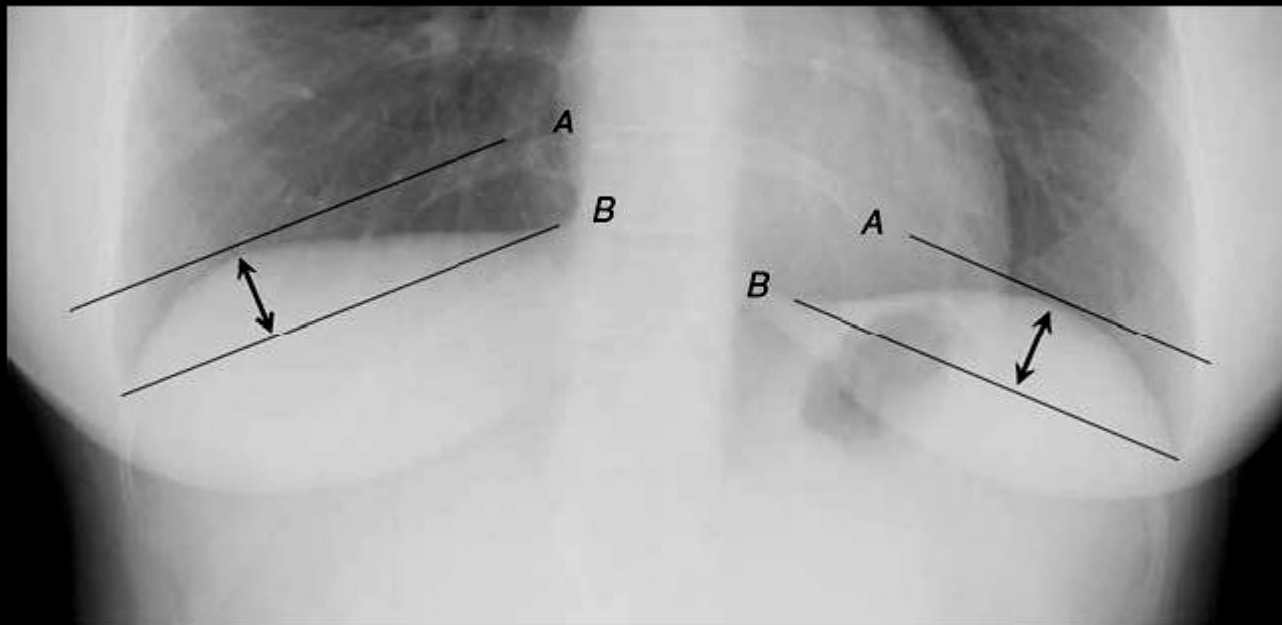
- The highest point of the right diaphragm is usually 1–1.5 cm higher than that of the left.
- Each costophrenic angle should be sharply outlined.



Pleura and Diaphragm:

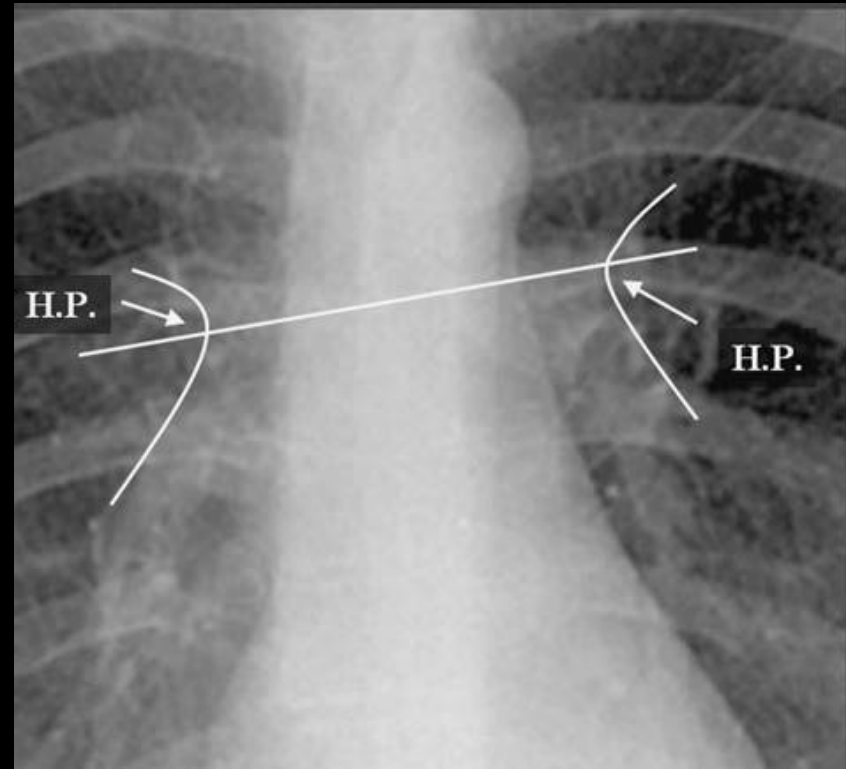
- **Assessment of diaphragmatic flattening**

- The highest point of a hemidiaphragm should be at least 1.5 cm above a line drawn from the cardiophrenic to the costophrenic angle.



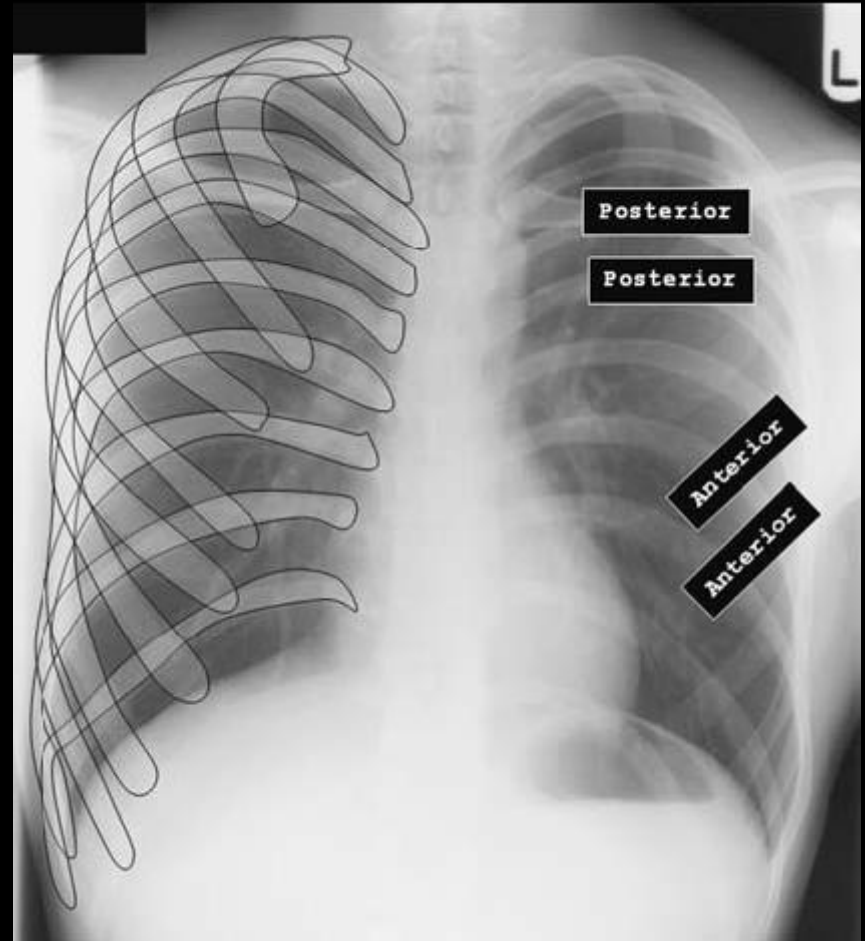
Hilar region:

- Both hila should be concave.
- Both hila should be of similar density.
- The left hilum is usually superior to the right by up to 1 cm.

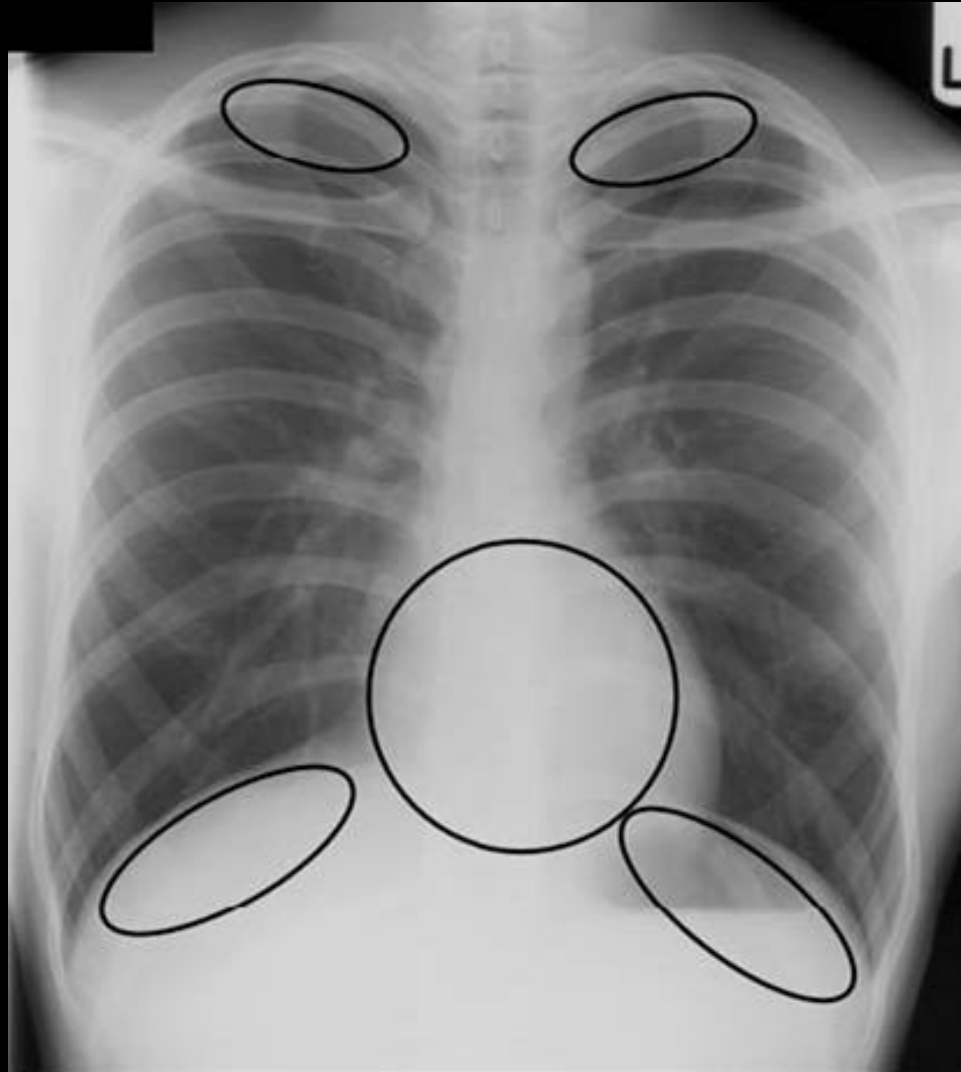


Bones and soft tissue:

- Ribs (anterior and posterior)
- Clavicles
- Vertebrae
- Shoulder joints
- Look carefully at the soft tissues for asymmetry (i.e. mastectomy)

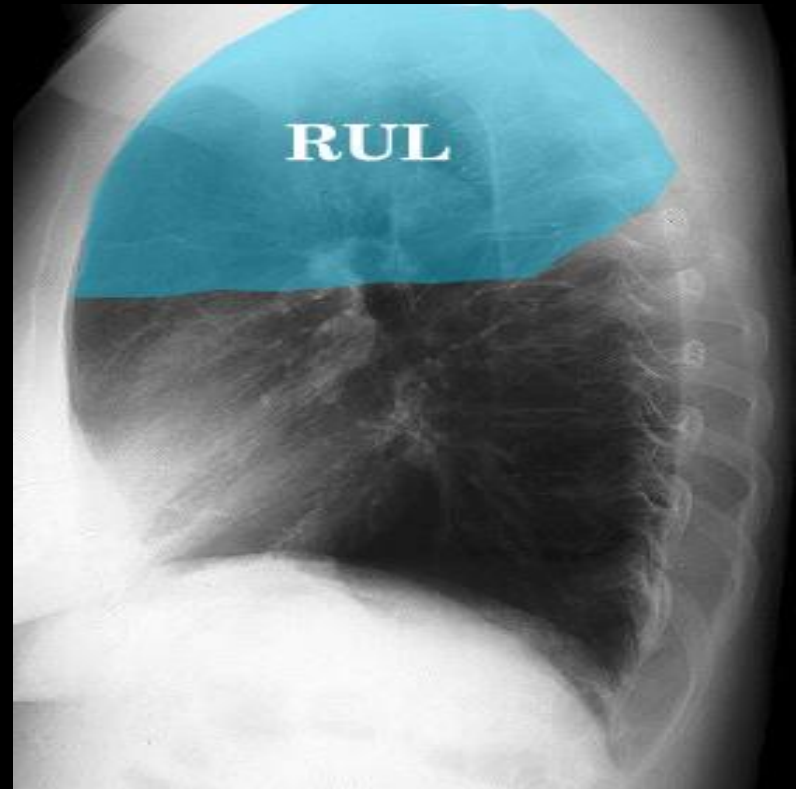
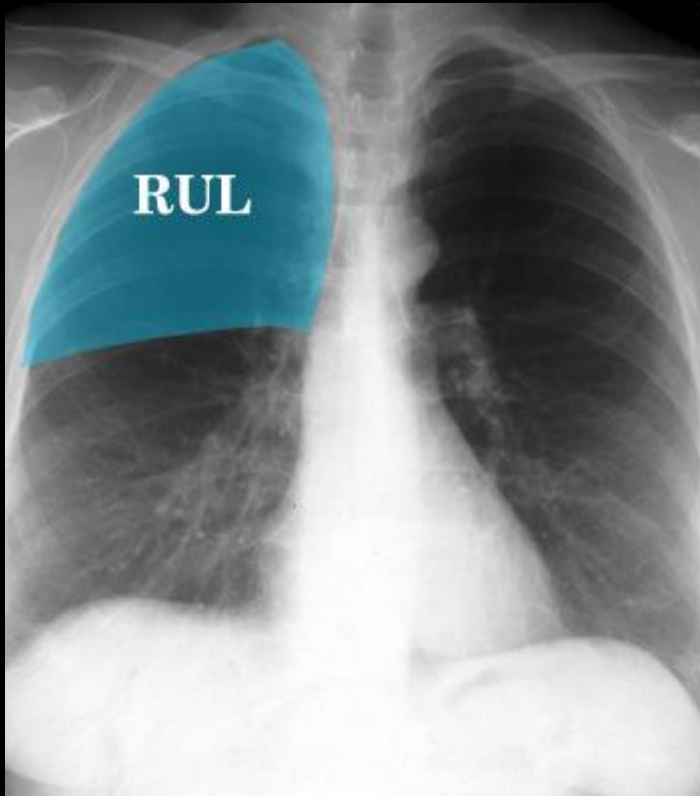


Ribs

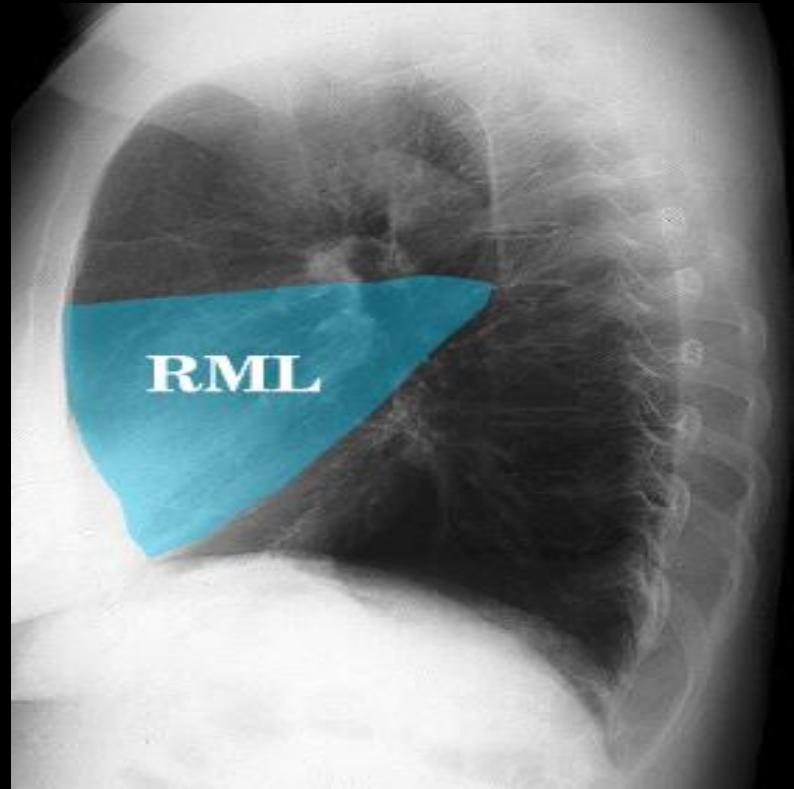
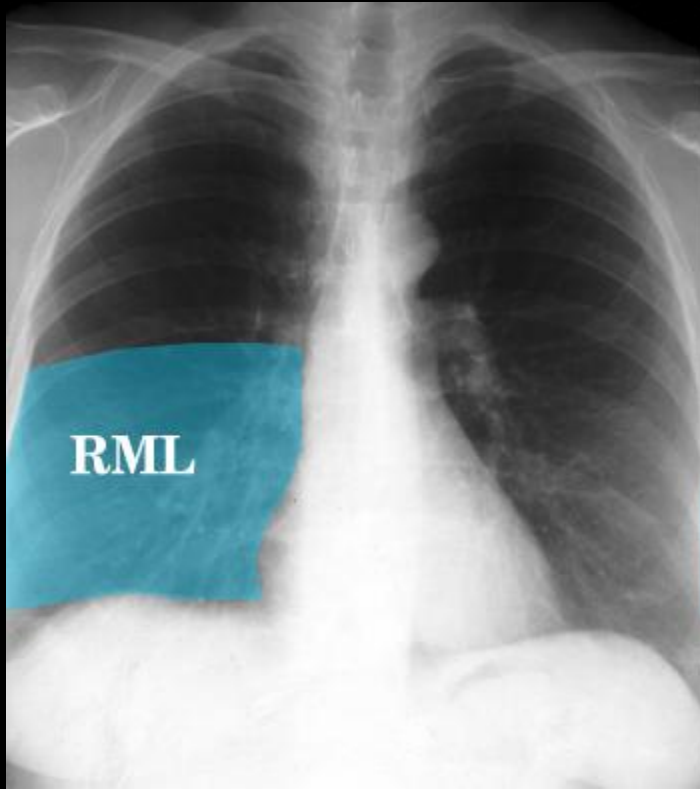


Don't Forget to look at hidden areas

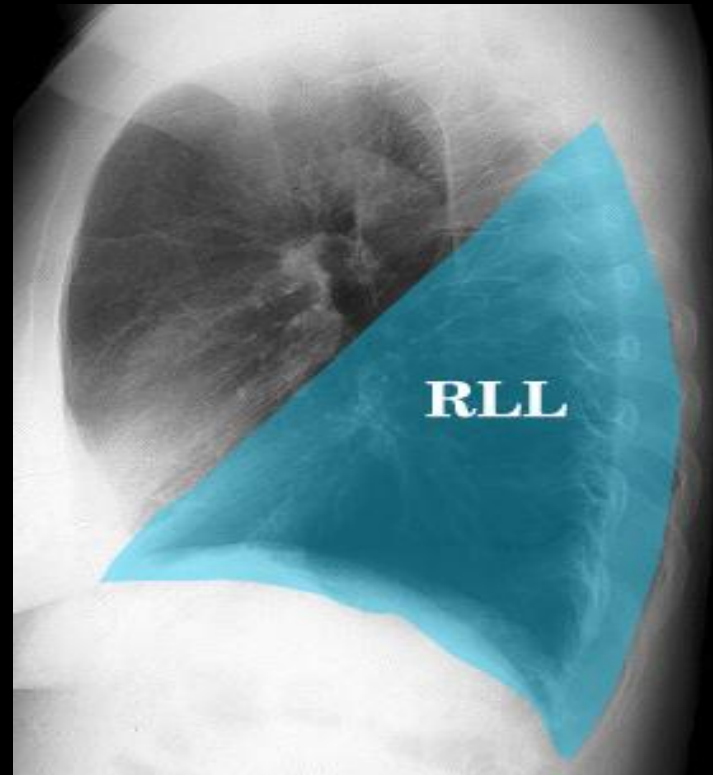
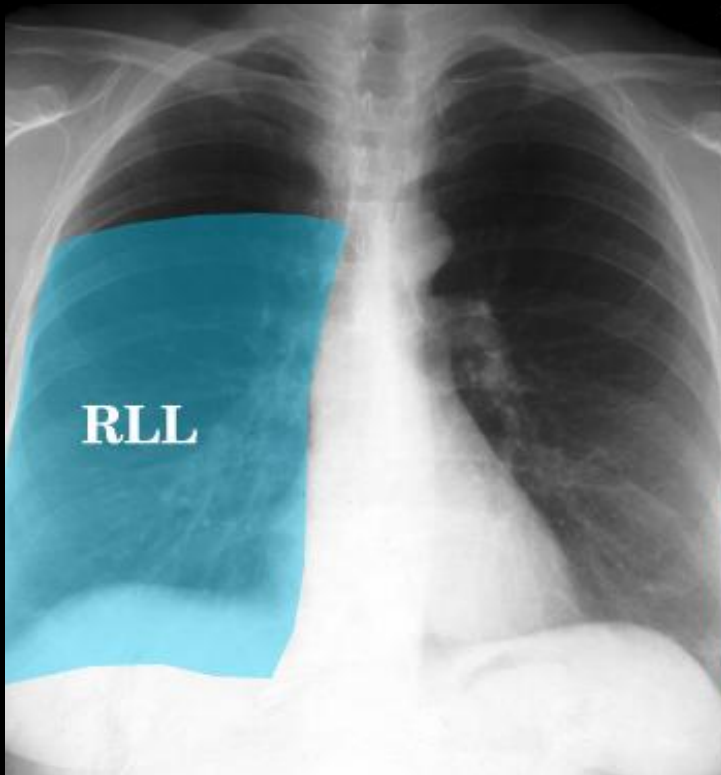
The upper lobe of the right lung



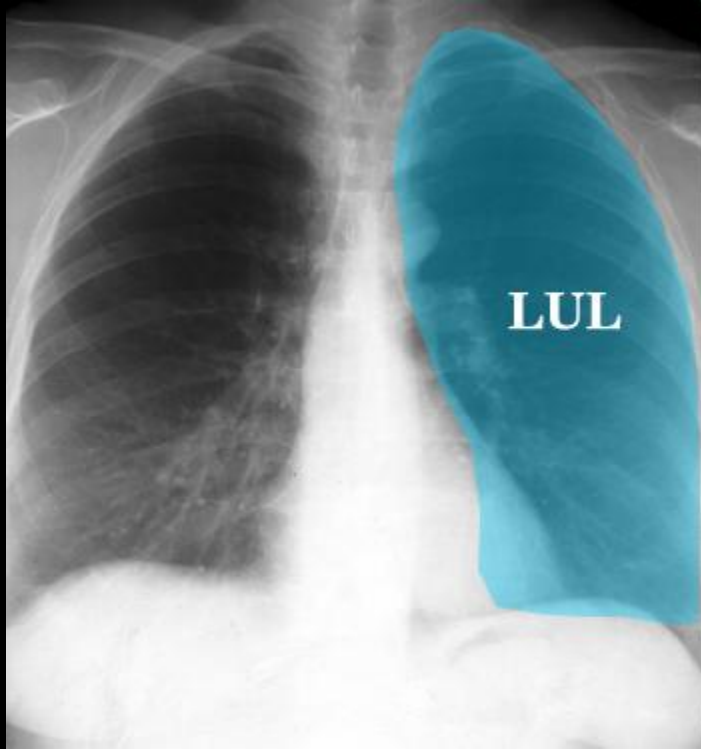
The middle lobe of the right lung



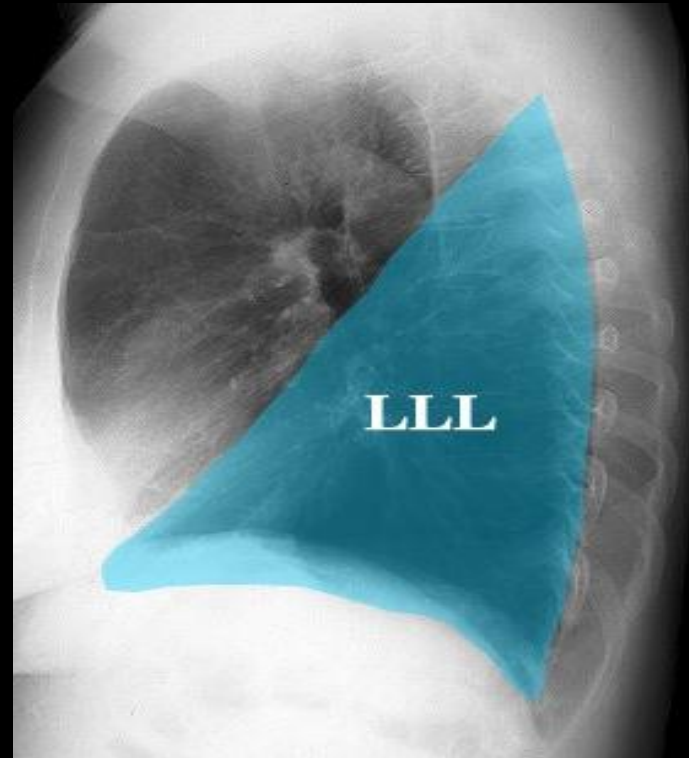
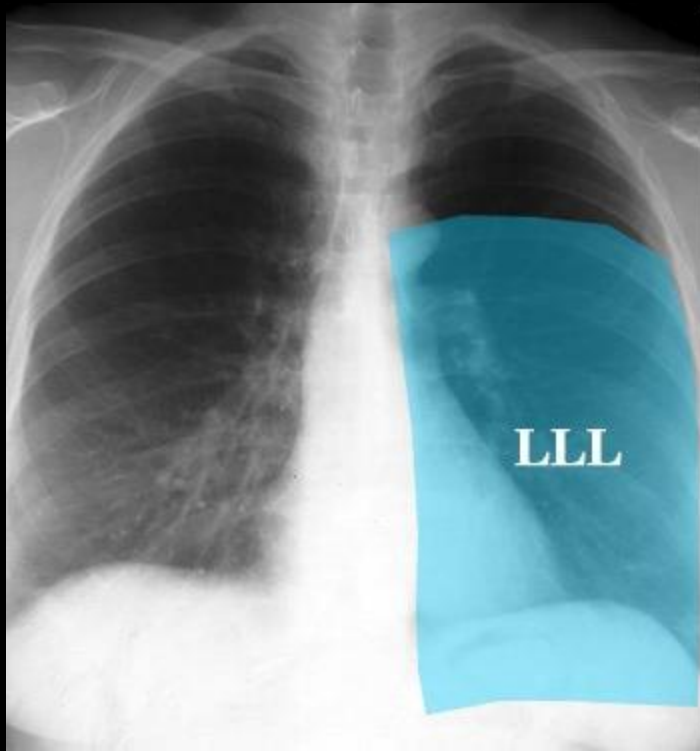
The lower lobe of the right lung



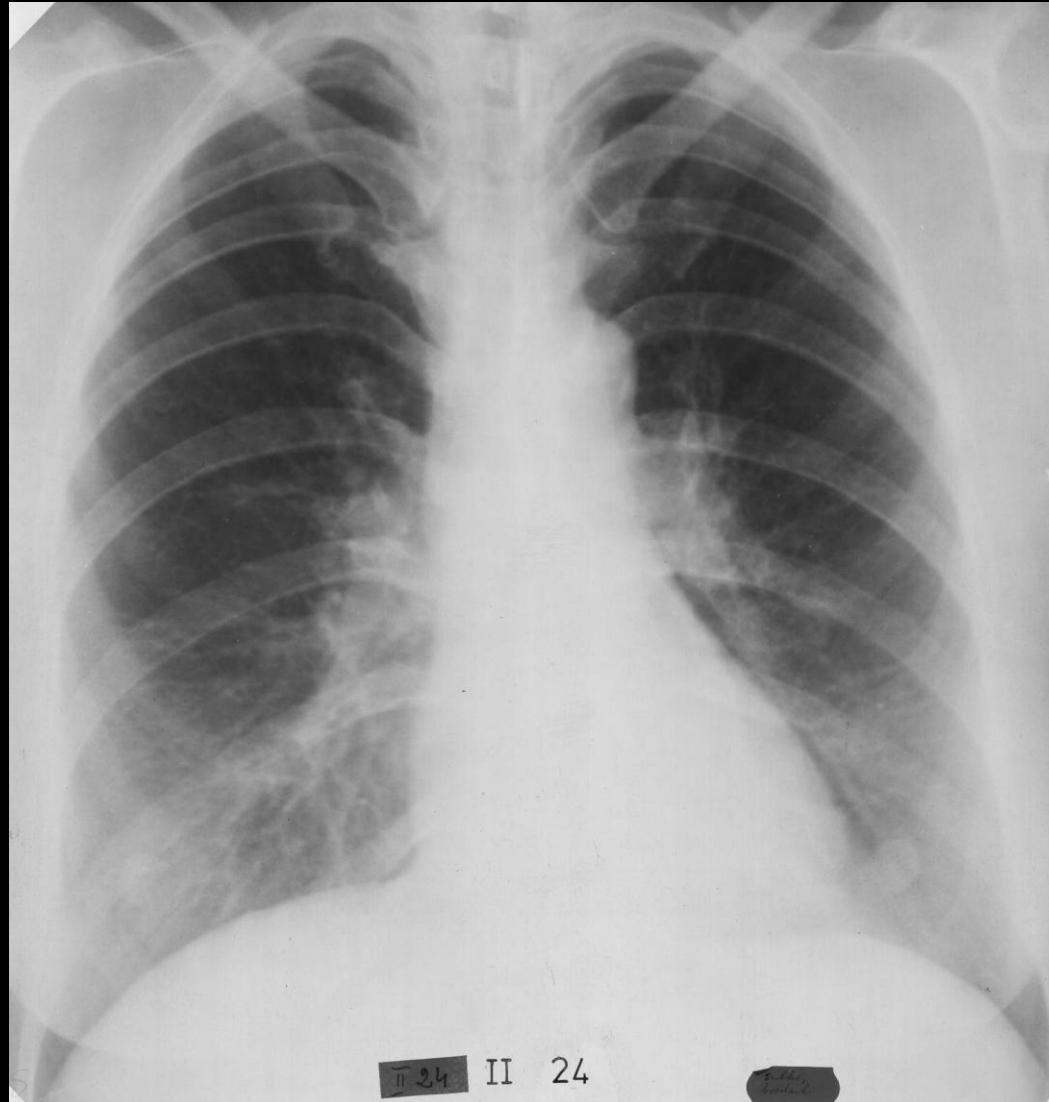
The upper lobe of the left lung



The lower lobe of the left lung



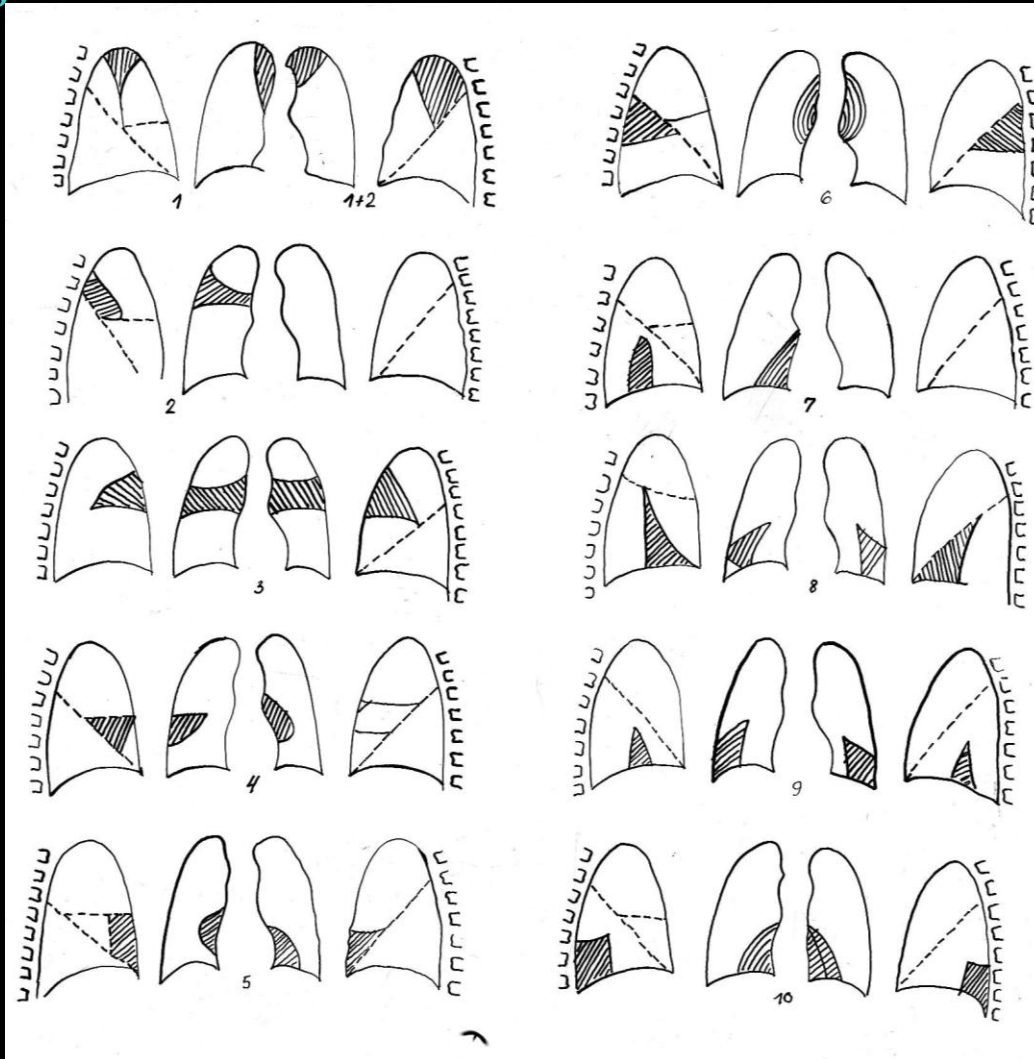
Mammilla



Segments of lungs

Right lung

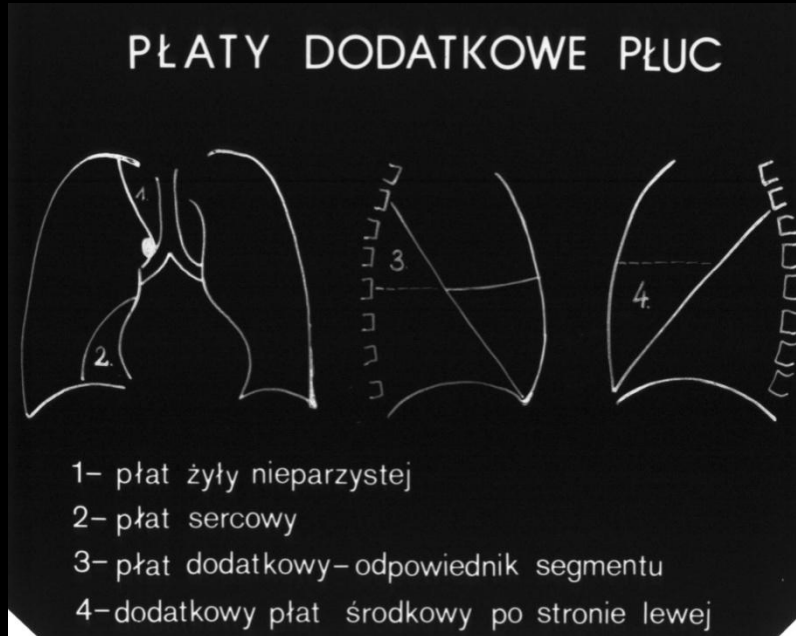
Left lung



- 1-apical
- 2-posterior
- 3-anterior
- 4-lateral
- 5-paracentral
- 6-apical
- 7-basal paracentral
- 8-b.anterior
- 9-b.lateral
- 10-b.posterior

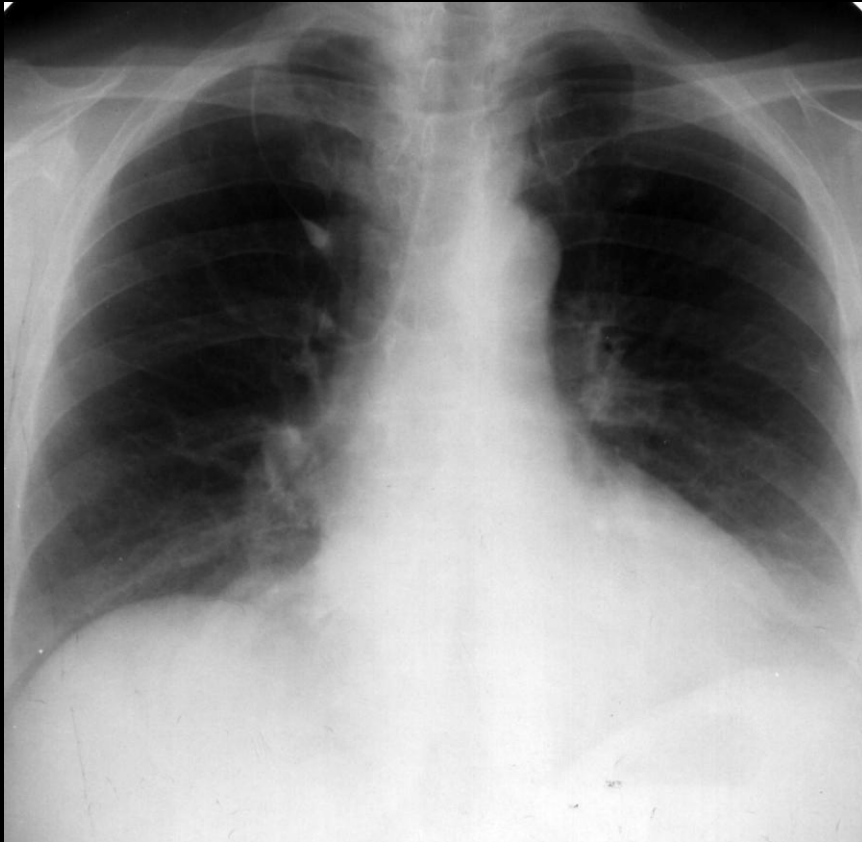
- 1+2-apicoposterior
- 3-anterior
- 4-upper
- 5-lower
- 4+5 - lingula
- 6-apical
- 8-b.anterior
- 9-b.lateral
- 10-b.posterior

Additional pulmonary lobes

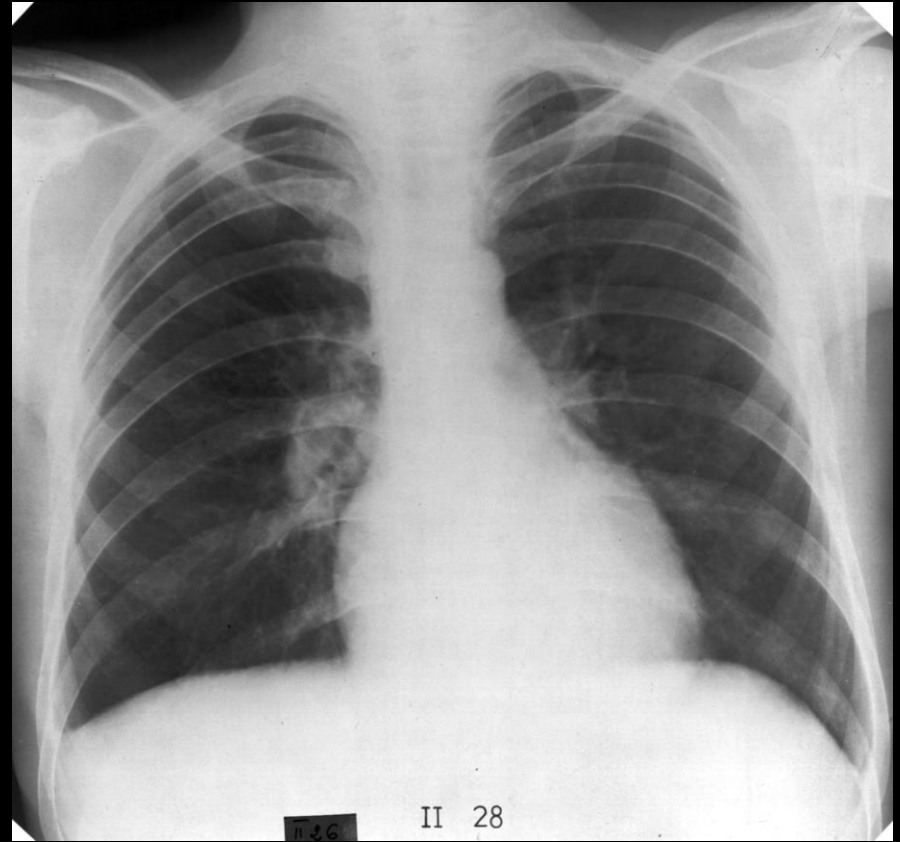


1. lobe of azygous vein
2. cardiac lobe
3. additional lobe - counterpart of a segment
4. additional middle lobe on the left side

Additional pulmonary lobes



azygous vein lobe



cardiac lobe

What to Evaluate

- Lungs
- Pleural surfaces
- Cardiomediastinal contours
- Bones and soft tissues
- Abdomen

Where to Look

- Apices
- Retrocardiac areas (left and right)
- Below diaphragm



Differential X-Ray Absorption

- The absence of a normal interface may indicate disease;
- The presence of an unexpected interface may also indicate disease
- The presence of interfaces can be used to localize abnormalities

COMMON SIGNS IN CHEST RADIOLOGY

- Silhouette sign
- Air bronchogram
- Solitary pulmonary nodule
- Bulging fissure sign
- Continuous diaphragm sign
- Deep sulcus sign
- Fallen lung sign
- Flat waist sign
- Finger-in-glove sign
- Golden sign
- Halo sign
- Hampton hump sign
- Juxtaphrenic peak sign
- Luftsischel sign

Silhouette Sign

- Loss of the expected interface normally created by juxtaposition of two structures of different density
- No boundary can be seen between two structures of similar density

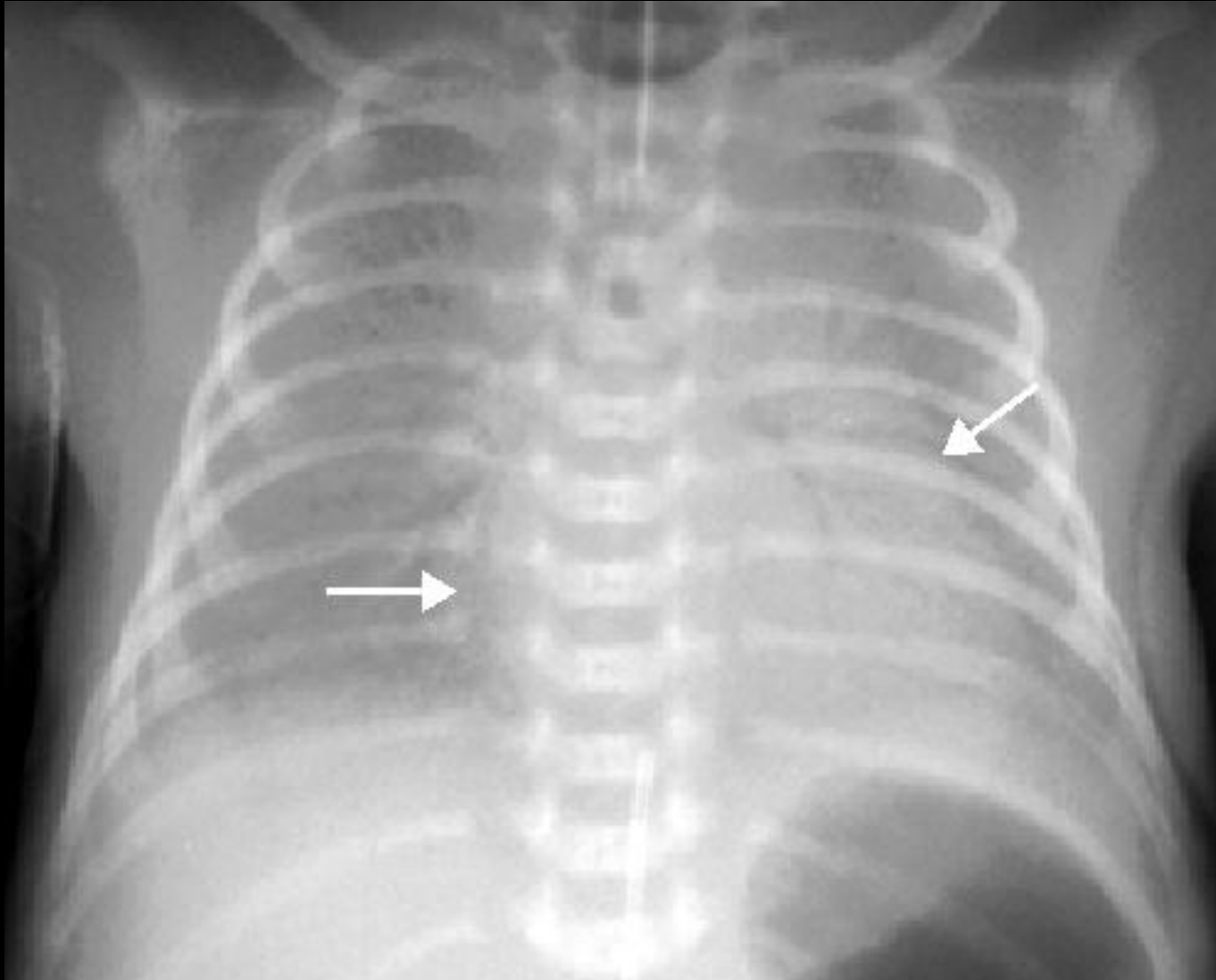
SILHOUETTE SIGN



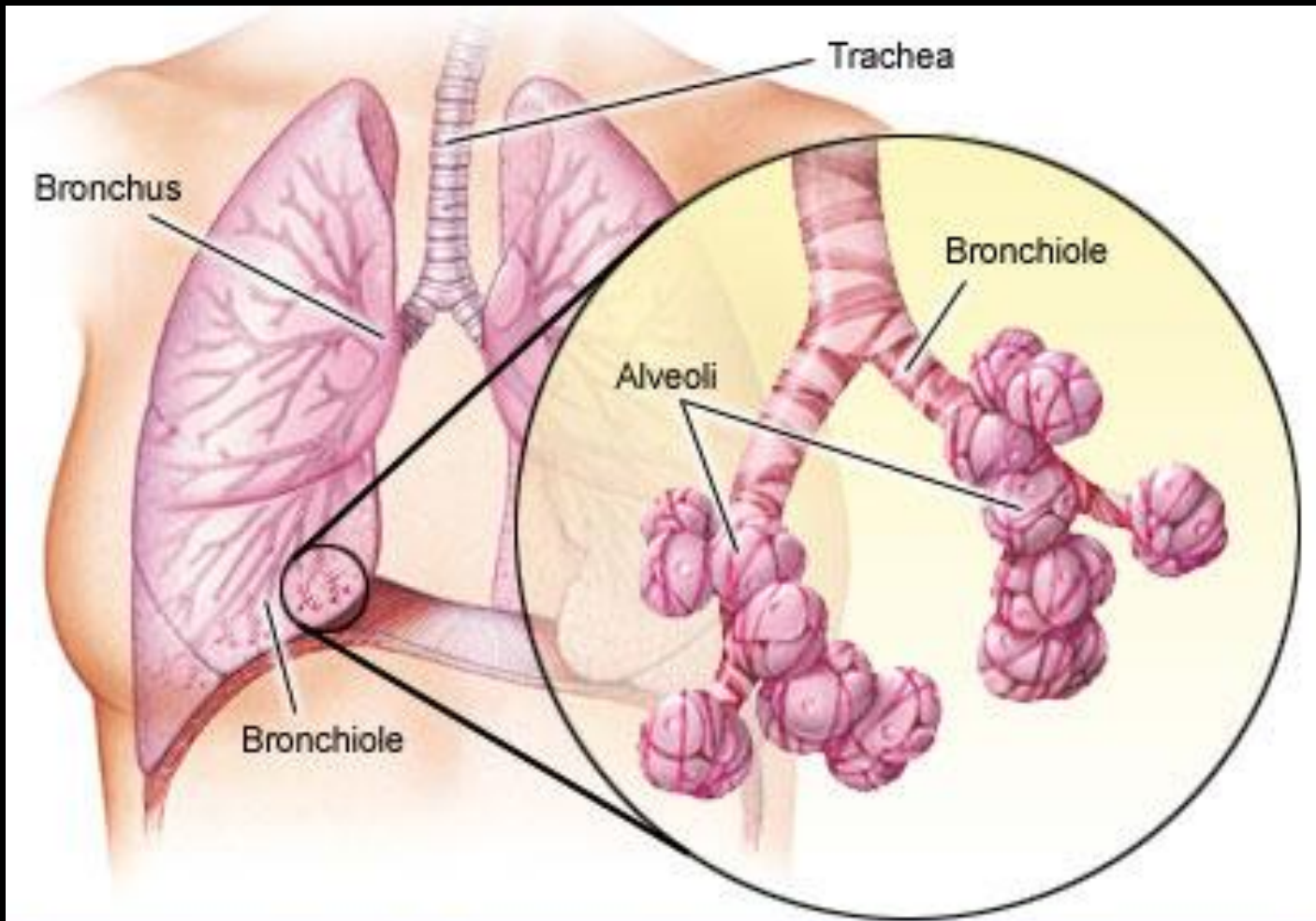
SILHOUETTE SIGN



AIR BRONCHOGRAM



AIR BRONCHOGRAM



AIR BRONCHOGRAM



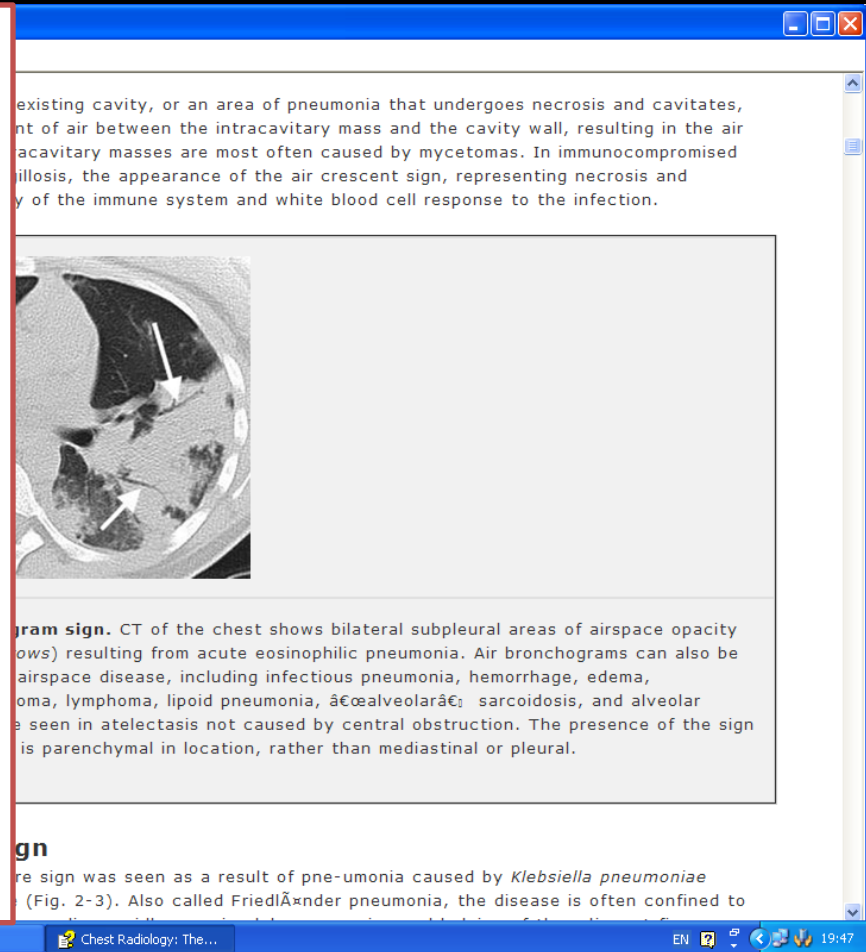
Air Bronchogram Sign

Branching, linear, tubular lucency representing a bronchus or bronchiole passing through airless lung parenchyma .

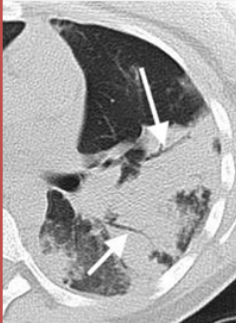
This sign indicates that the underlying opacity must be parenchymal rather than pleural or mediastinal in location.

DD:

Pneumonia
lymphoma
bronchoalveolar cell carcinoma.



existing cavity, or an area of pneumonia that undergoes necrosis and cavitates, ent of air between the intracavitary mass and the cavity wall, resulting in the acavitary masses are most often caused by mycetomas. In immunocompromised illosis, the appearance of the air crescent sign, representing necrosis and y of the immune system and white blood cell response to the infection.



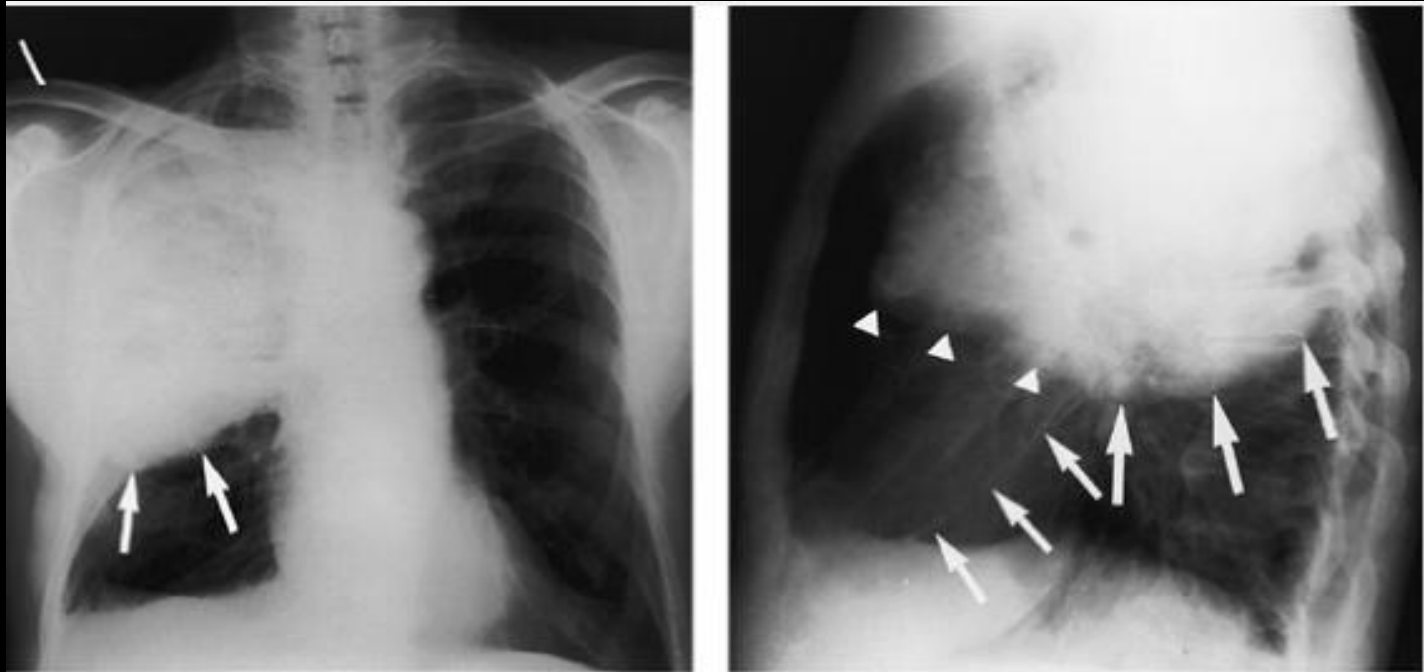
gram sign. CT of the chest shows bilateral subpleural areas of airspace opacity (arrows) resulting from acute eosinophilic pneumonia. Air bronchograms can also be seen in airspace disease, including infectious pneumonia, hemorrhage, edema, lymphoma, lipoid pneumonia, "alveolar" sarcoidosis, and alveolar carcinoma. The presence of the sign is parenchymal in location, rather than mediastinal or pleural.

gn
The sign was seen as a result of pneumonia caused by *Klebsiella pneumoniae* (Fig. 2-3). Also called Friedländer pneumonia, the disease is often confined to

SOLITARY PULMONARY NODULE



Bulging Fissure Sign



Consolidation spreading rapidly, causing lobar expansion and bulging of the adjacent fissure inferiorly .

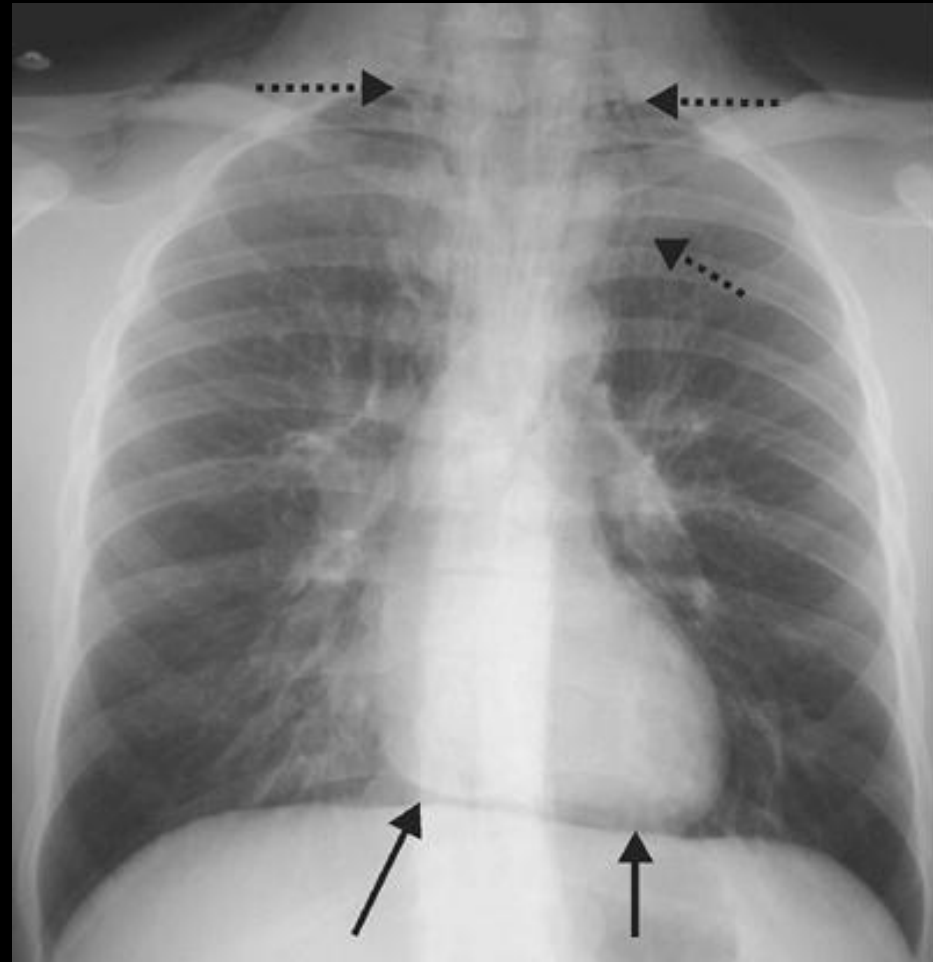
Historically *Klebsiella pneumoniae* involving the right upper lobe .
Friedlander pneumonia.

Continuous Diaphragm Sign

Continuous lucency outlining the base of the heart, representing **pneumomediastinum**.

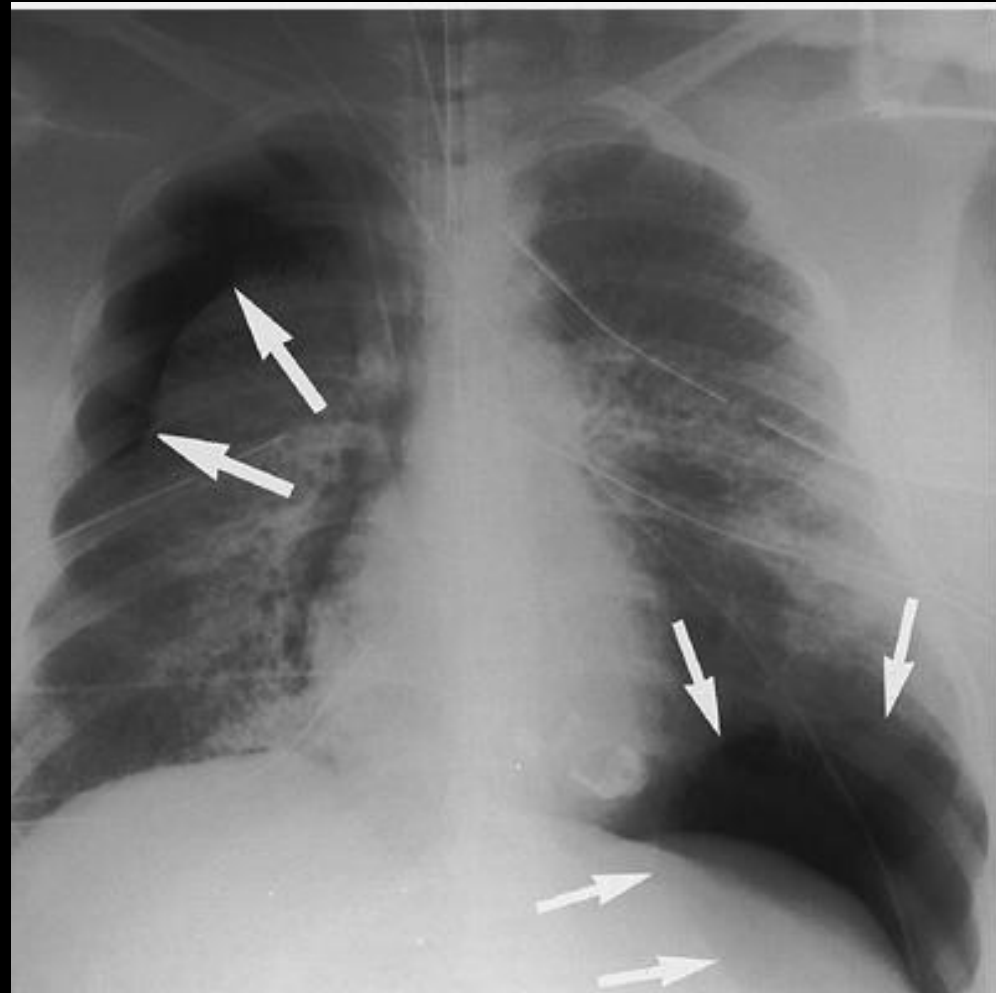
Air in the mediastinum tracks extrapleurally, between the heart and diaphragm.

Pneumopericardium can have a similar appearance but will show air circumferentially outlining the heart.



Deep Sulcus Sign

This sign refers to a deep collection of intrapleural air (pneumothorax) in the costophrenic sulcus as seen on the supine chest radiograph .



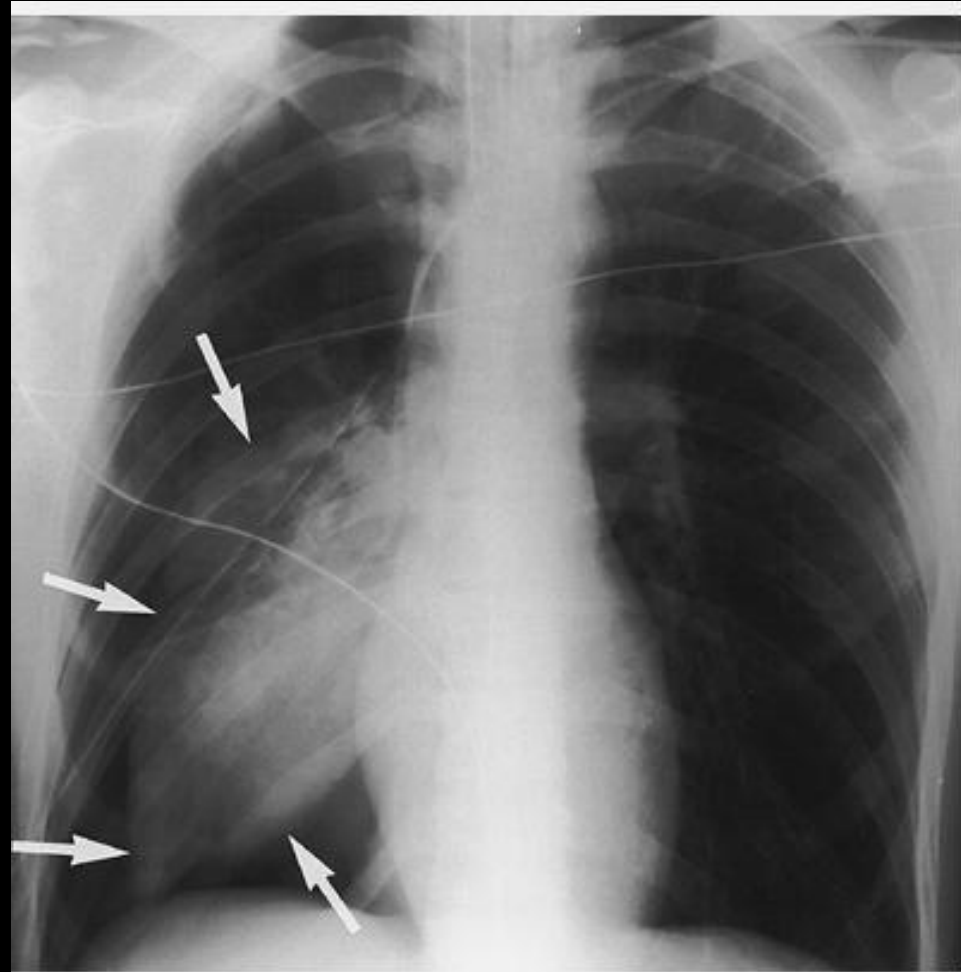
Fallen Lung Sign

This sign refers to the appearance of the collapsed lung occurring with a **fractured bronchus** .

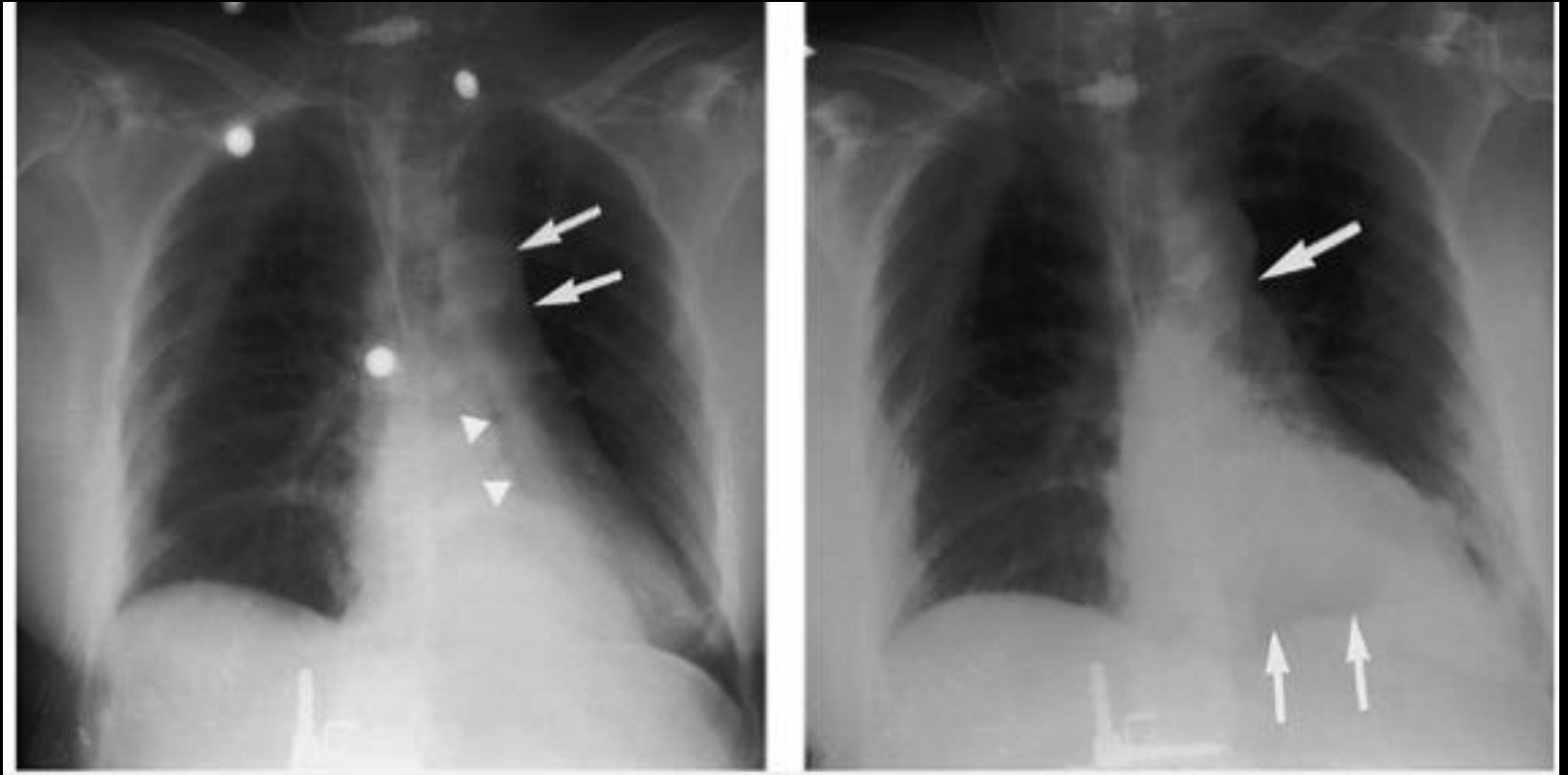
The bronchial fracture results in the lung to fall away from the hilum, either inferiorly and laterally in an upright patient or posteriorly, as seen on CT in a supine patient.

DD:

Pneumothorax causes a lung to collapse inward toward the hilum.



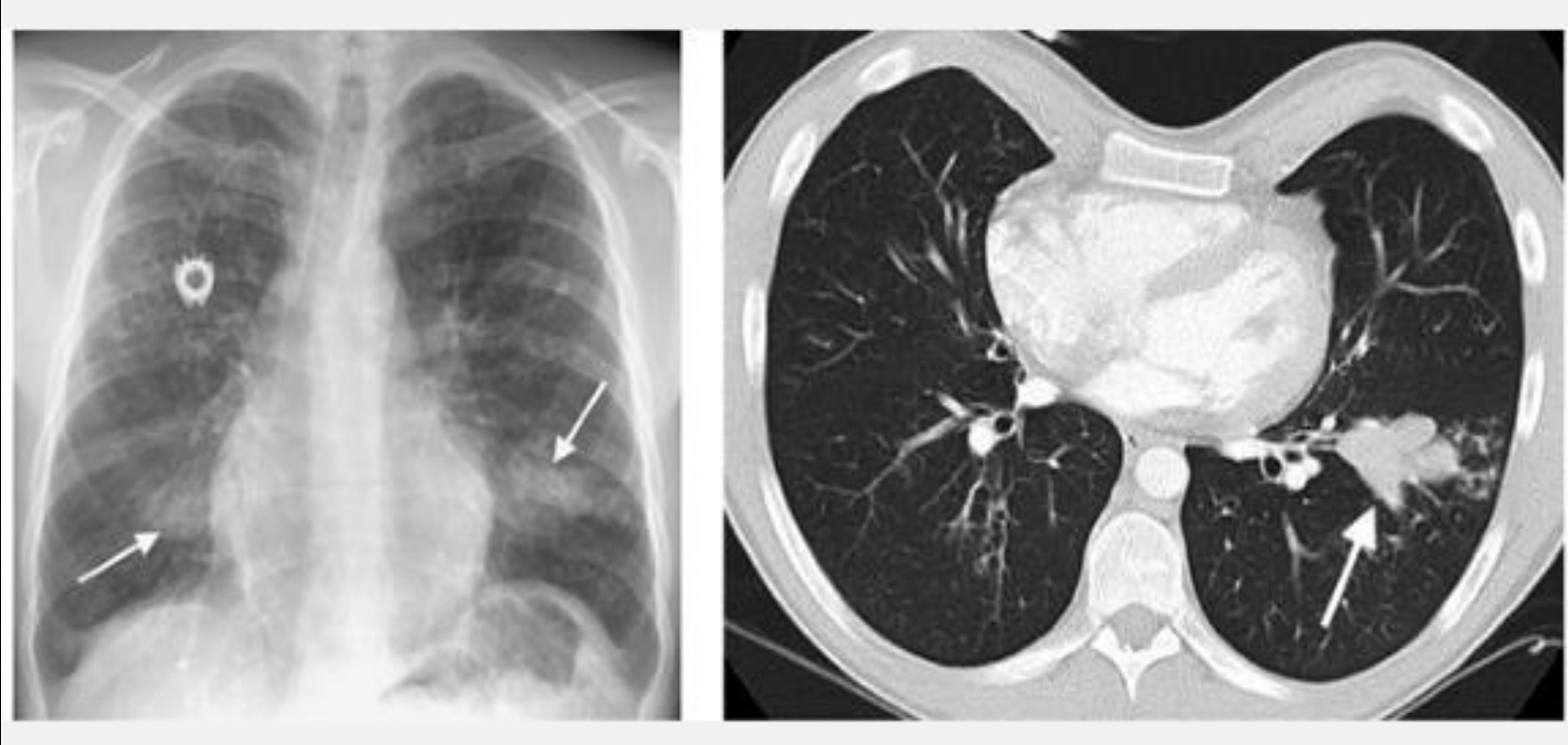
Flat waist Sign



This sign refers to flattening of the contours of the aortic knob and adjacent main pulmonary artery .

It is seen in severe collapse of the left lower lobe and is caused by leftward displacement and rotation of the heart

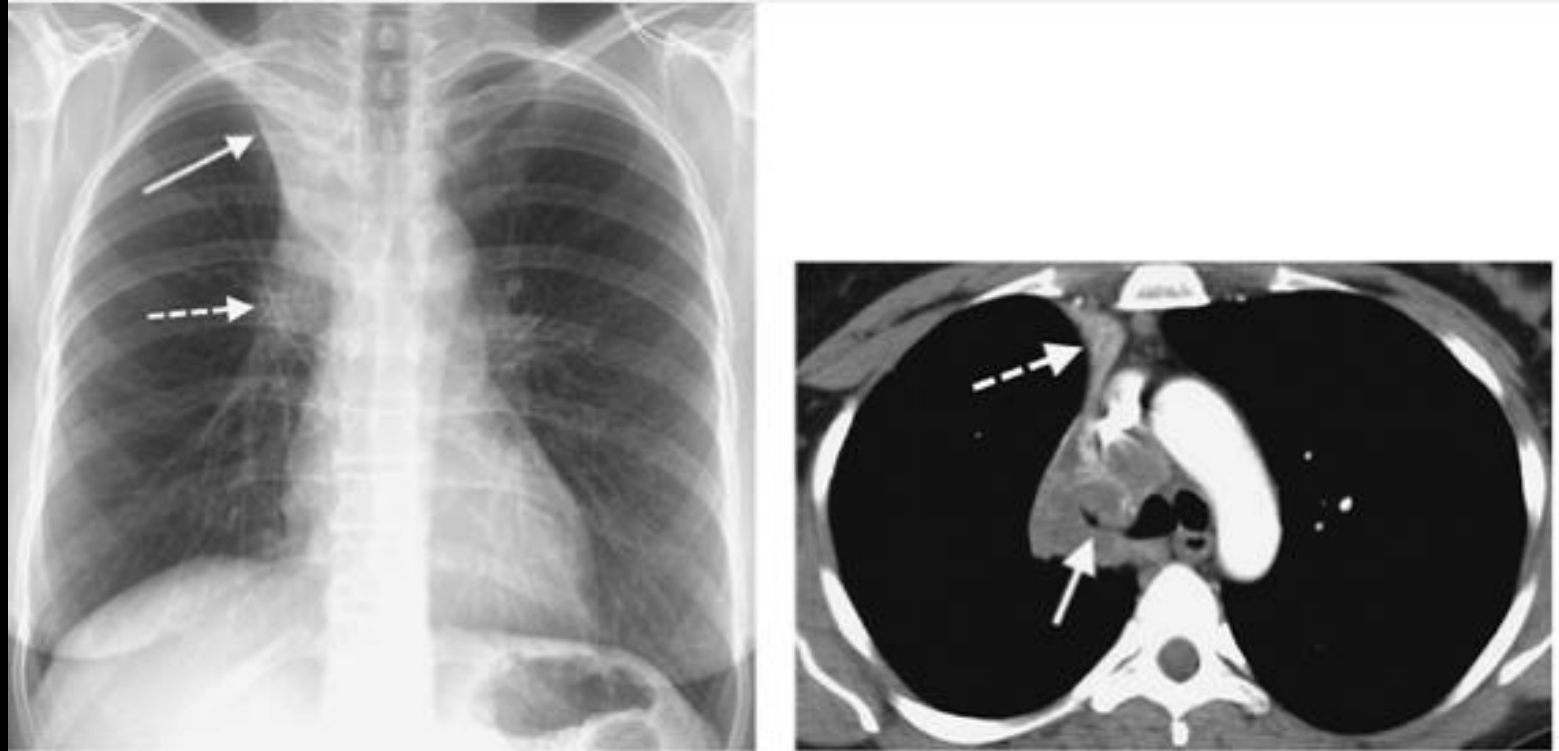
Finger in Glove Sign



In allergic bronchopulmonary aspergillosis.

The impacted bronchi appear radiographically as opacities with distinctive shapes.

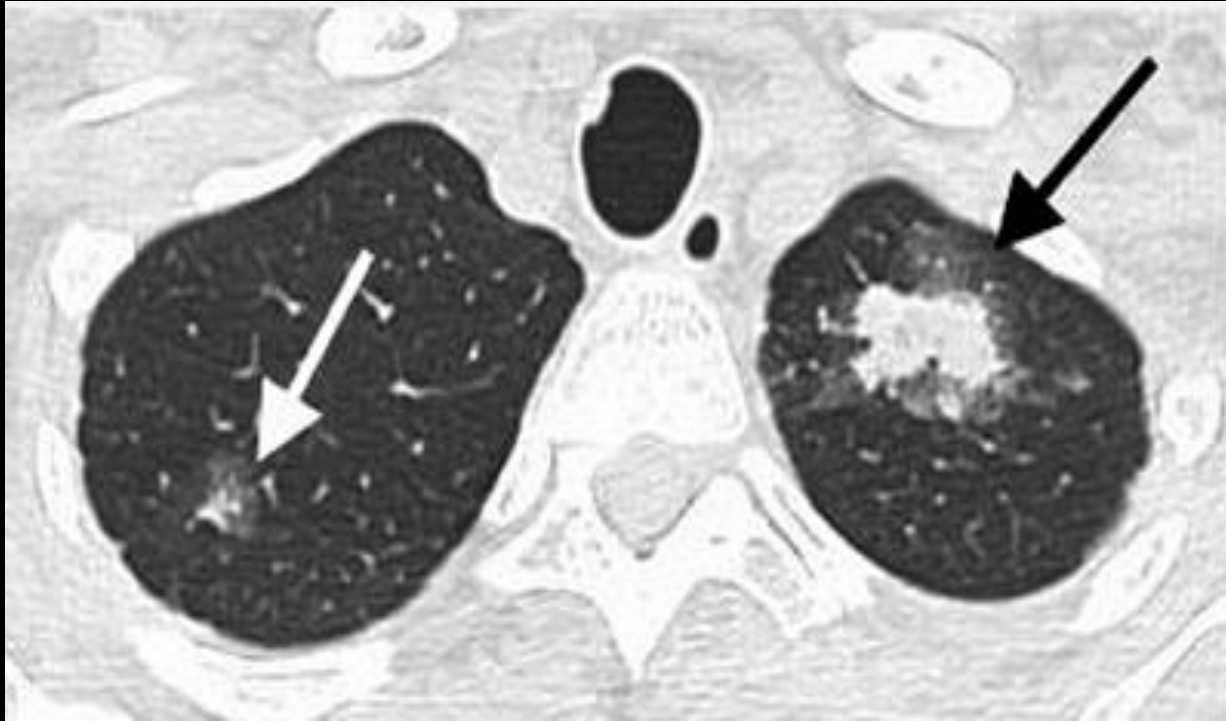
Golden sign:



When a lobe collapses around a large central mass, the peripheral lung collapses and the central portion of lung is prevented from collapsing by the presence of the mass.

The relevant fissure is concave toward the lung peripherally but convex centrally, and the shape of **the fissure resembles an S or a reverse S**.

Halo Sign

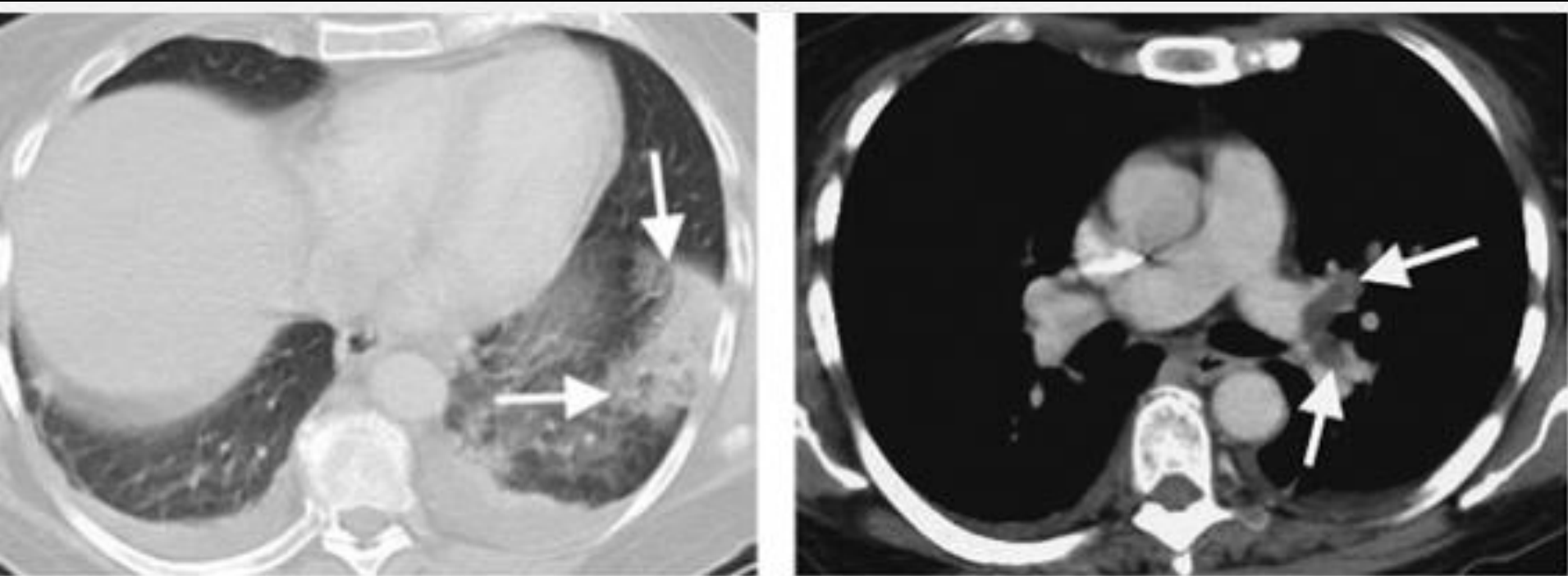


CT shows nodular consolidation associated with a halo of ground-glass opacity (GGO) in both apices resulting from invasive pulmonary aspergillosis.

This halo represents hemorrhage.

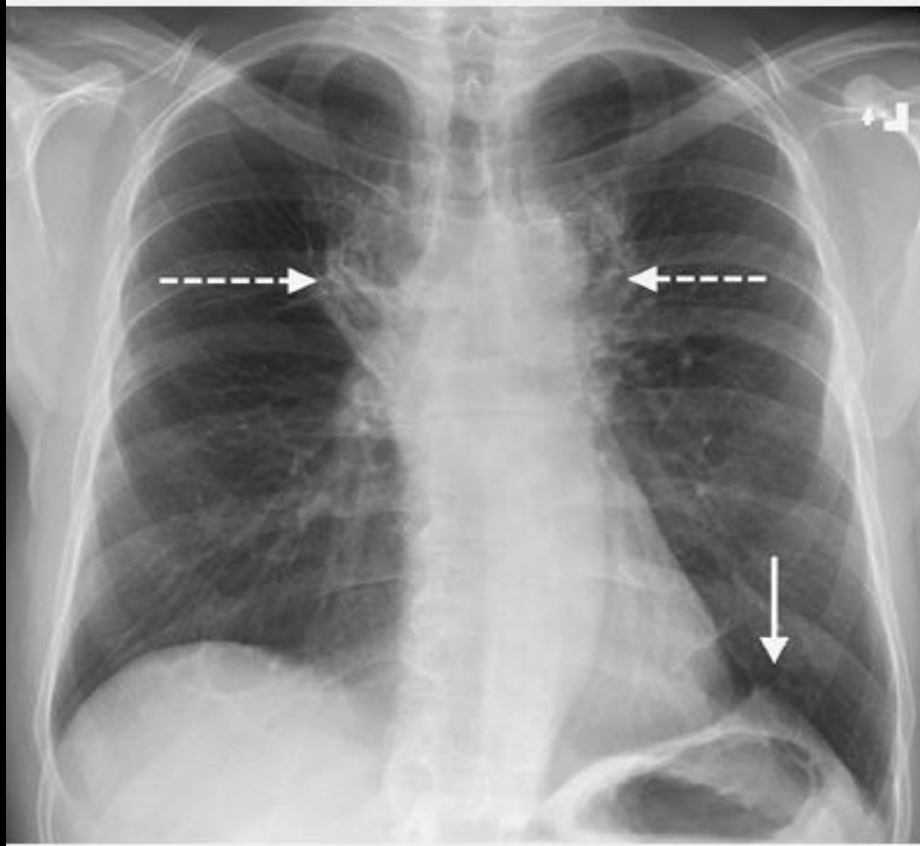
When seen in leukemic patients, is highly suggestive of the diagnosis of invasive **pulmonary aspergillosis.**

Hampton Hump Sign



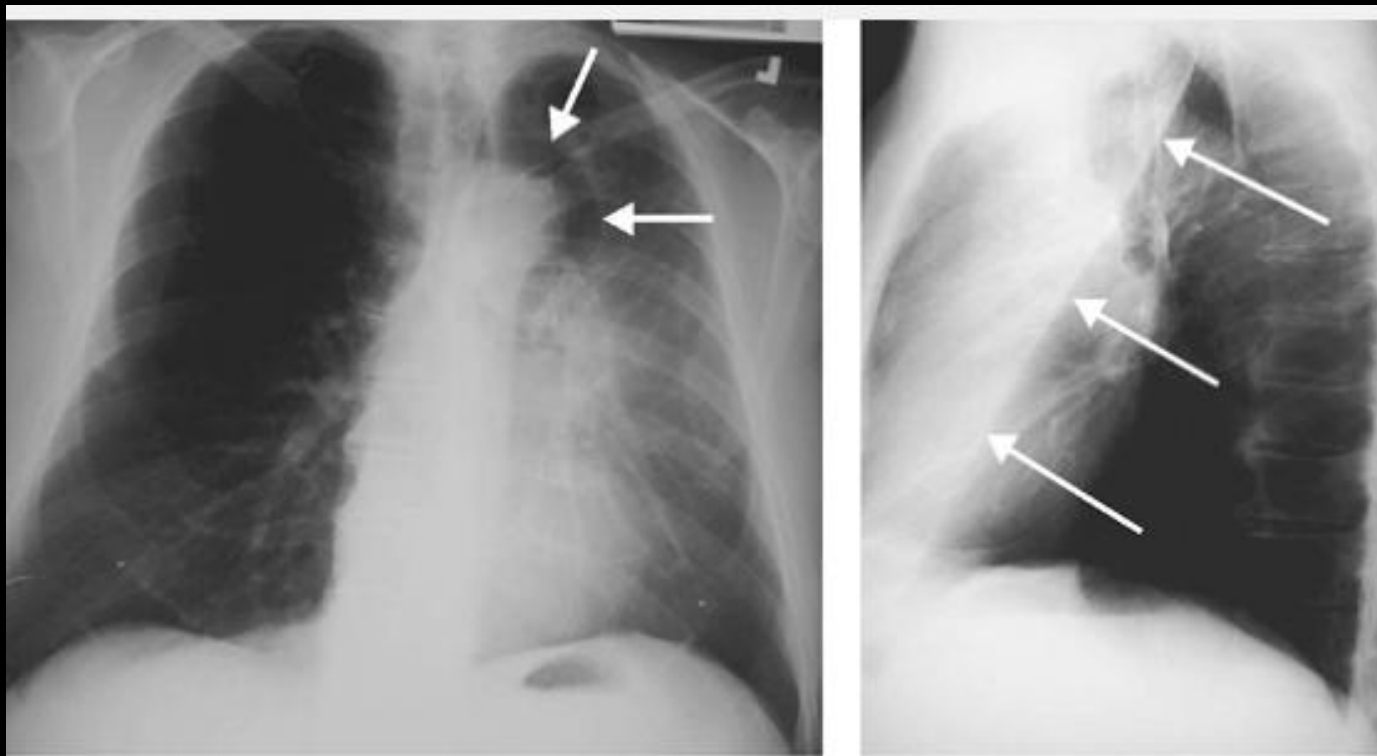
Pulmonary infarction secondary to pulmonary embolism produces an abnormal area of opacification on the chest radiograph, which is always in contact with the pleural surface.

Juxtaphrenic Peak Sign



This sign refers to a small triangular shadow that obscures the dome of the diaphragm secondary to upper lobe atelectasis. The shadow is caused by traction on the lower end of the major fissure, the inferior accessory fissure, or the inferior pulmonary ligament.

Luftsichel Sign



In **left upper lobe collapse**, the superior segment of the left lower lobe, which is positioned between the aortic arch and the collapsed left upper lobe, is hyperinflated. This aerated segment of left lower lobe is hyperlucent and shaped like a sickle, where it outlines the aortic arch on the frontal chest radiograph.

This peri-aortic lucency has been termed the **luftsichel sign**, derived from the German words **luft** (air) and **sichel** (sickle).

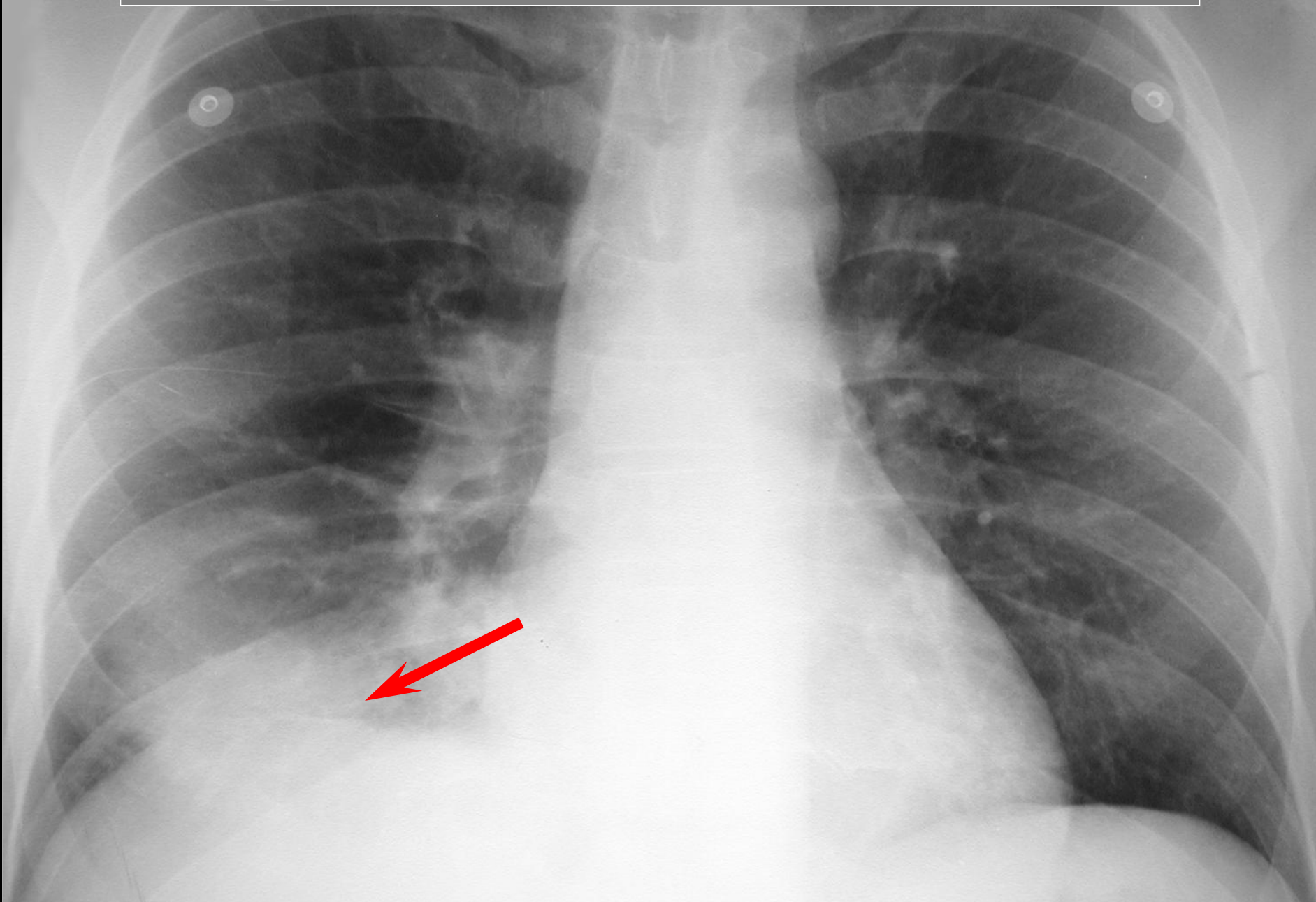
The chest X-ray

Hilus: at the level of front segments III-IV ribs.

Properly visible only vascular structures, axial section of bronchial tubes. The left hilum slightly higher, obscured by heart; the right hilum - angle between upper lobe vein and medium artery.

- Pulmonary fields: visible profiles of ribs, expanding from hilums bifurcations pulmonary artery and pulmonary veins, on the right-horizontal fissure
- The outline of diaphragm formed by liver shade, stomach shade; during breathing relocates by one intercostal.

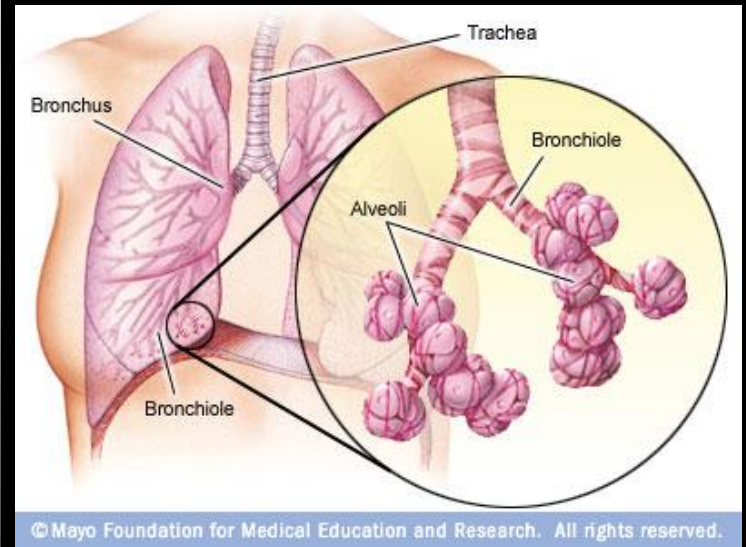
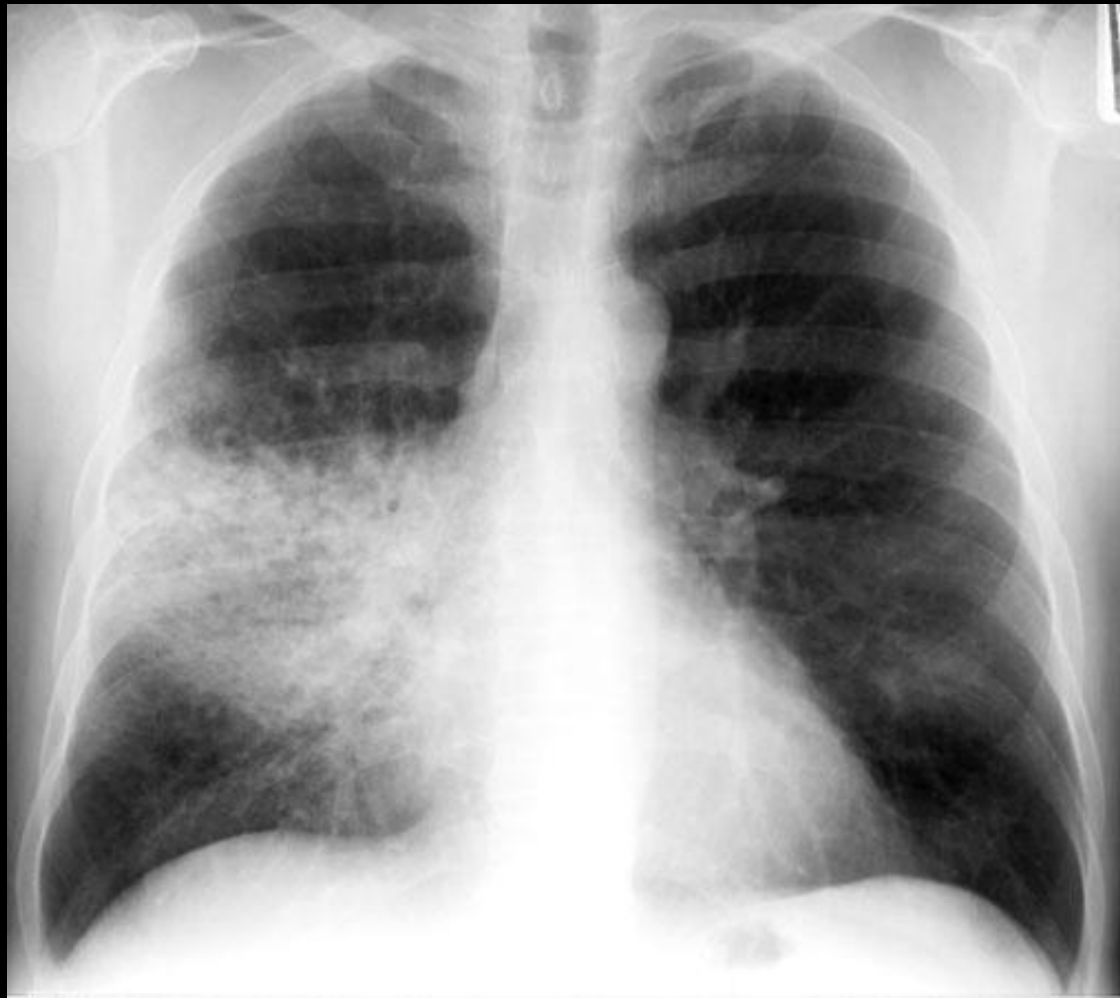
Right Lower Lobe Pneumonia



Chest Radiographic Patterns of Disease

- Air space opacity
- Interstitial opacity
- Nodules and masses
- Lymphadenopathy
- Cysts and cavities
- Lung volumes
- Pleural diseases

Air Space Opacity



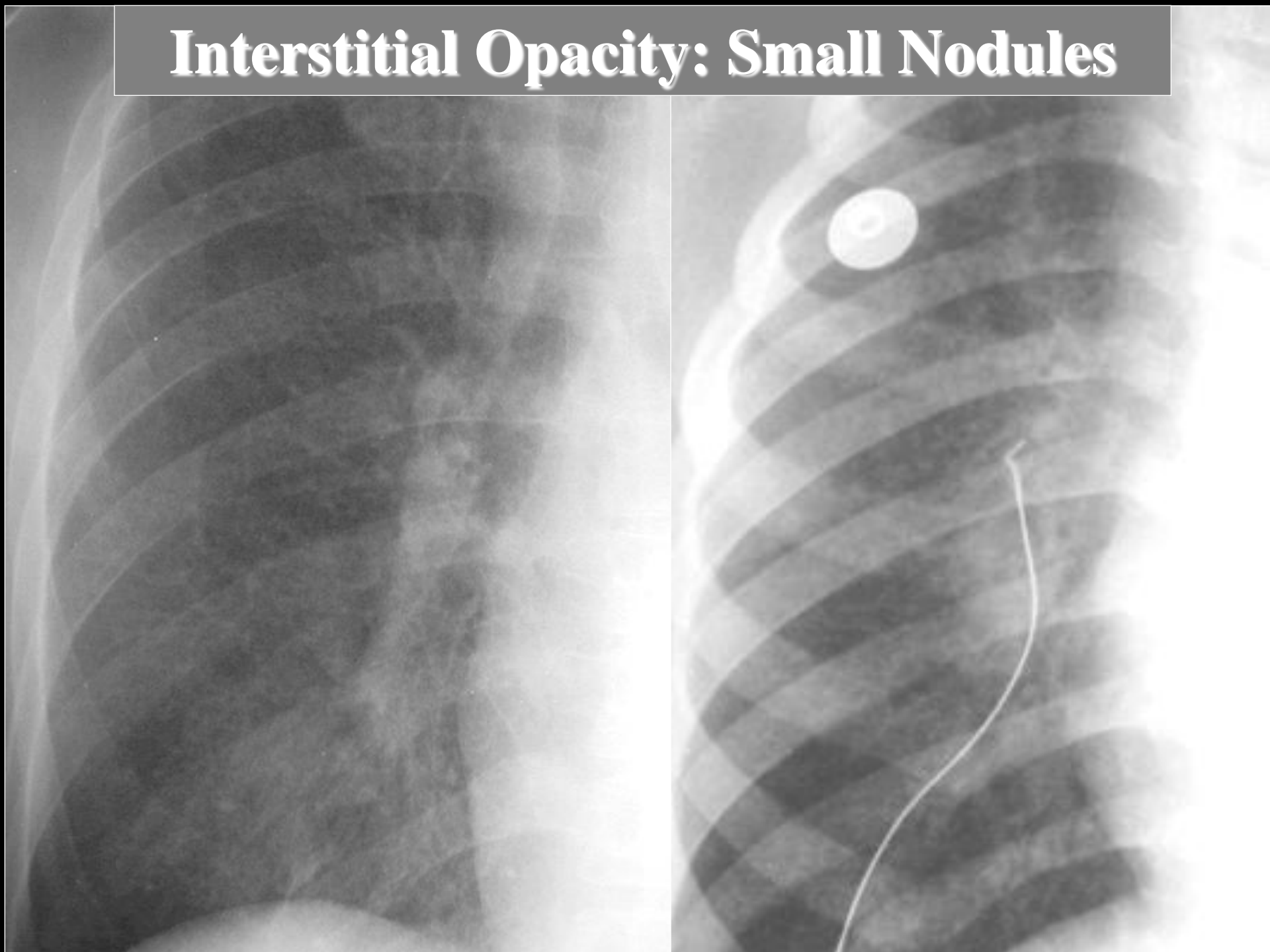
Air Space Opacity

- Components:
 - air bronchogram: air-filled bronchus surrounded by airless lung
 - confluent opacity extending to pleural surfaces
 - segmental distribution

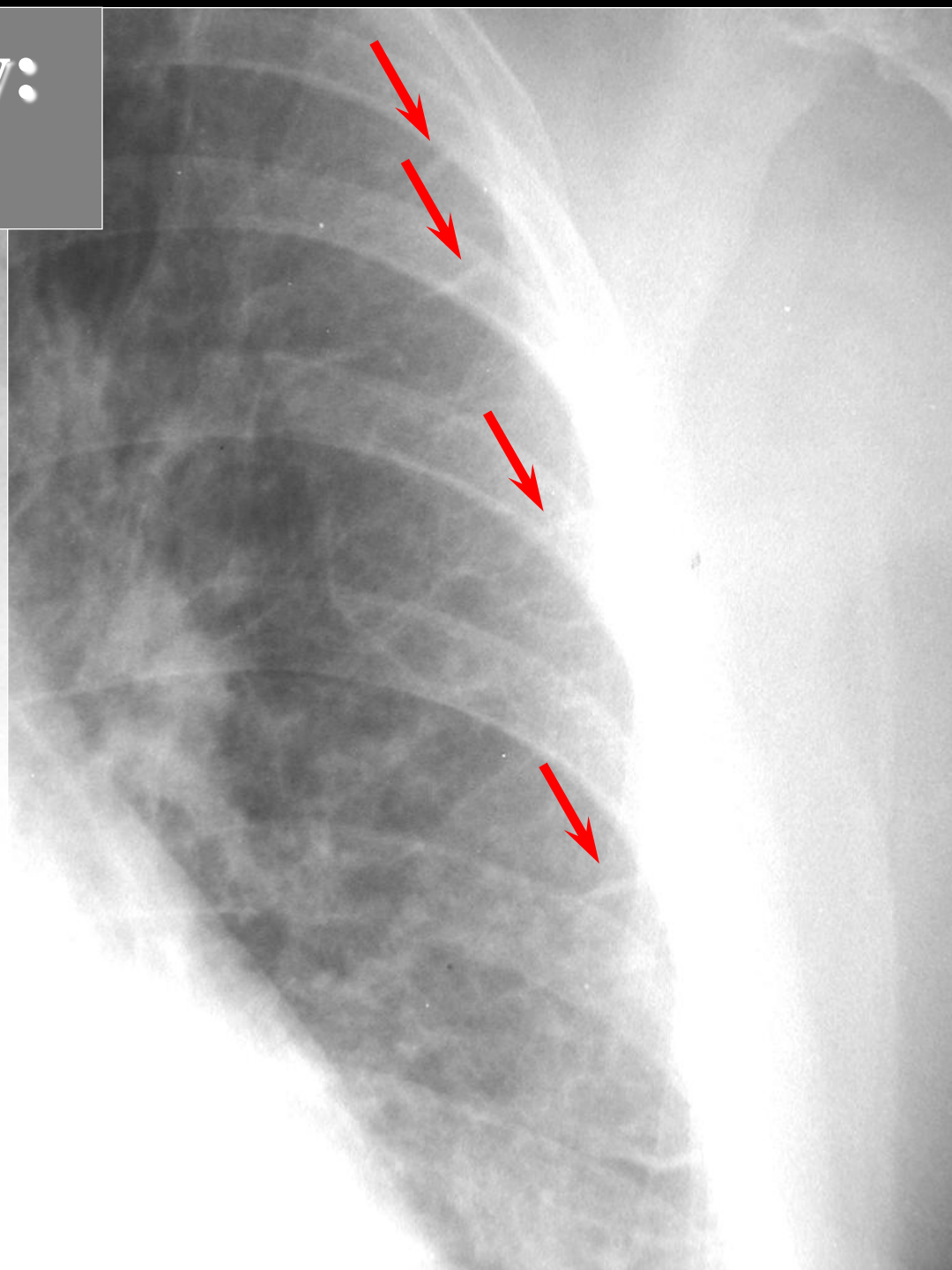
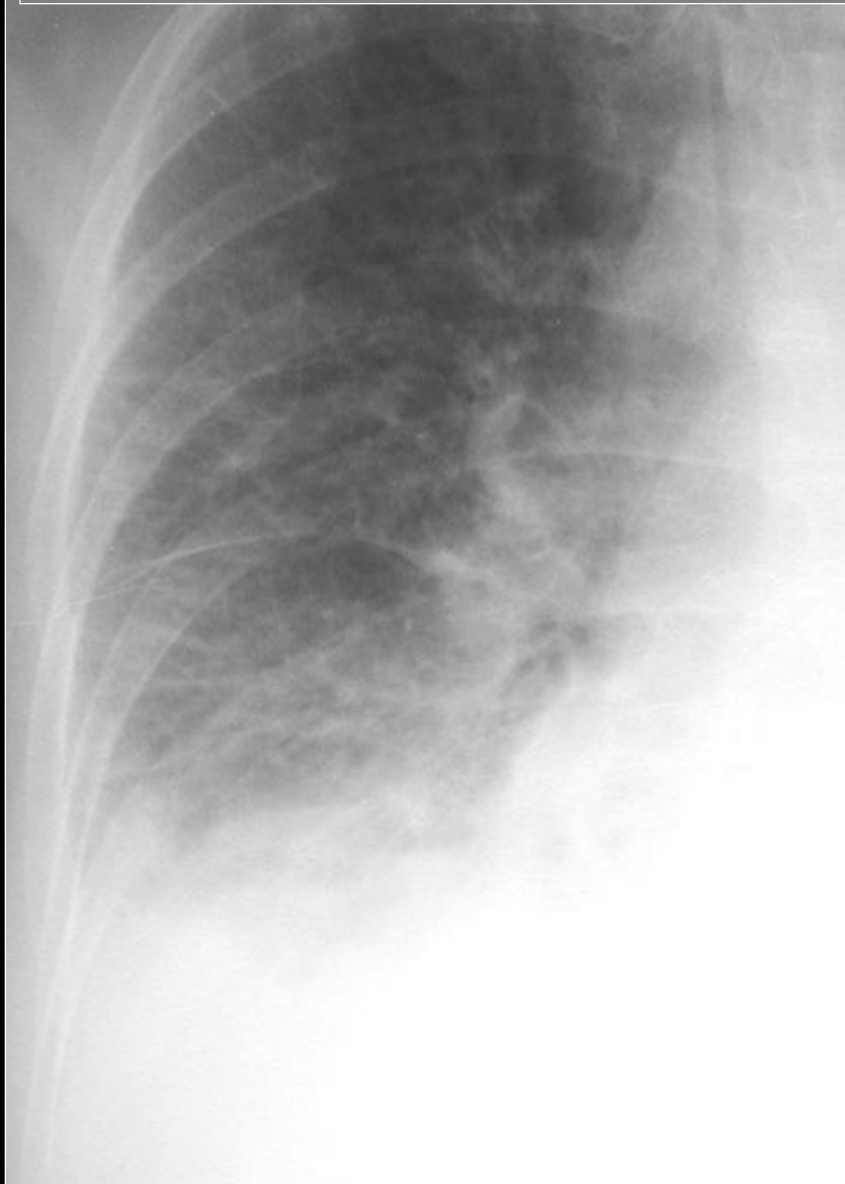
Air Space Opacity: DDX

- Blood (hemorrhage)
- Pus (pneumonia)
- Water (edema)
 - hydrostatic or non-cardiogenic
- Cells (tumor)
- Protein/fat: alveolar proteinosis and lipoid pneumonia

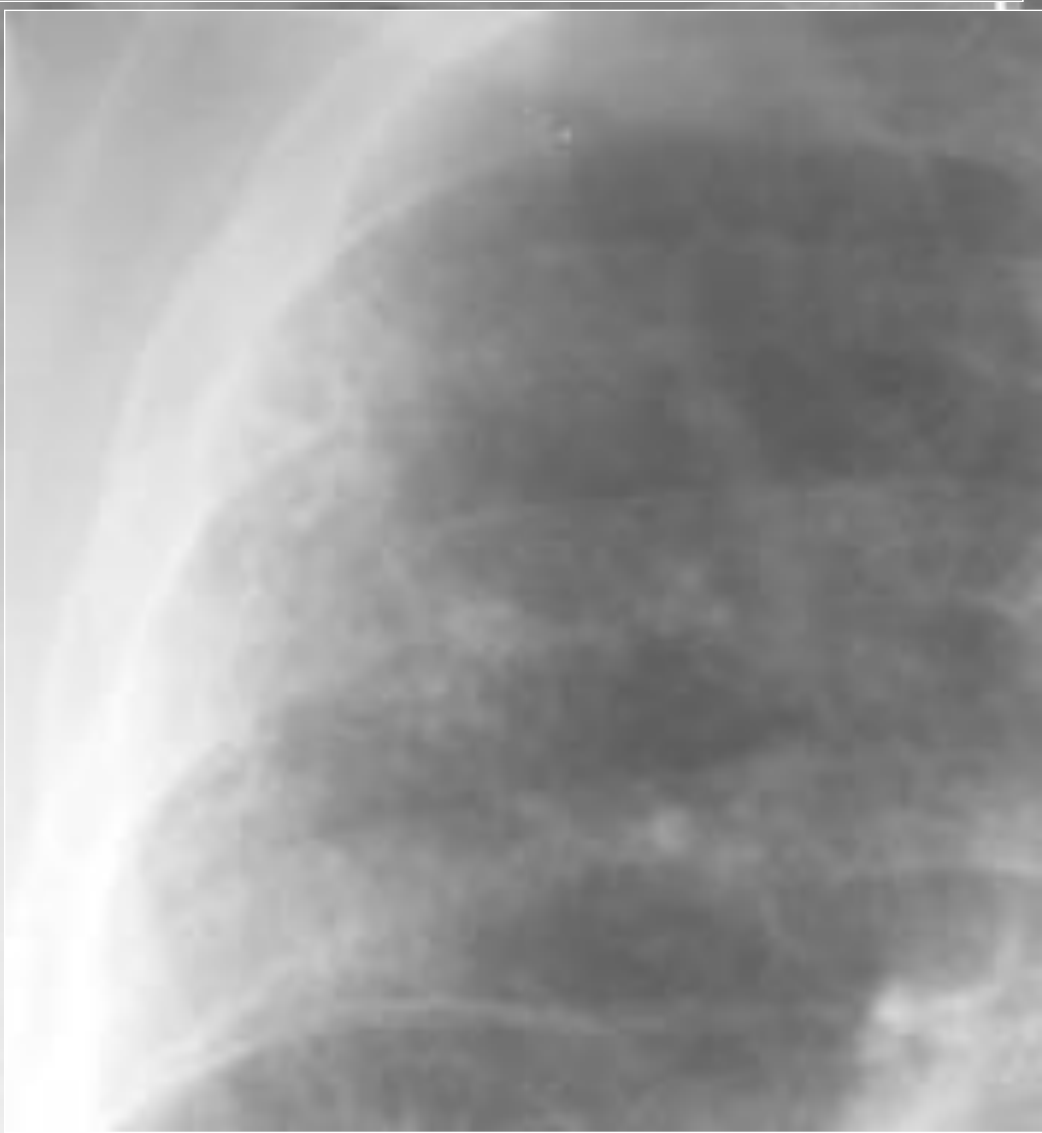
Interstitial Opacity: Small Nodules



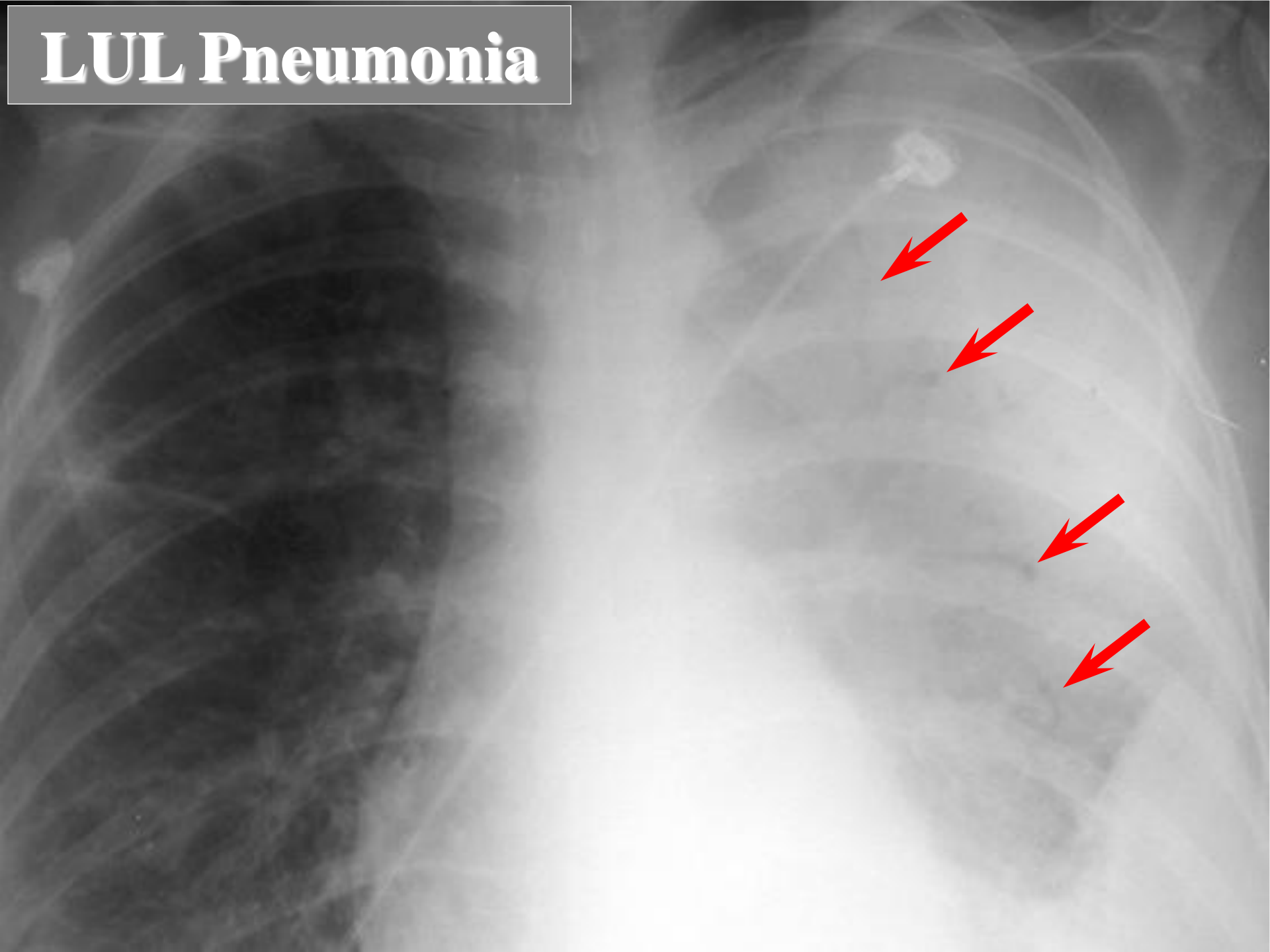
Interstitial Opacity: Lines



Interstitial Opacity: Lines & Reticulation



LUL Pneumonia



Interstitial Opacity

- Hallmarks:
 - small, well-defined nodules
 - lines
 - interlobular septal thickening
 - fibrosis
 - reticulation

Interstitial Opacity: DDX

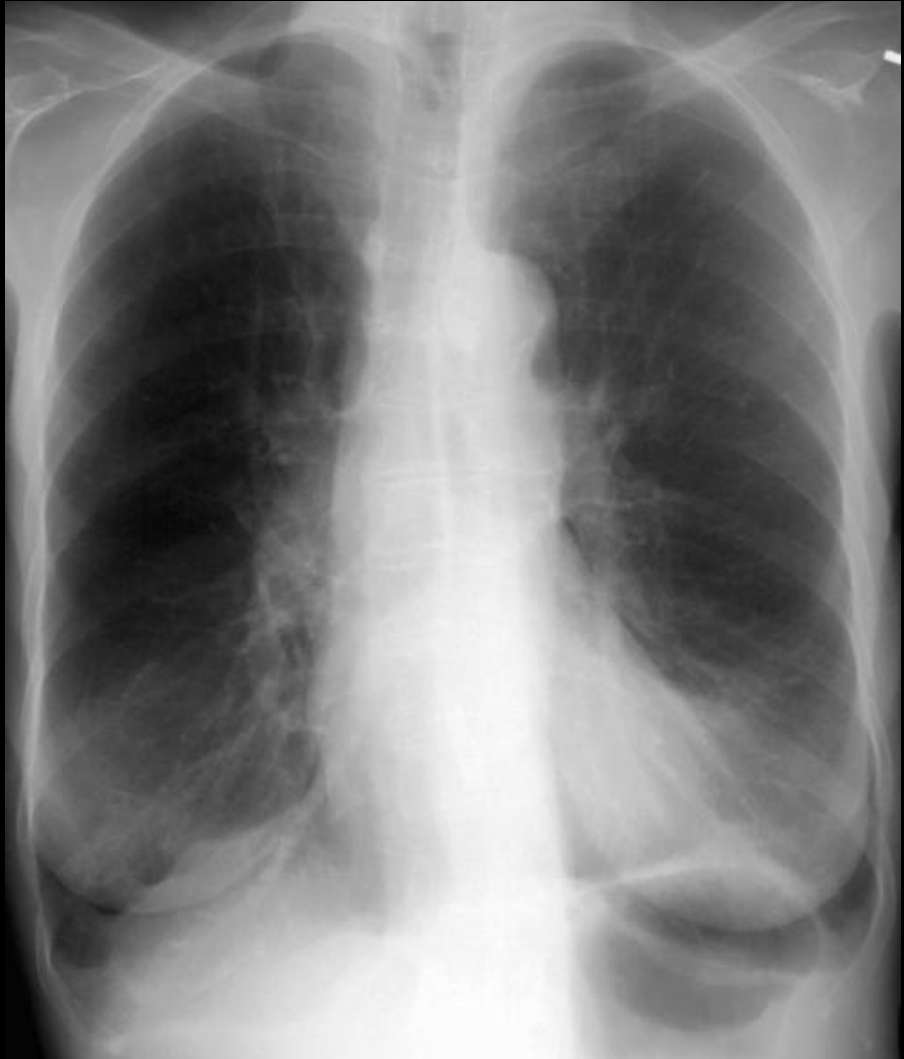
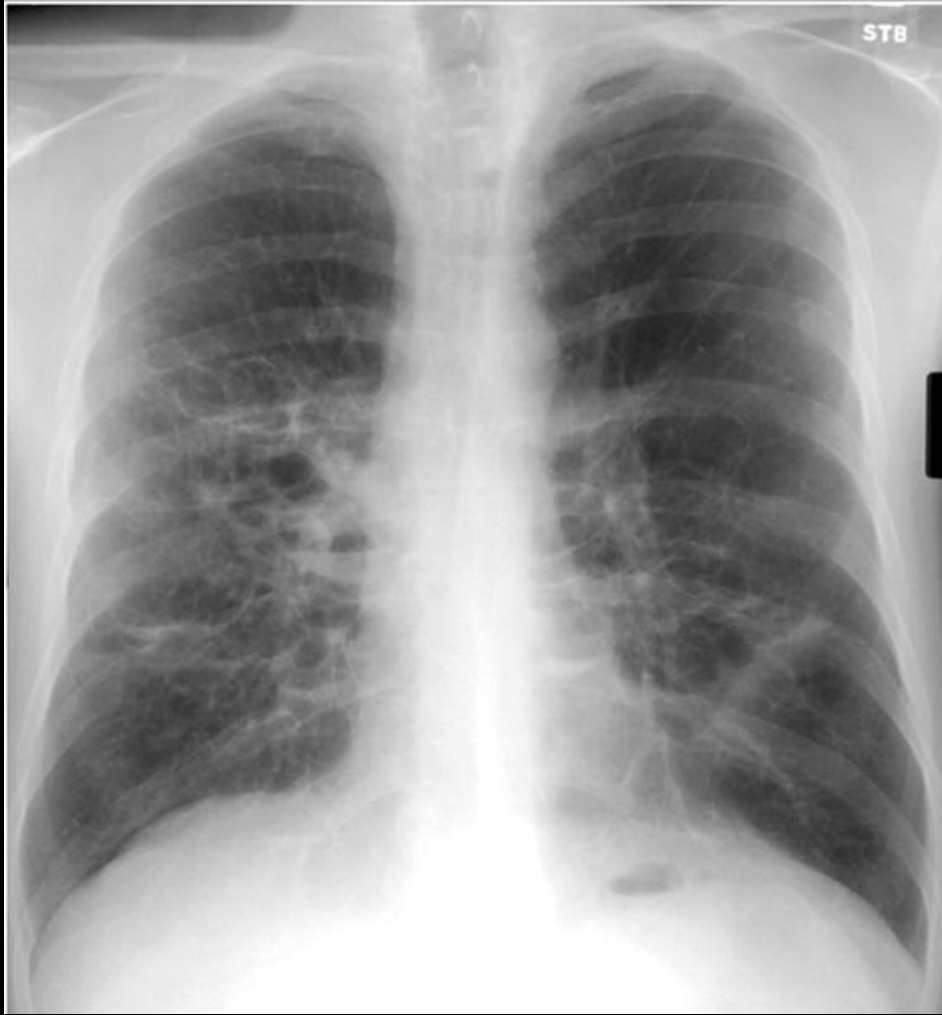
- Idiopathic interstitial pneumonias
- Infections (TB, viruses)
- Edema
- Hemorrhage
- Non–infectious inflammatory lesions
 - sarcoidosis
- Tumor

Interstitial Opacity



Interstitial Opacity





Nodules and Masses

- Nodule: any pulmonary lesion represented in a radiograph by a sharply defined, discrete, nearly circular opacity 2-30 mm in diameter
- Mass: larger than 3 cm

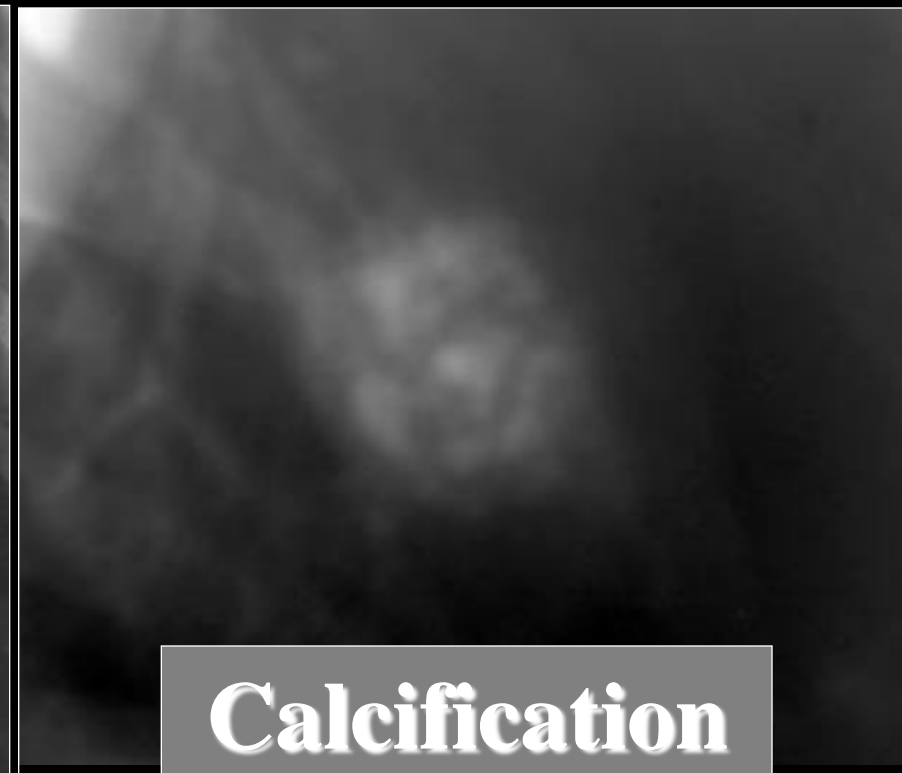
Nodules and Masses

- Qualifiers:
 - single or multiple
 - size
 - border definition
 - presence or absence of calcification
 - location

Well-Defined



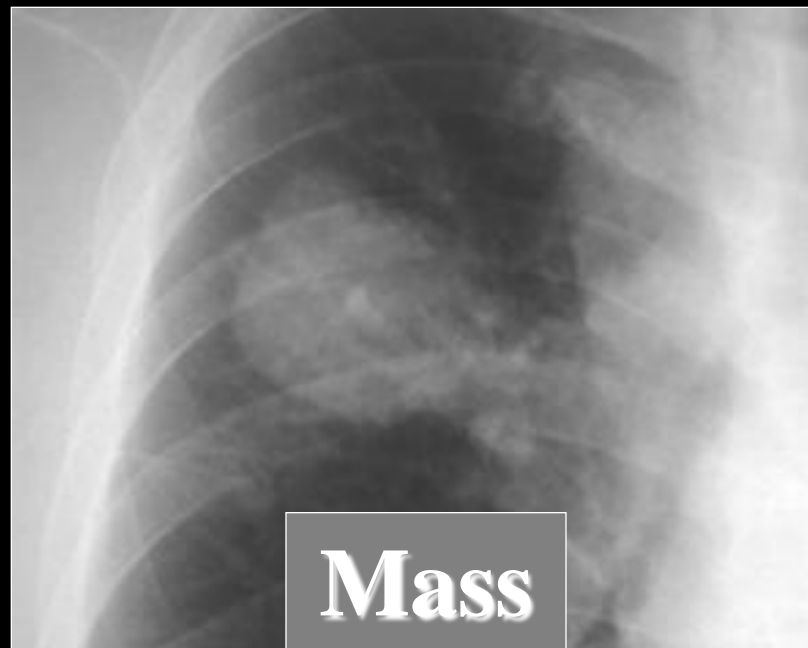
Calcification



Ill-Defined



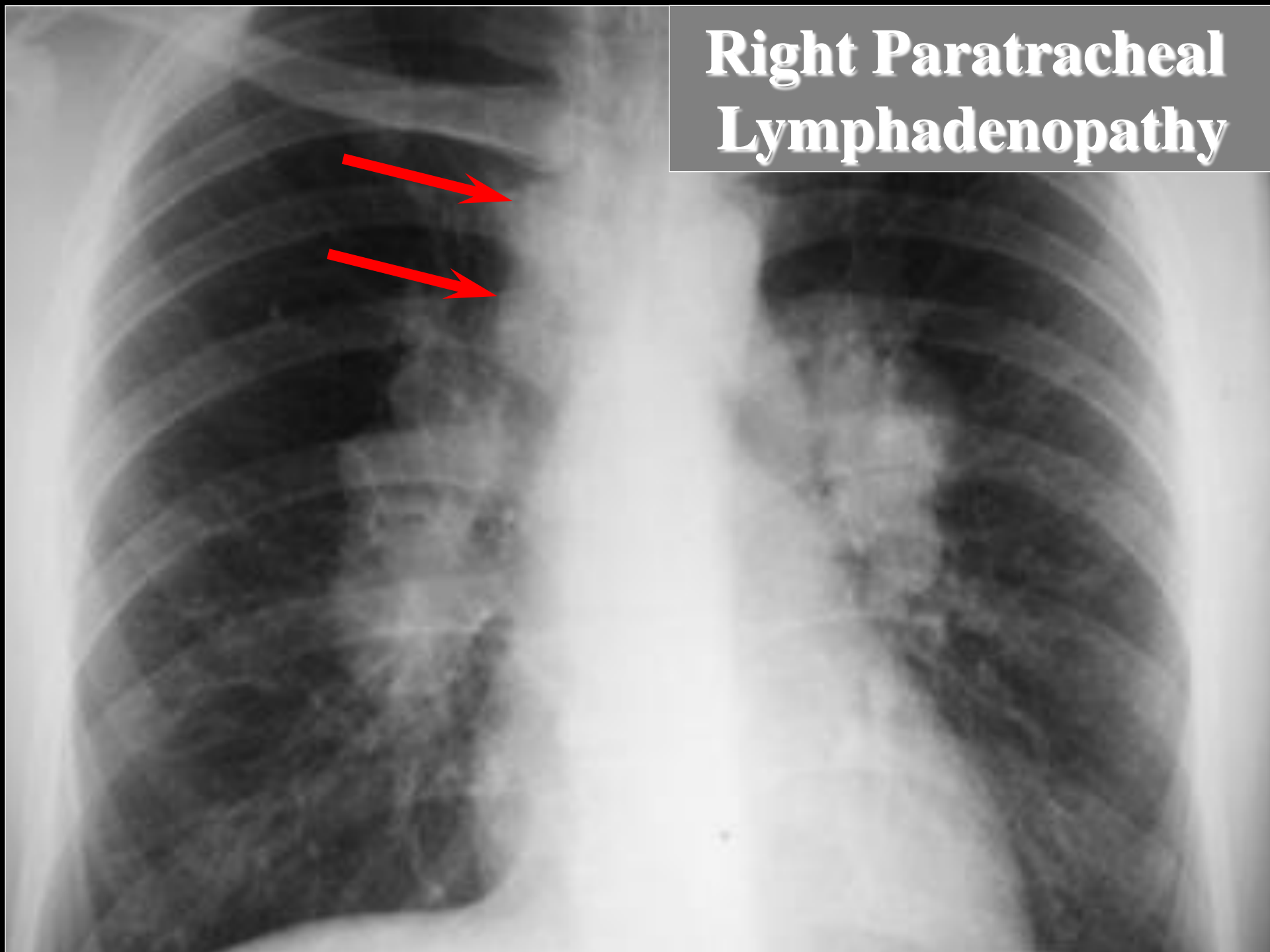
Mass



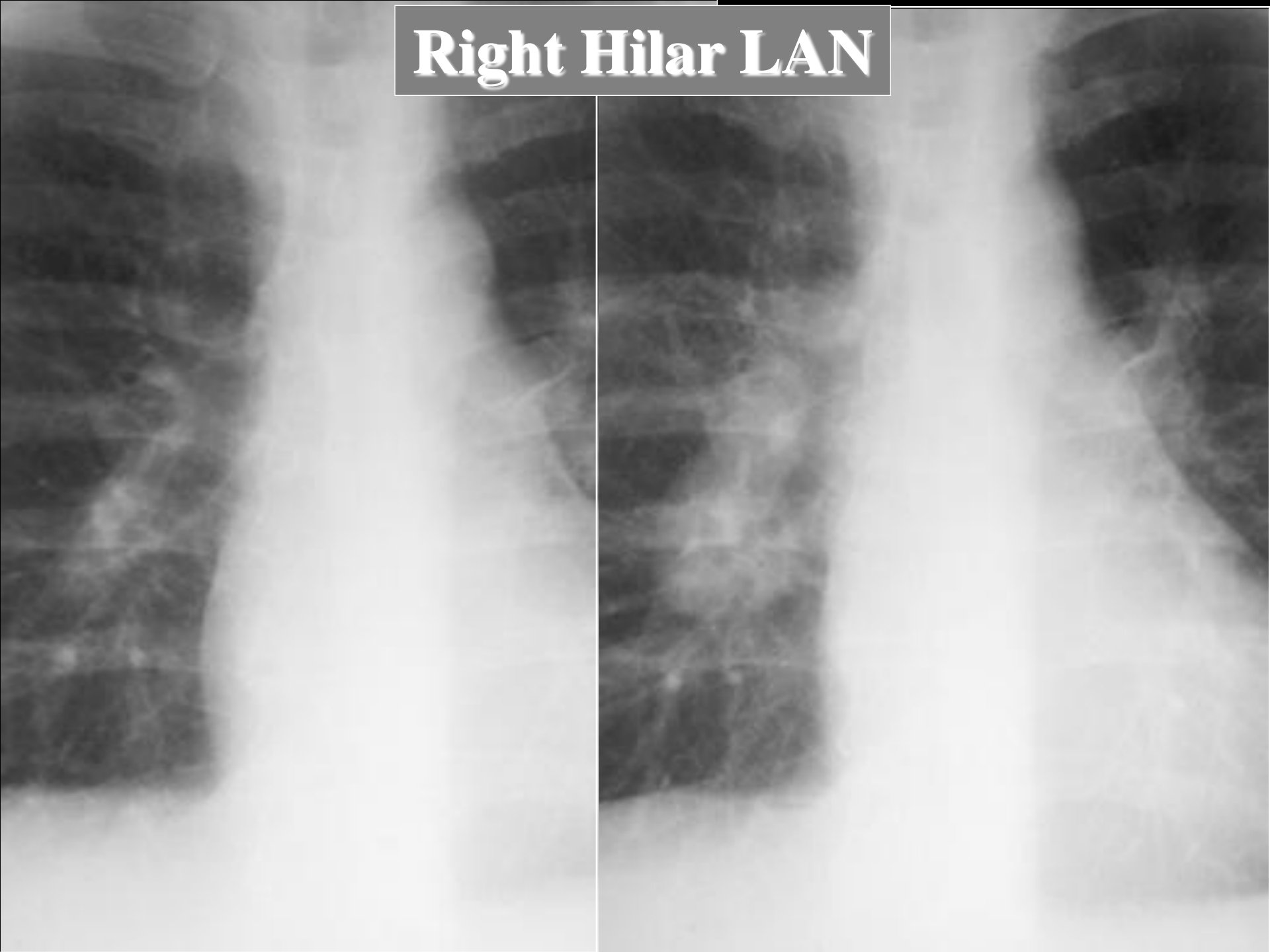
Lymphadenopathy (LAN)

- Non-specific presentations:
 - mediastinal widening
 - hilar prominence
- Specific patterns:
 - particular station enlargement

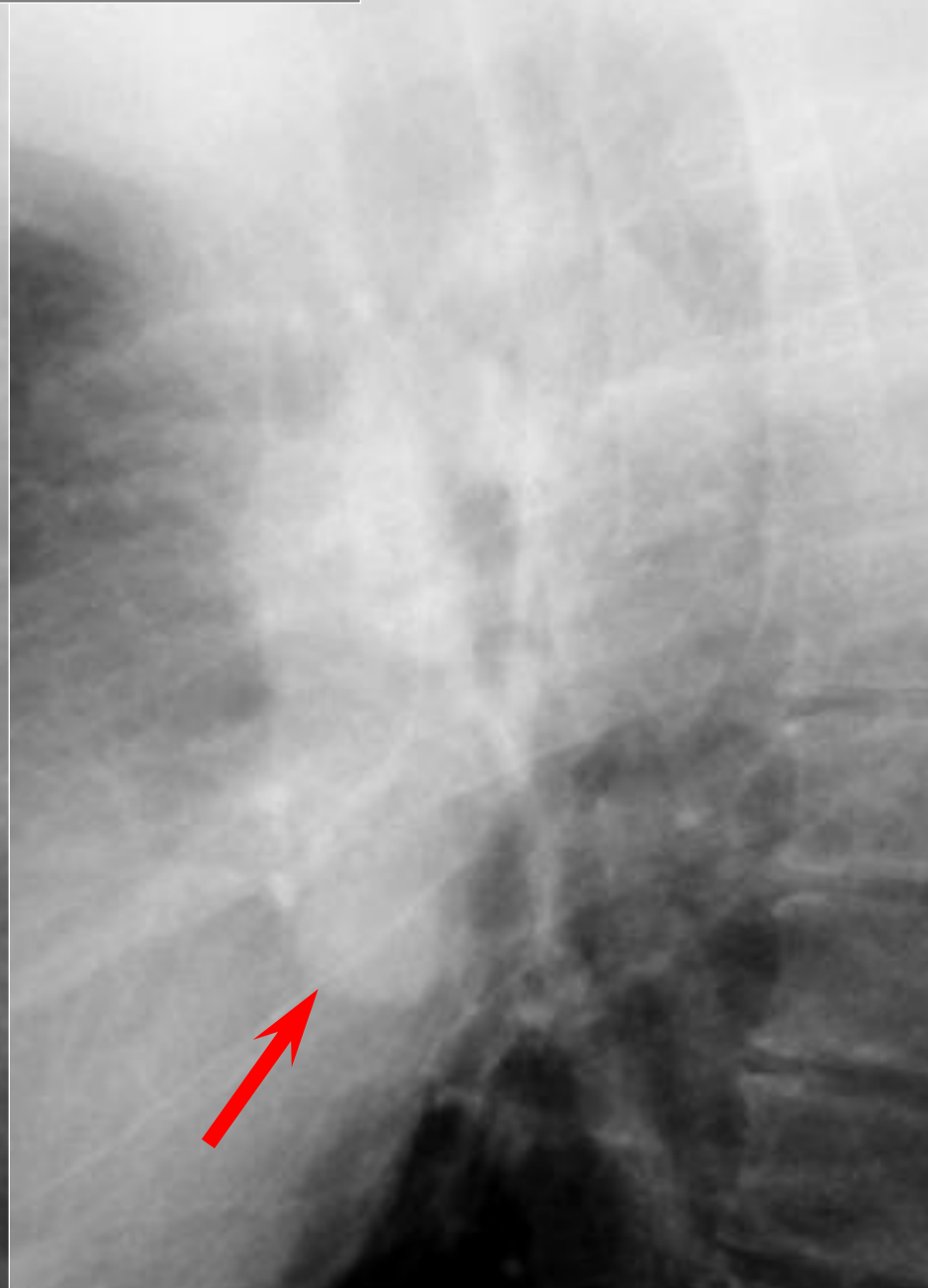
Right Paratracheal Lymphadenopathy



Right Hilar LAN

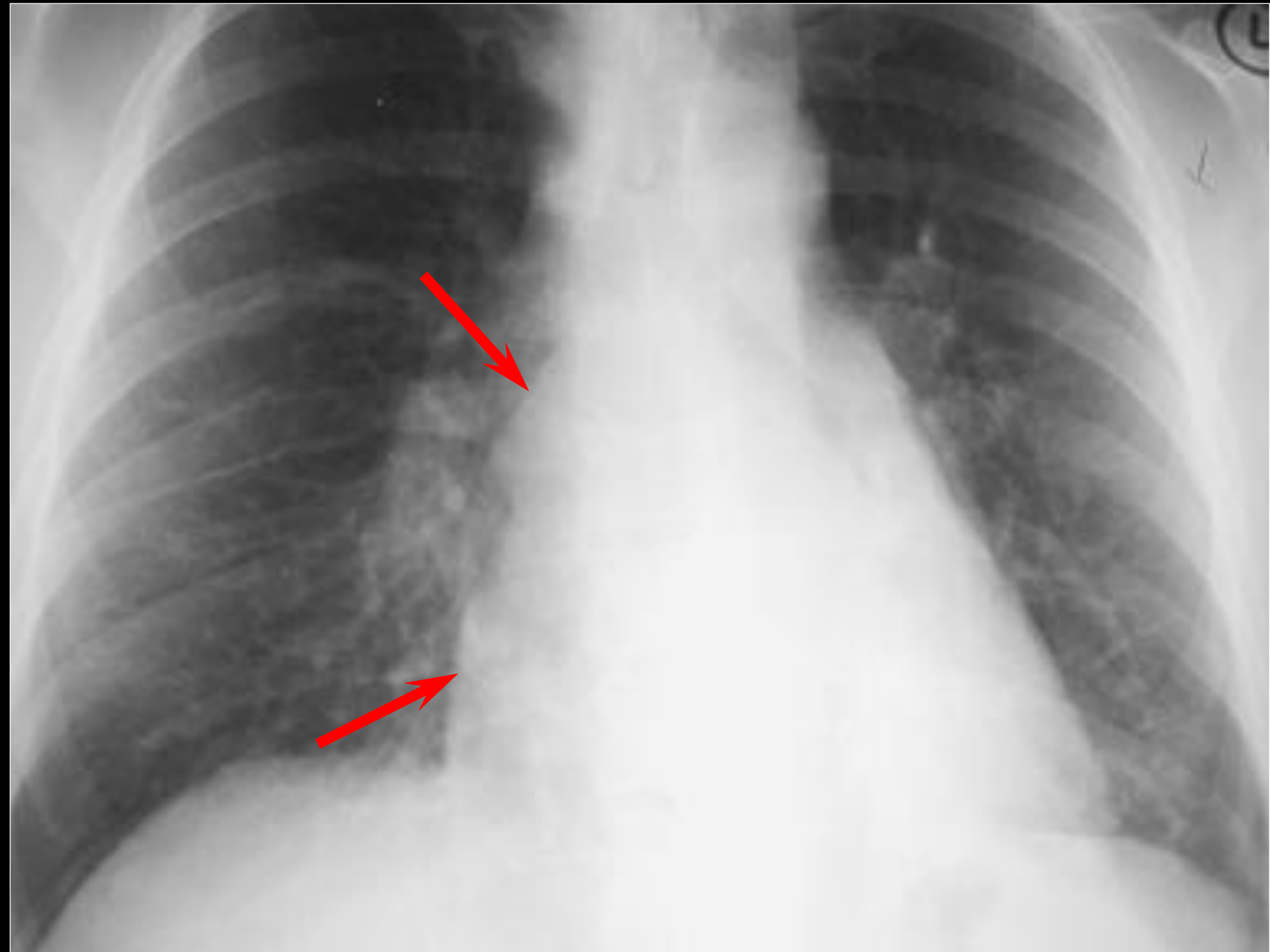


Right Hilar LAN

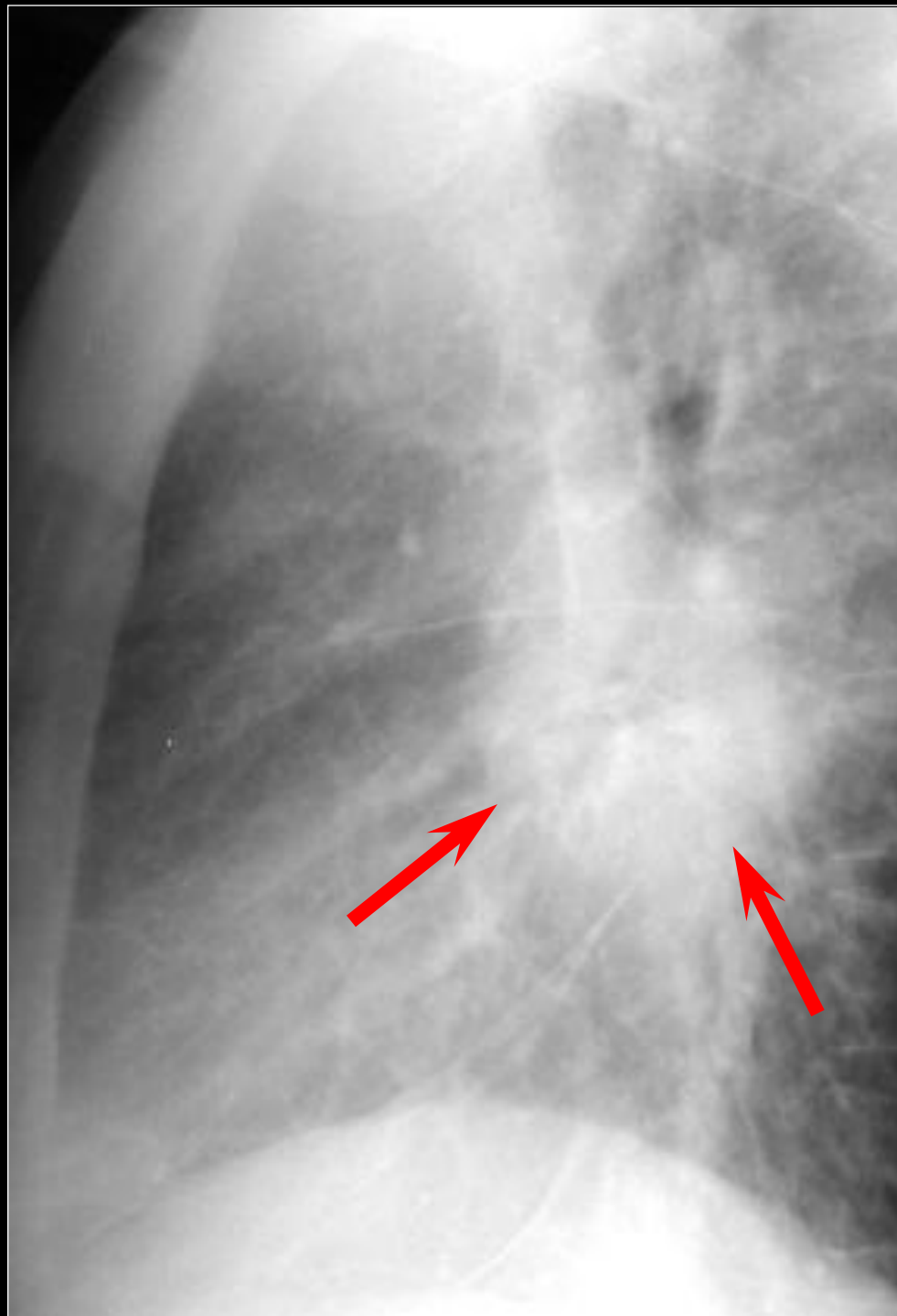


Left Hilar LAN





Subcarinal LAN



AP Window LAN



Cysts & Cavities

- Cyst: abnormal pulmonary parenchymal space, not containing lung but filled with air and/or fluid, congenital or acquired, with a wall thickness greater than 1 mm
- epithelial lining often present

Cysts & Cavities

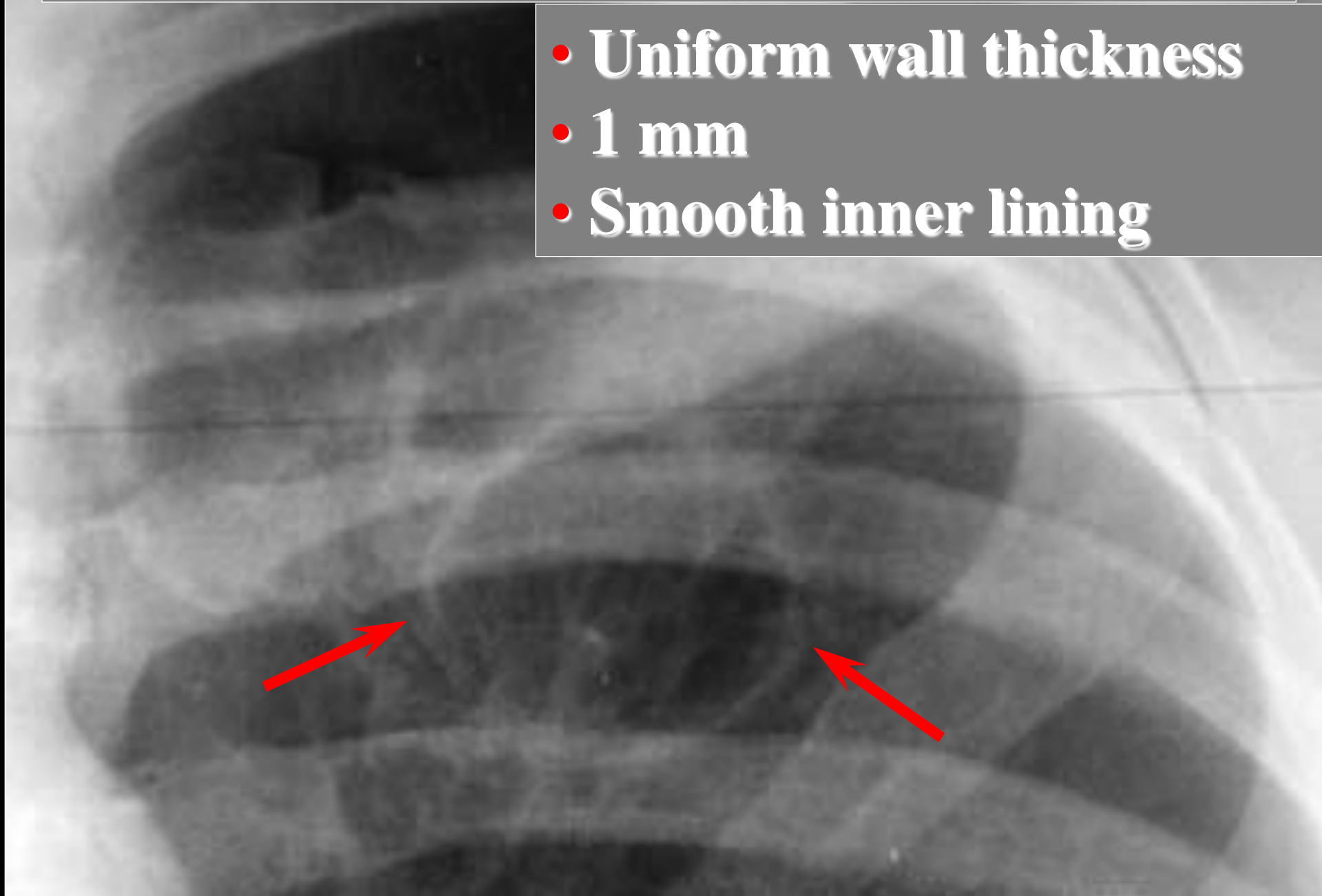
- Cavity: abnormal pulmonary parenchymal space, not containing lung but filled with air and/or fluid, caused by tissue necrosis, with a definitive wall greater than 1 mm in thickness and comprised of inflammatory and/or neoplastic elements

Cysts & Cavities

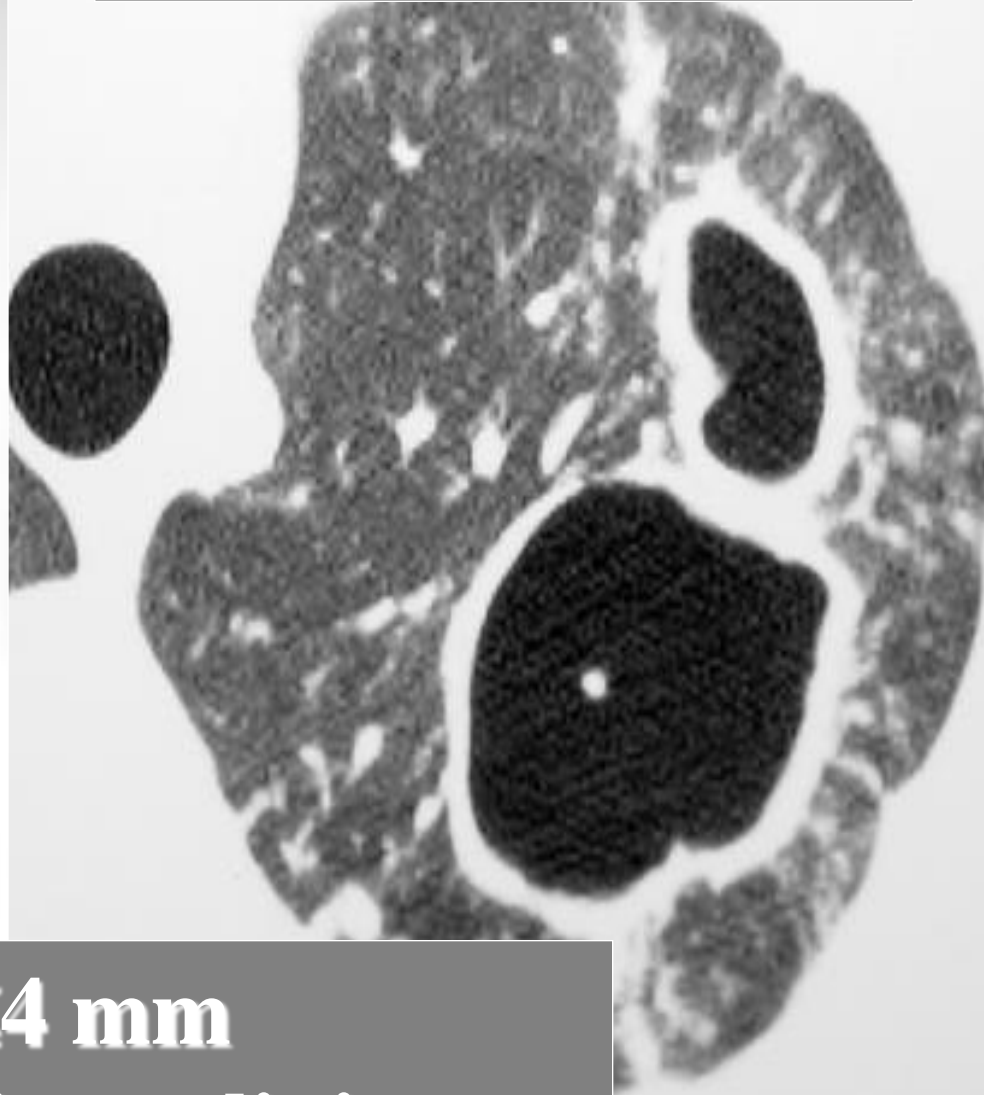
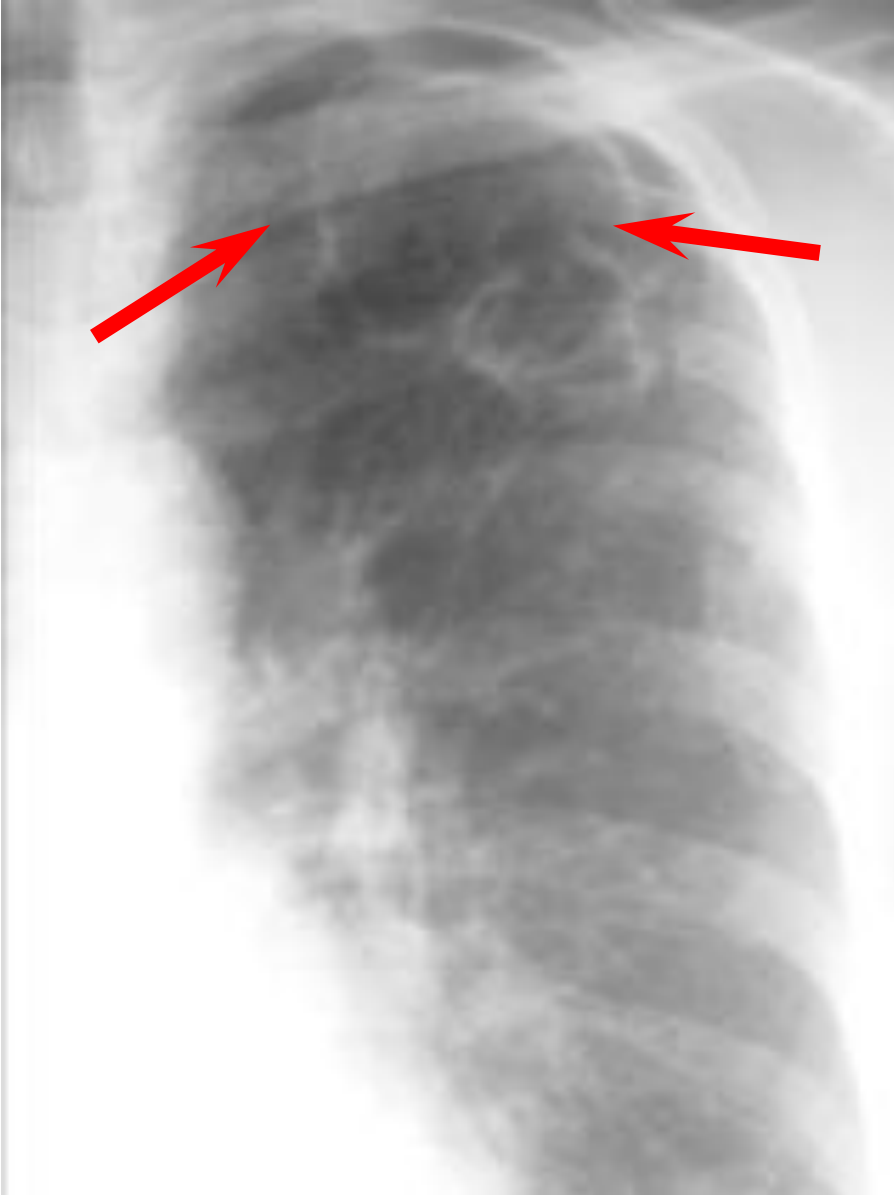
- Characterize:
 - wall thickness at thickest portion
 - inner lining
 - presence/absence of air/fluid level
 - number and location

Benign Lung Cyst : *PCP* Pneumatocele

- Uniform wall thickness
- 1 mm
- Smooth inner lining



Benign Cavities : Cryptococcus



- max wall thickness ≤ 4 mm
- minimally irregular inner lining

Indeterminate Cavities

- max wall thickness 5-15 mm
- mildly irregular inner lining



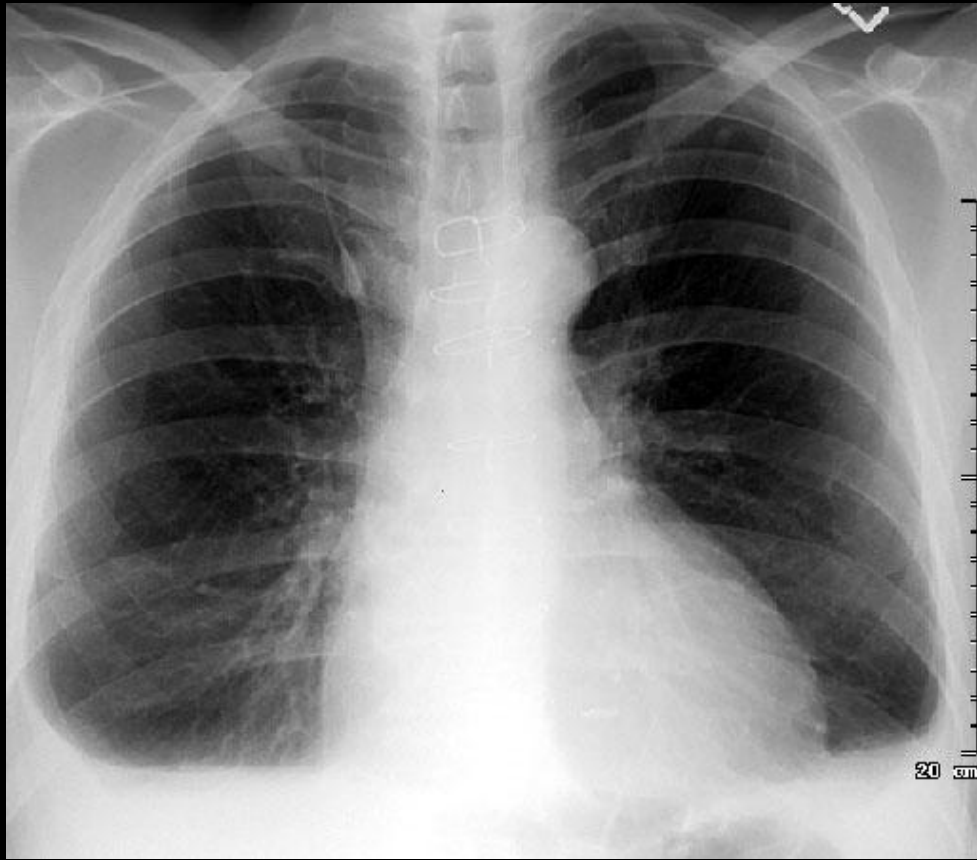
Malignant Cavities: Squamous Cell Ca

- **max wall thickness ≥ 16 mm**
- **Irregular inner lining**

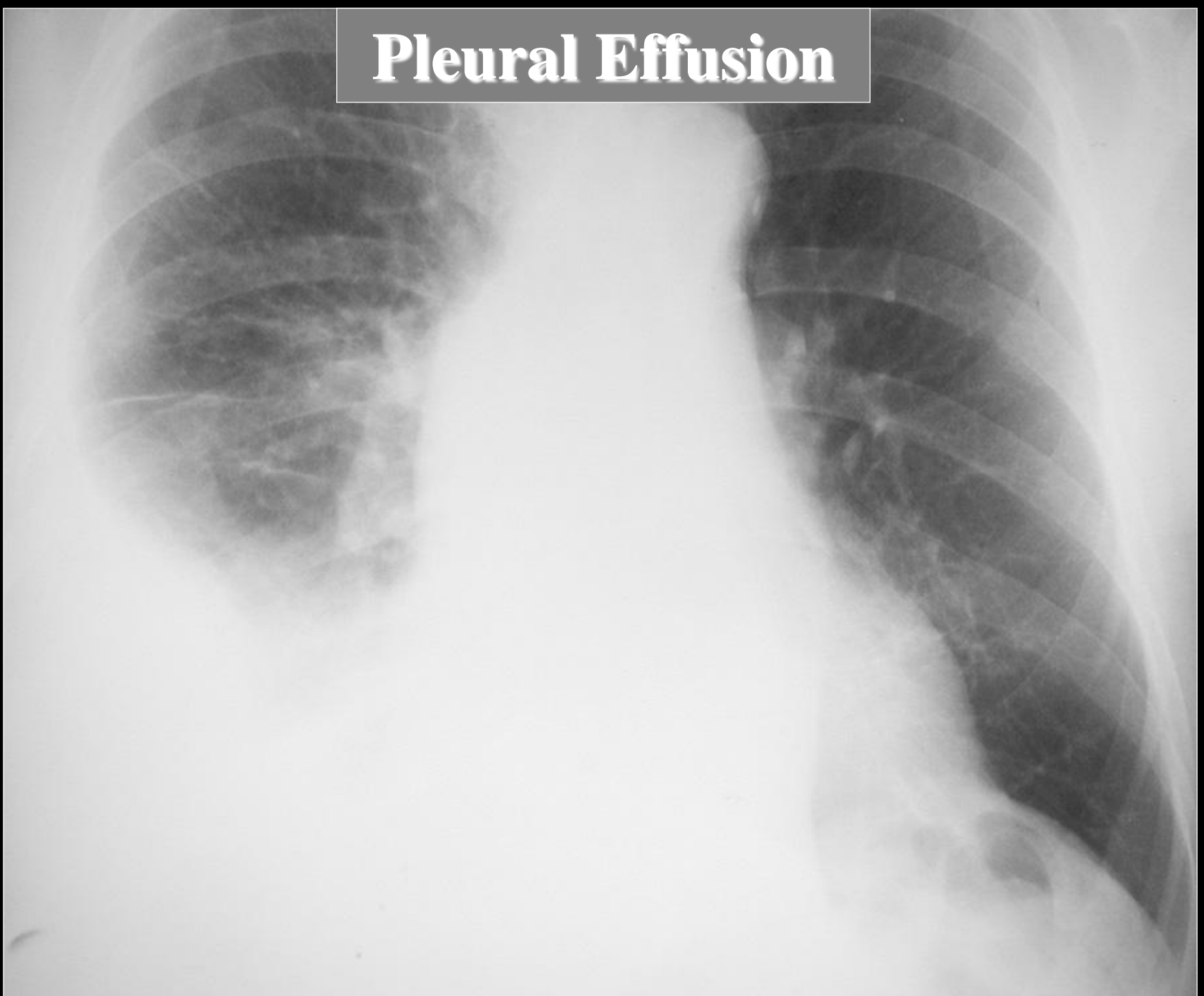
Pleural Disease: Basic Patterns

- Effusion
 - angle blunting to massive
 - mobility
- Thickening
 - distortion, no mobility
- Mass
- Air
- Calcification

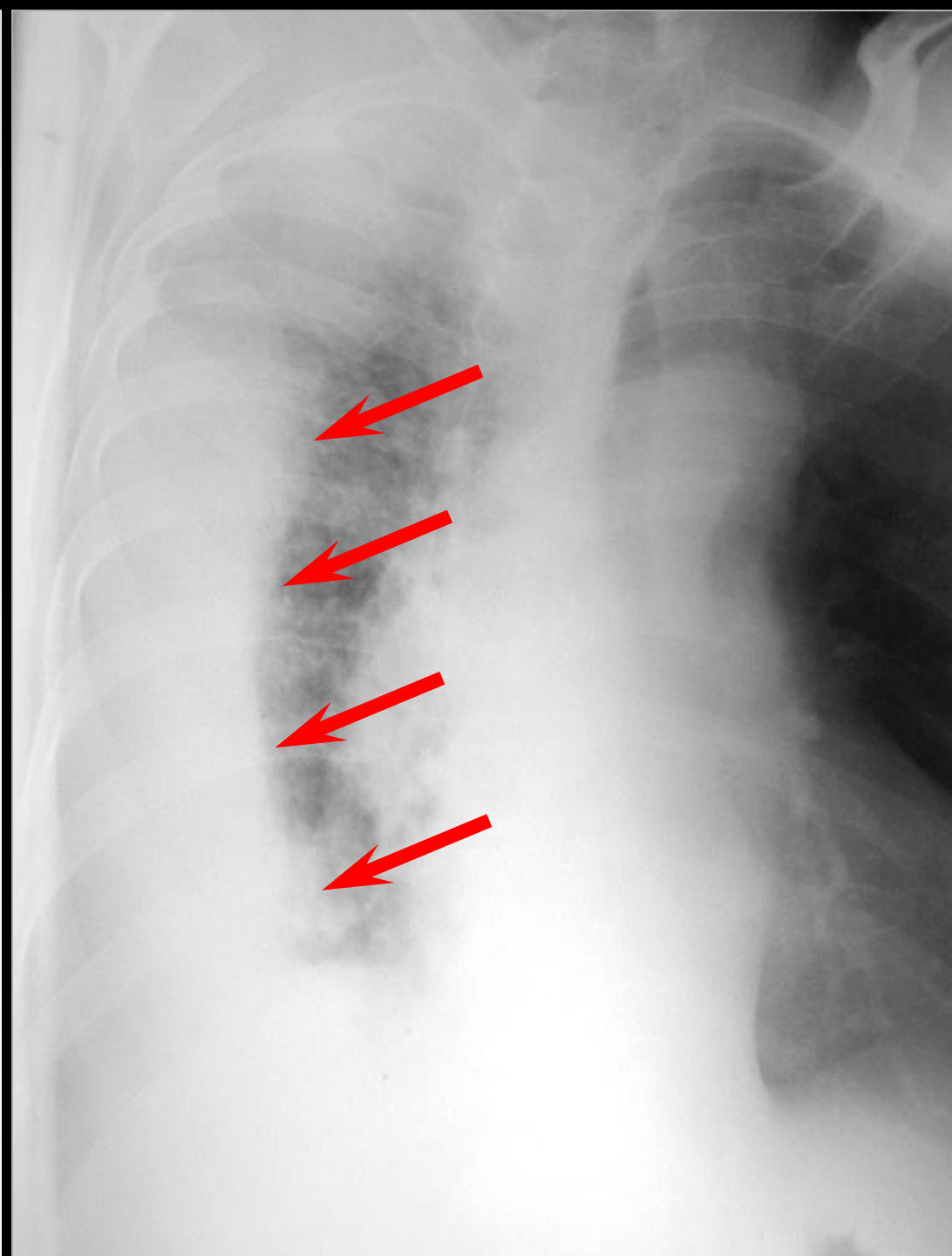
Pleural Disease - effusion



Pleural Effusion

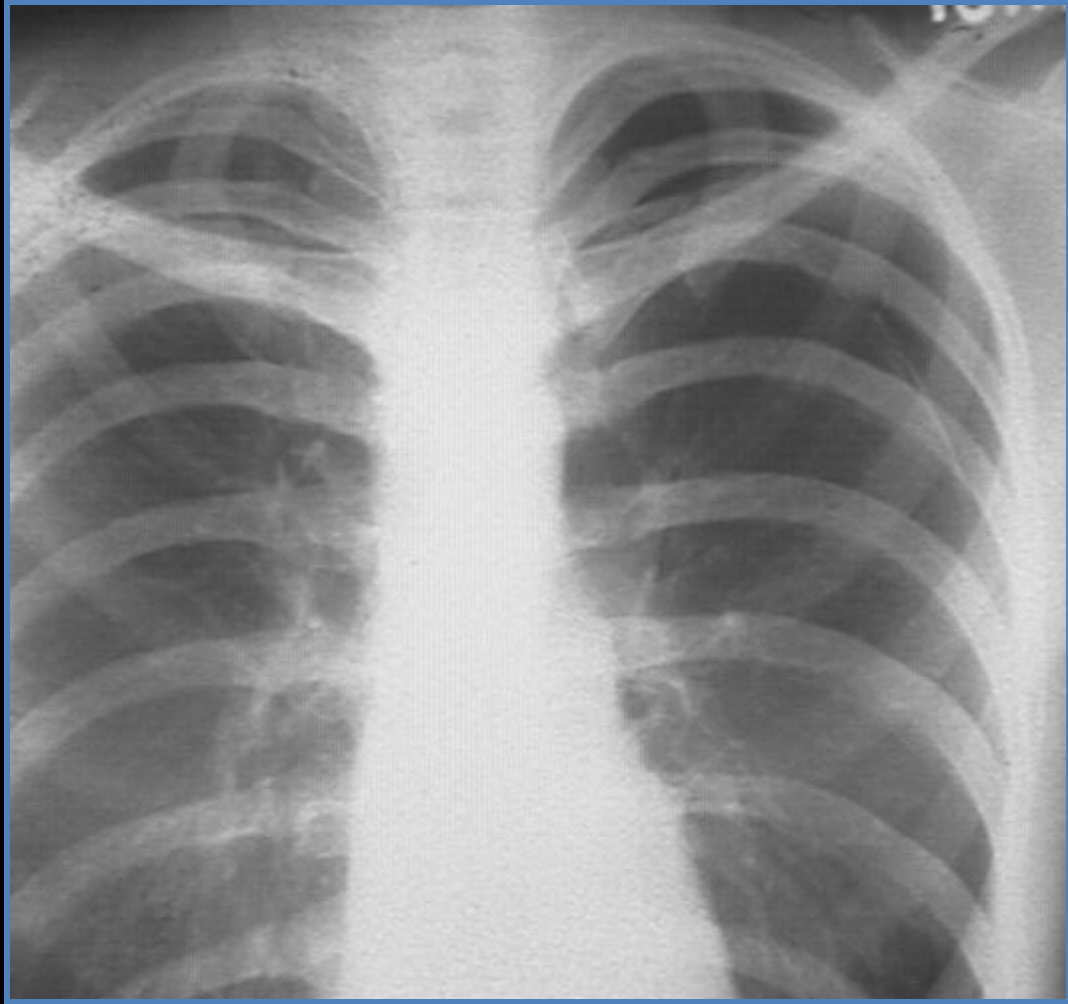


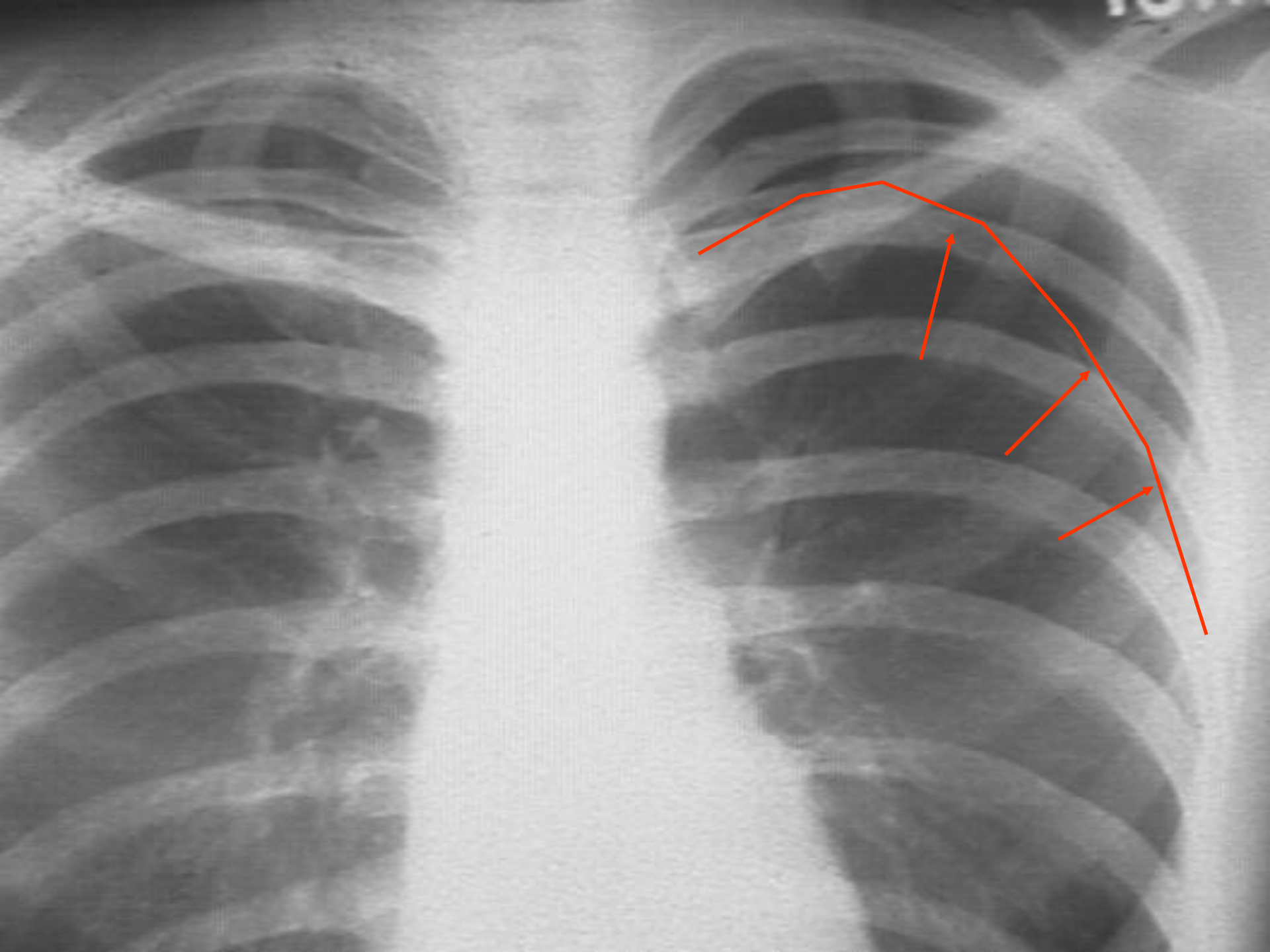
Pleural Effusion

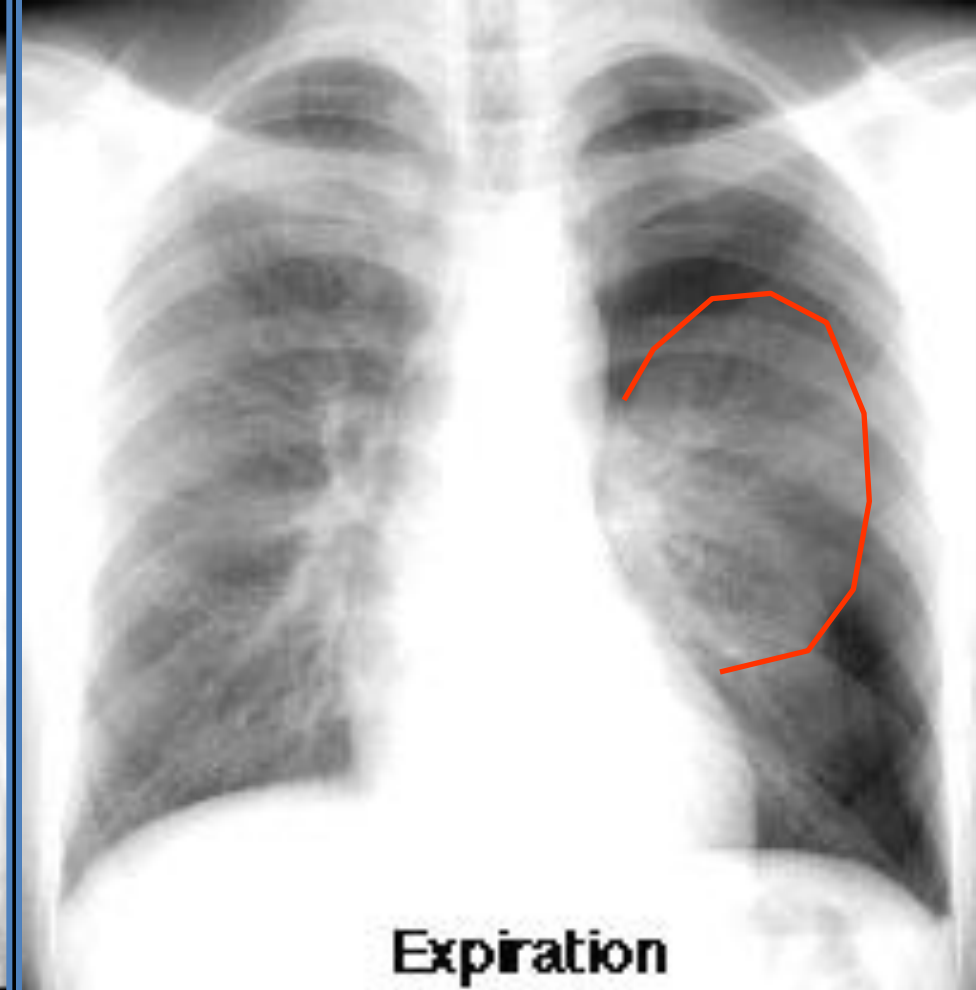
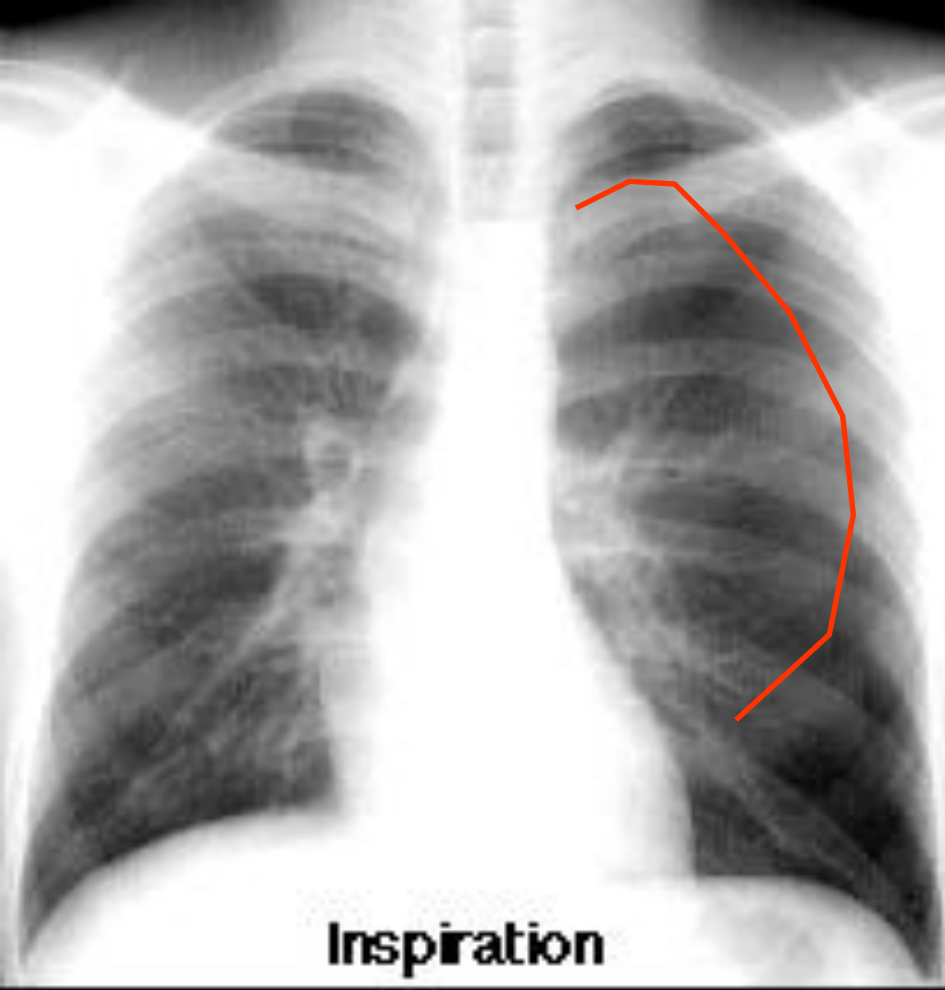


Pleural Disease - pneumothorax

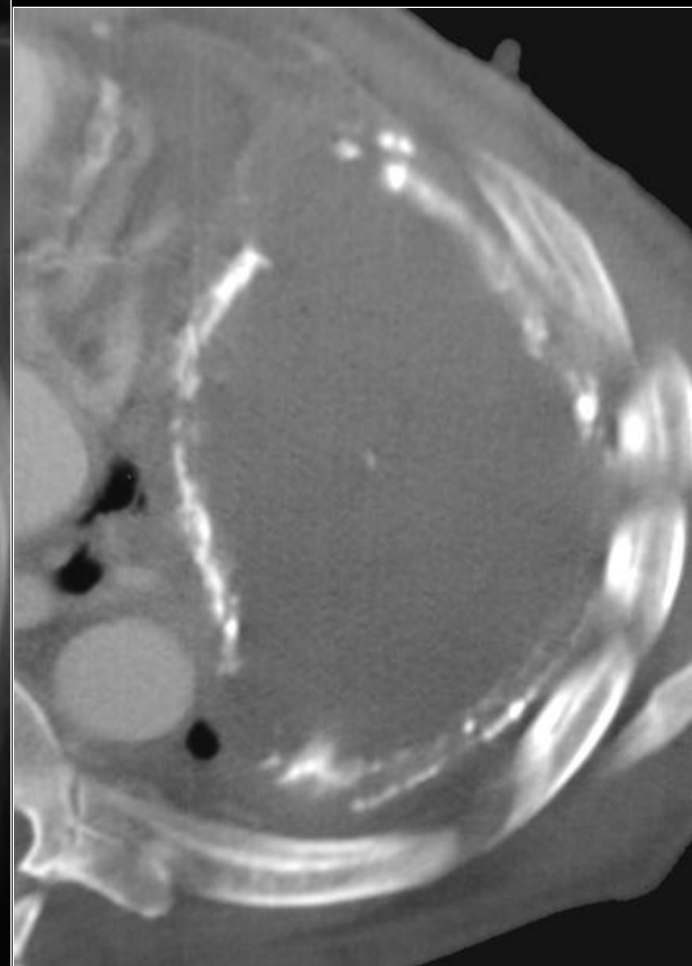








Pleural Calcification



01-OCT-1996
IMAGE 66

Tension Pneumo

Mediastinum

Rt.

Lt.

Ao

SPI 35
TP -512.5

SL10.0/15.0

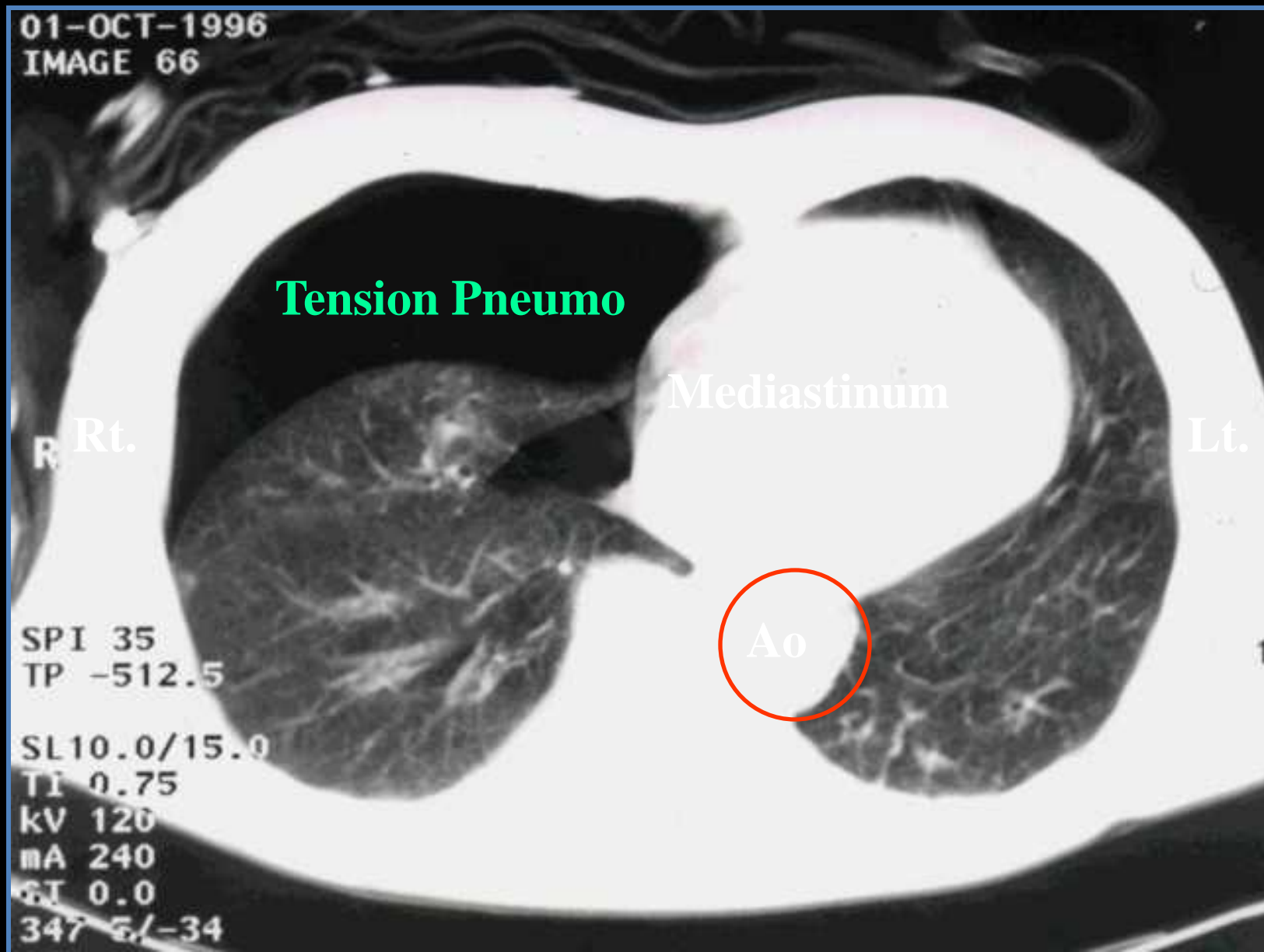
TI 0.75

kV 120

mA 240

CT 0.0

347 5/-34

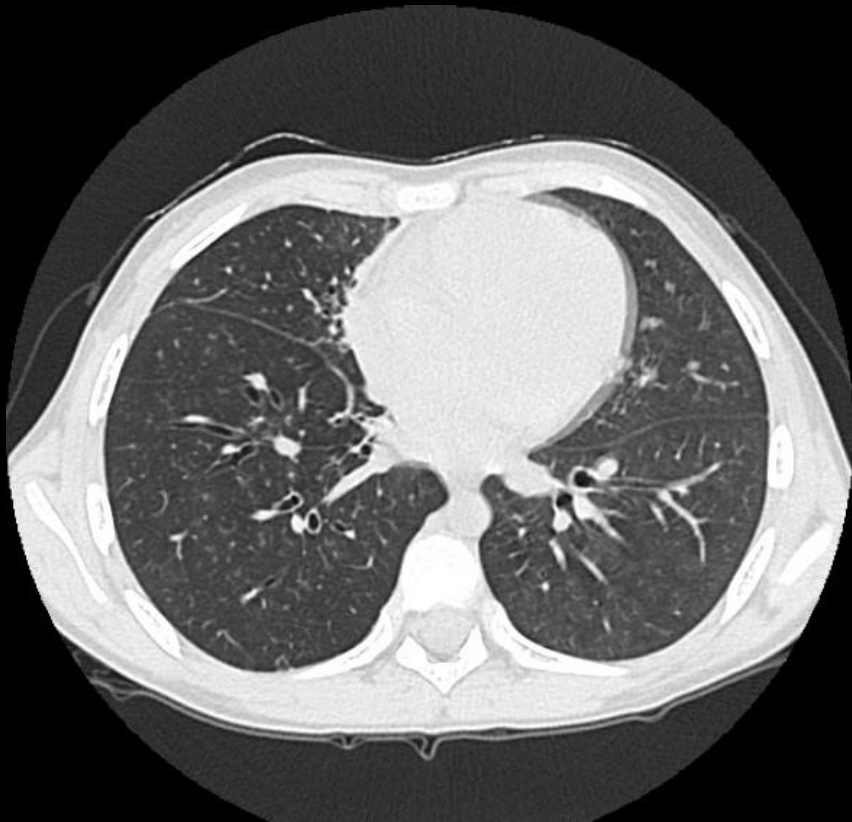




Bronchography – CM-filled bronchi

Computed tomography of the chest - types of examinations

1. Chest CT (non-CE / CE-enhanced)
2. CTA - CT angiography
3. HRCT – high-resolution CT
4. Virtual bronchoscopy



Lung Window

2 mm
|41.8



io: 94
|4 of 174

Mediastinal Window

CT Scan

Main Indications

- chest tumors
- atypical inflammatory diseases
- complications of pneumonia
- atypical fluid collections
- iatrogenic complications
- trauma

Indications for CTA

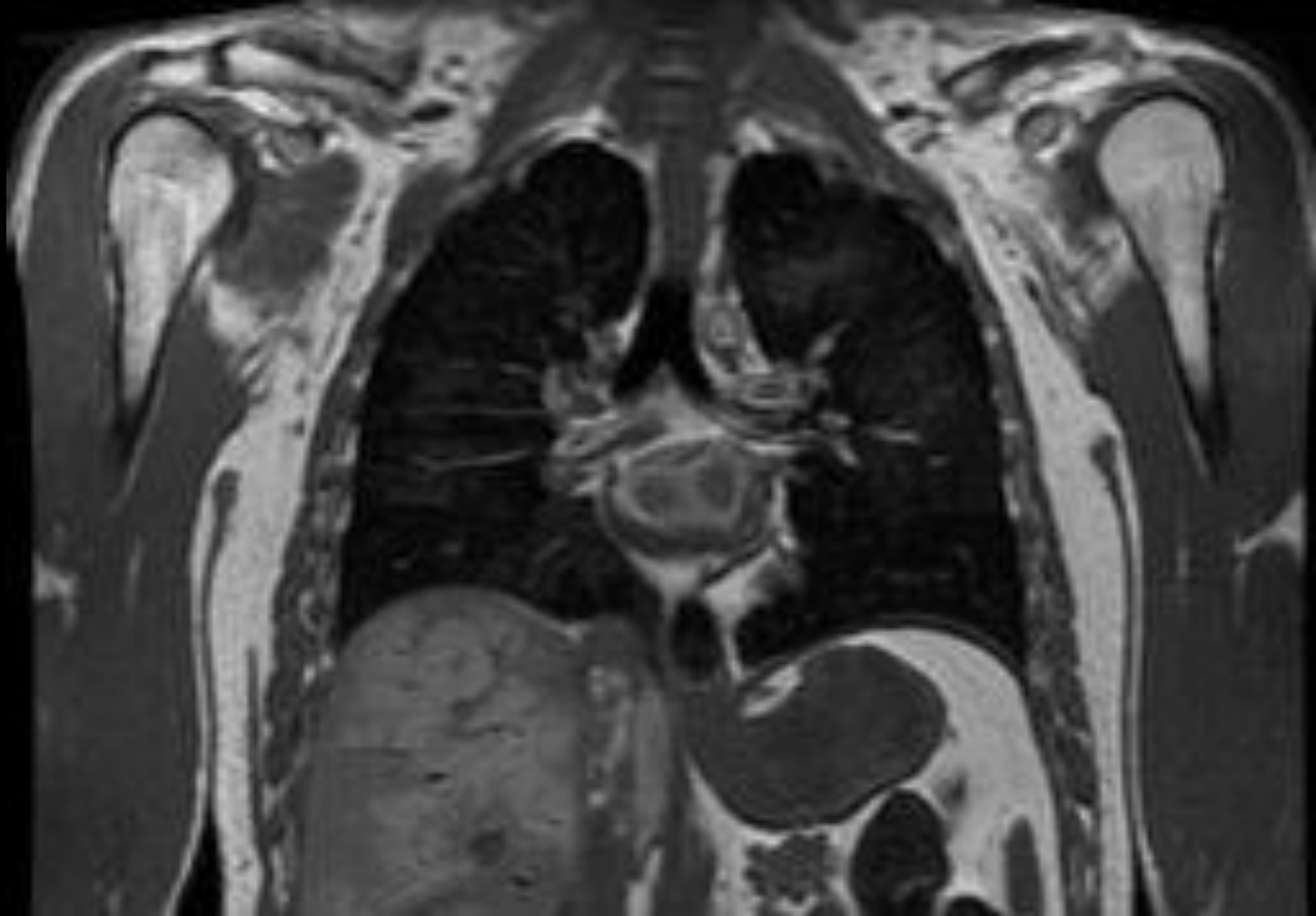
- pulmonary embolism
- aorta aneurysm
- vascular anomalies
- atherosclerosis
- pulmonary vascular malformations

Indications for HRCT

- interstitial lung disease
- pulmonary emphysema
- bronchiectasis
- atypical inflammations of the lung (fungal)
- chronic pulmonary hypertension

MRI of the chest

1. Not commonly used (poor imaging of the lung, high cost).
2. Requires ultra-fast sequences, ECG gating and respiratory compensation.
3. Indications – neurogenic tumors of posterior mediastinum, Pancoast's tumor, imaging of the heart and great vessels



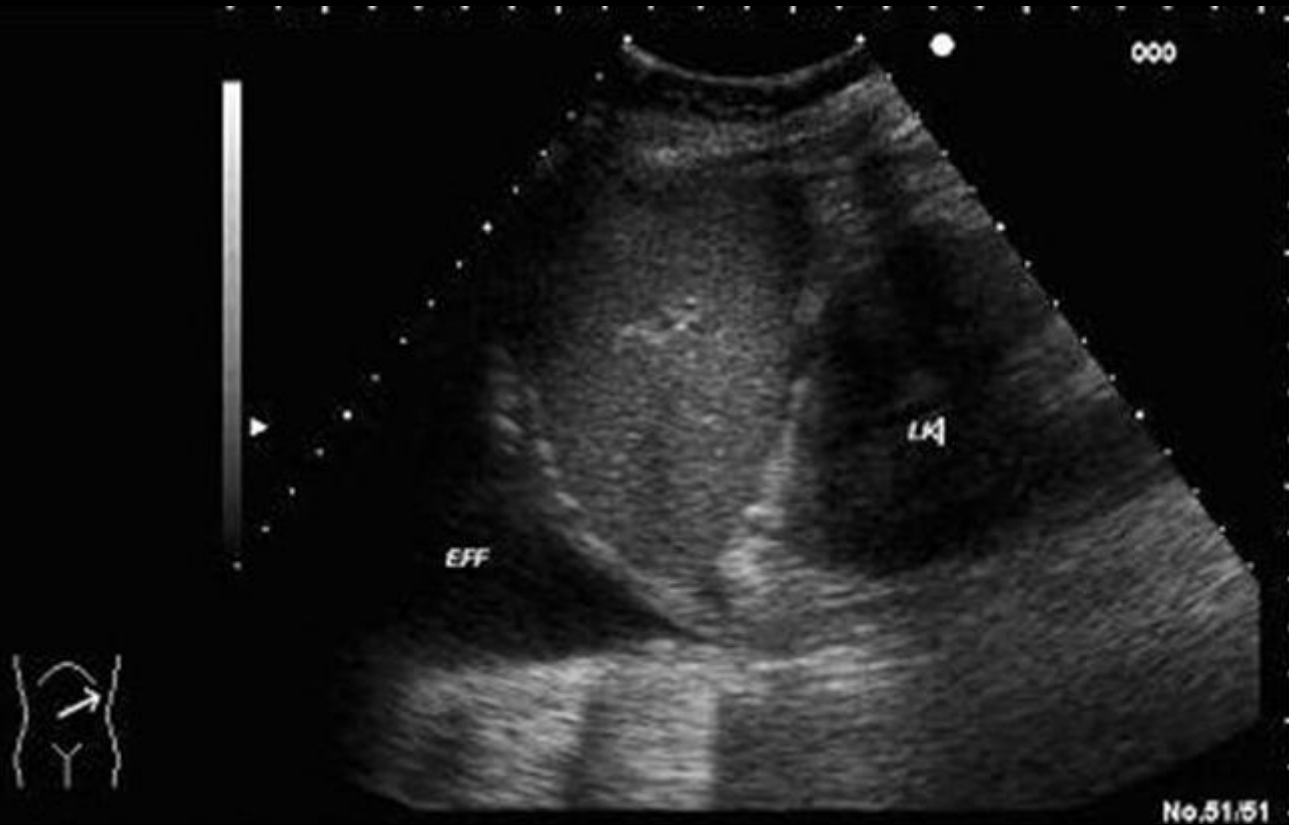
MRI

Transthoracic ultrasonography

1. Safe, cheap, can be used in any ultrasound lab, including at the bedside.
2. Allows to assess chest wall, pleura, diaphragm, airless lung regions adjacent to the pleura, thymus, heart and great vessels (echocardiography).

Indications for US of the chest

1. Diagnosis of pleural effusion (amount, distribution, nature)
2. Monitoring of biopsy and puncture
3. Diagnosis of ribs and sternum injuries



Ultrasound – pleural effusion

Conventional angiography

1. Not commonly used (invasive, high cost).
2. Indications – measurement of pressure in the pulmonary circulation, part of endovascular interventions



Pulmonary Angiography

PNEUMONIA

Lobar pneumonia

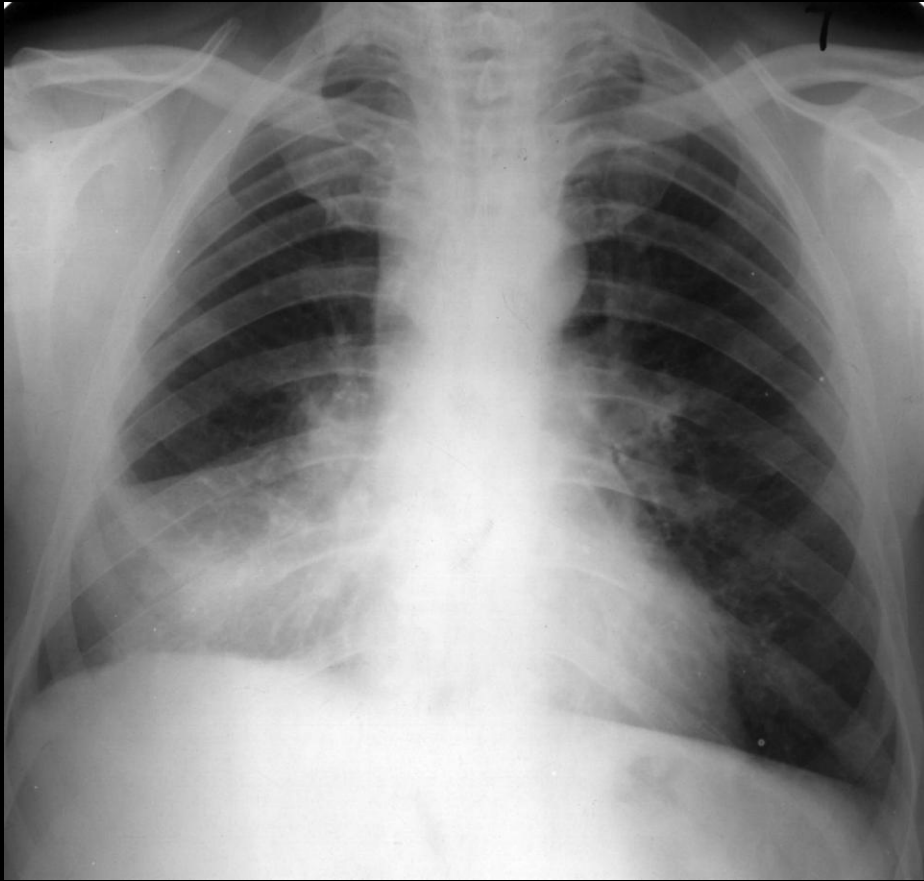
- Acute bacterial disease
- Diagnosis – clinical presentation
- CXR – assesment of dynamics and of the suspected complications,
- X-ray symptoms appear and regress later than clinical symptoms
- Complications: abcess, pleuritis, chronic pneumonia and *cirrhosis*

Lobar pneumonia

X-ray image of the full symptoms

- Lobe - uniformly shaded
- No change in the volume of an occupied lobe
- Shade with sharp outlines (interlobar fissure)
- Air-bronchogram
- Differentiation: pleural effusion, collapsed lung, cirrhosis, tuberculosis.

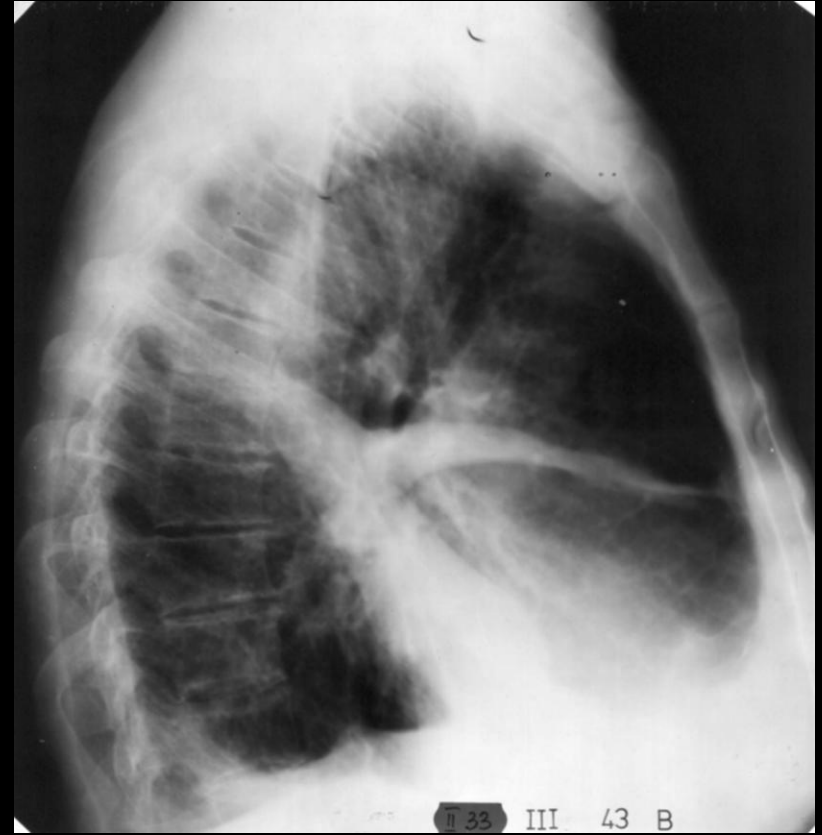
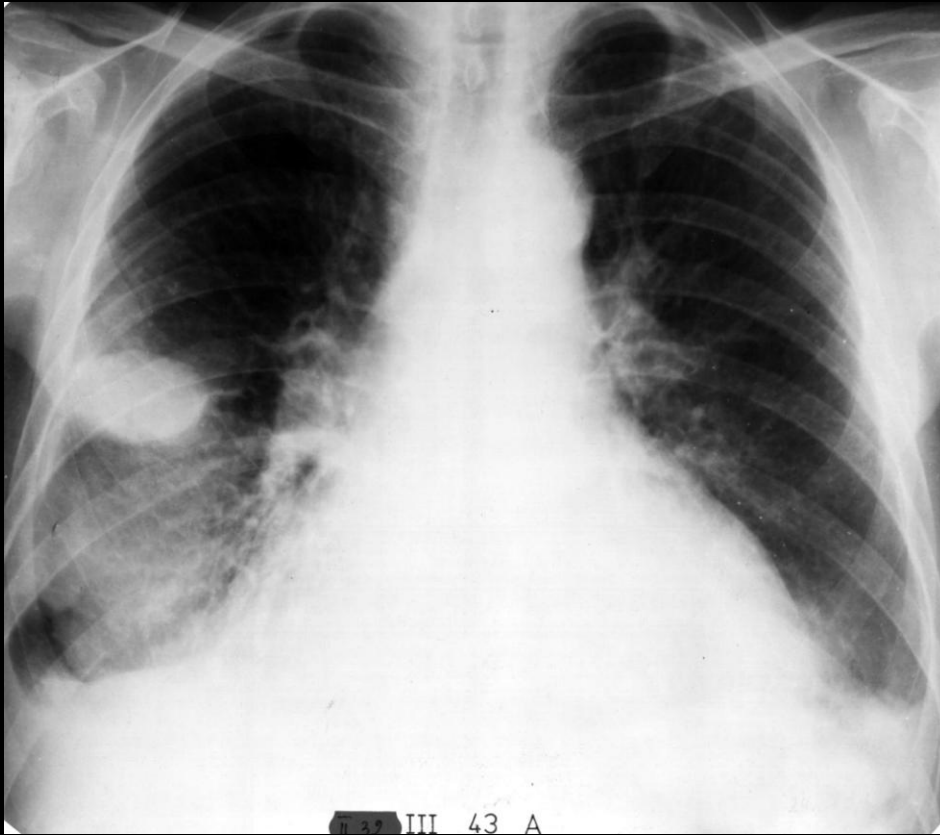
Lobar pneumonia



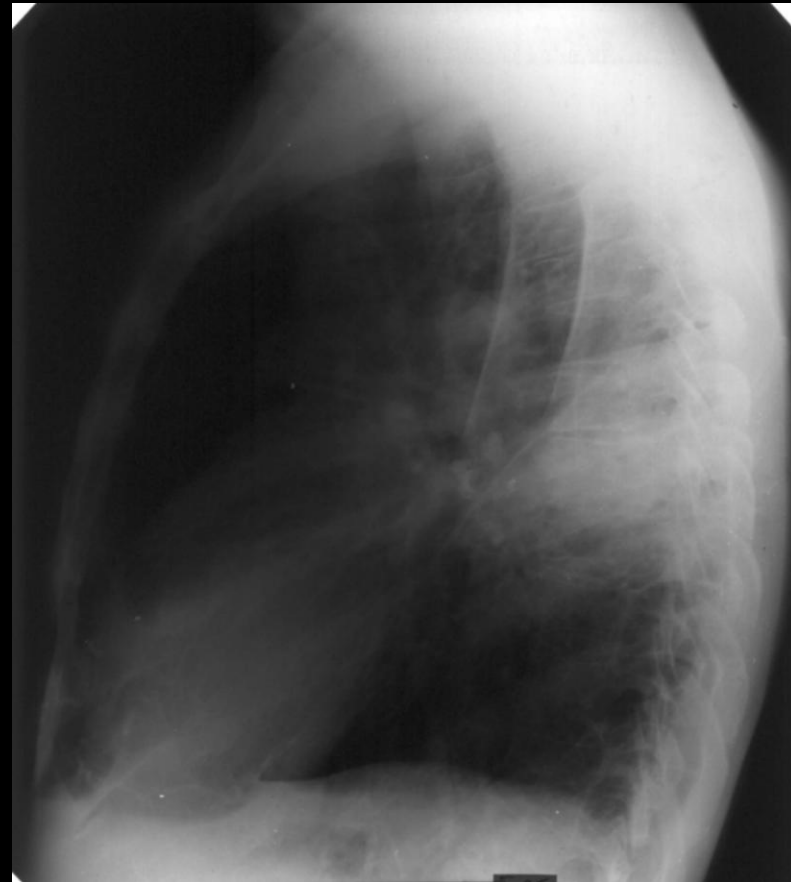
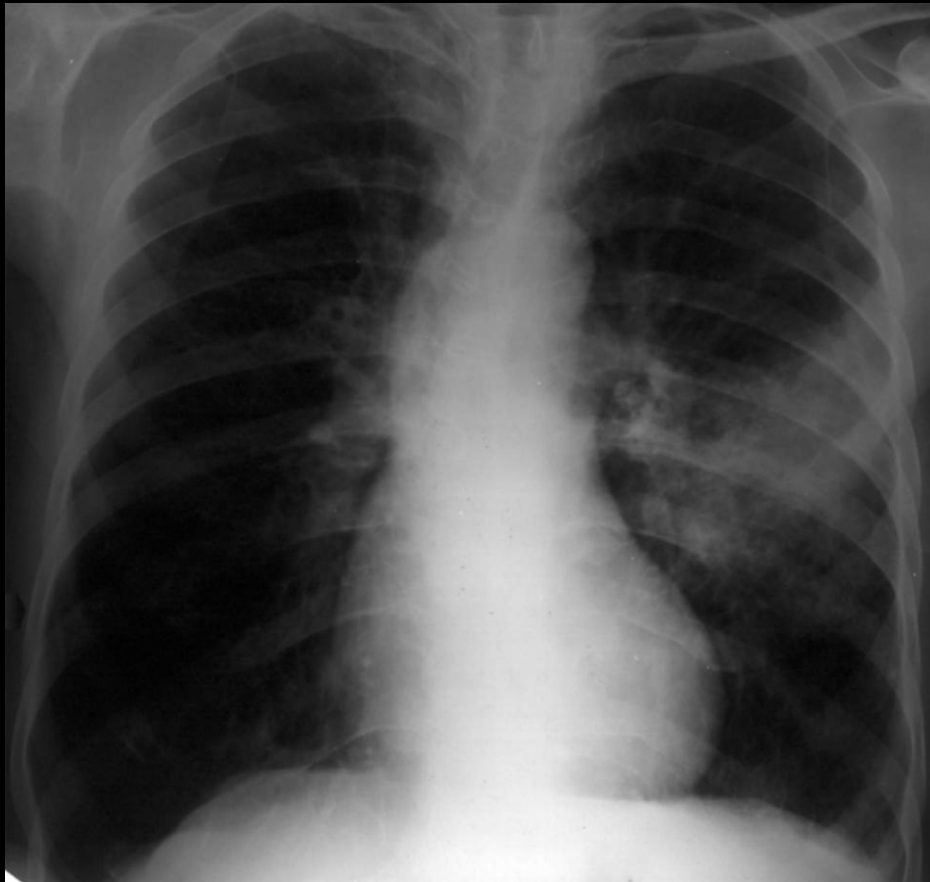
Lobar pneumonia



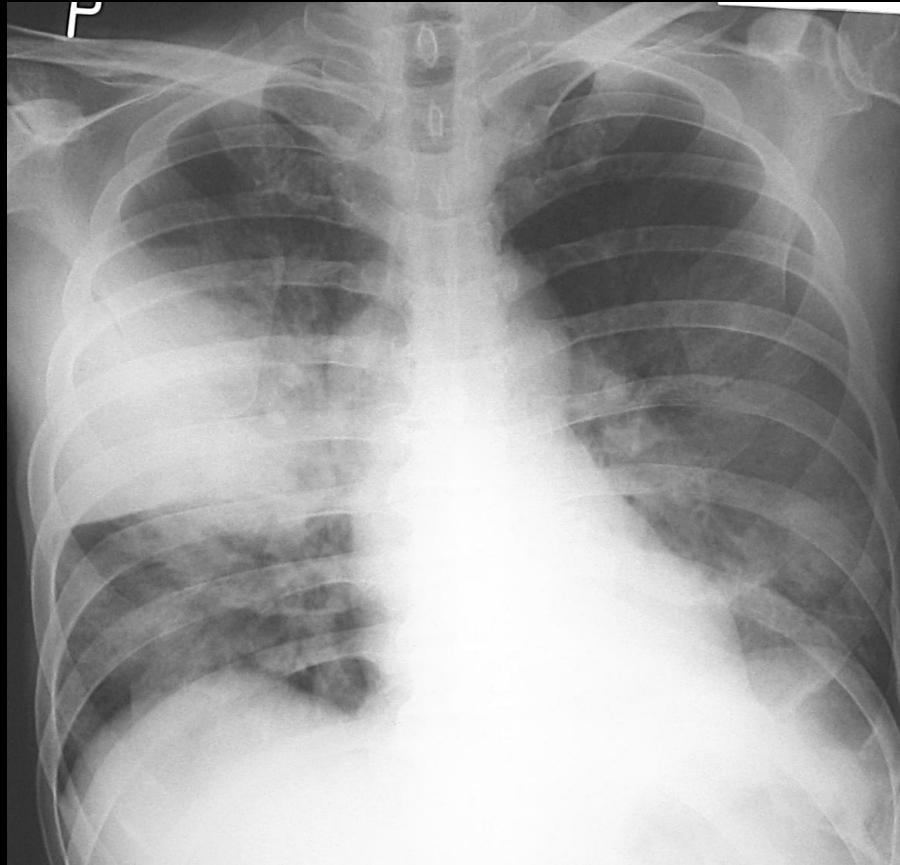
Fluid in horizontal and major fissures



Segmental pneumonia



Segmental pneumonia



Segmental pneumonia

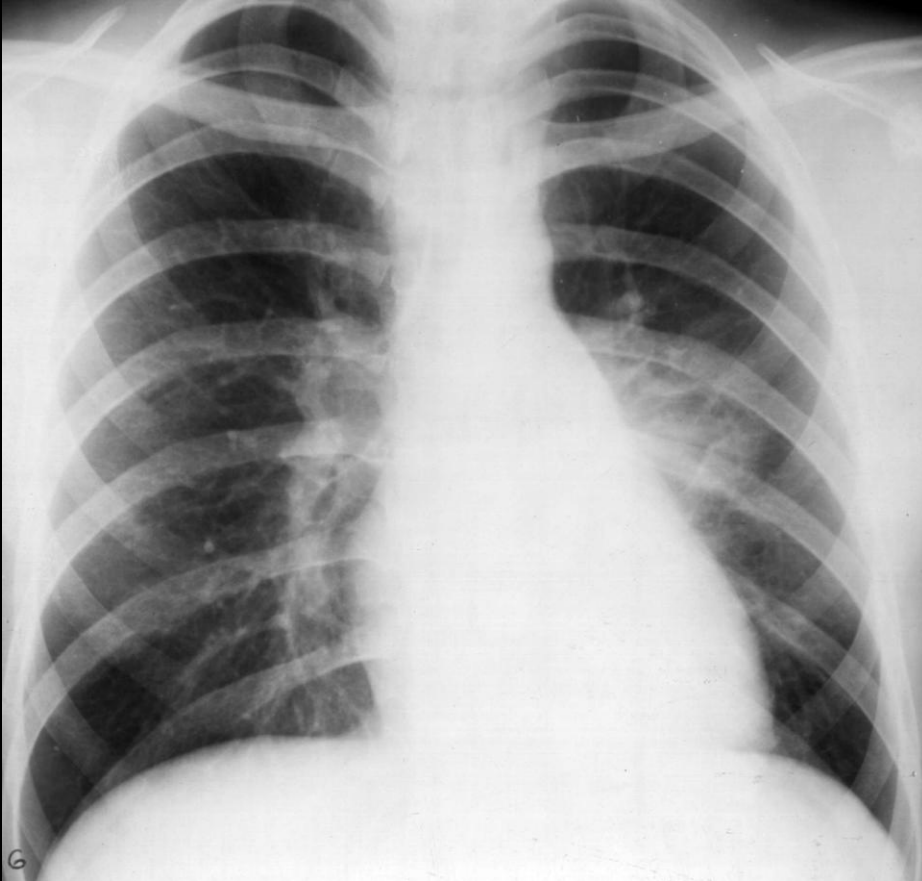


Segments:

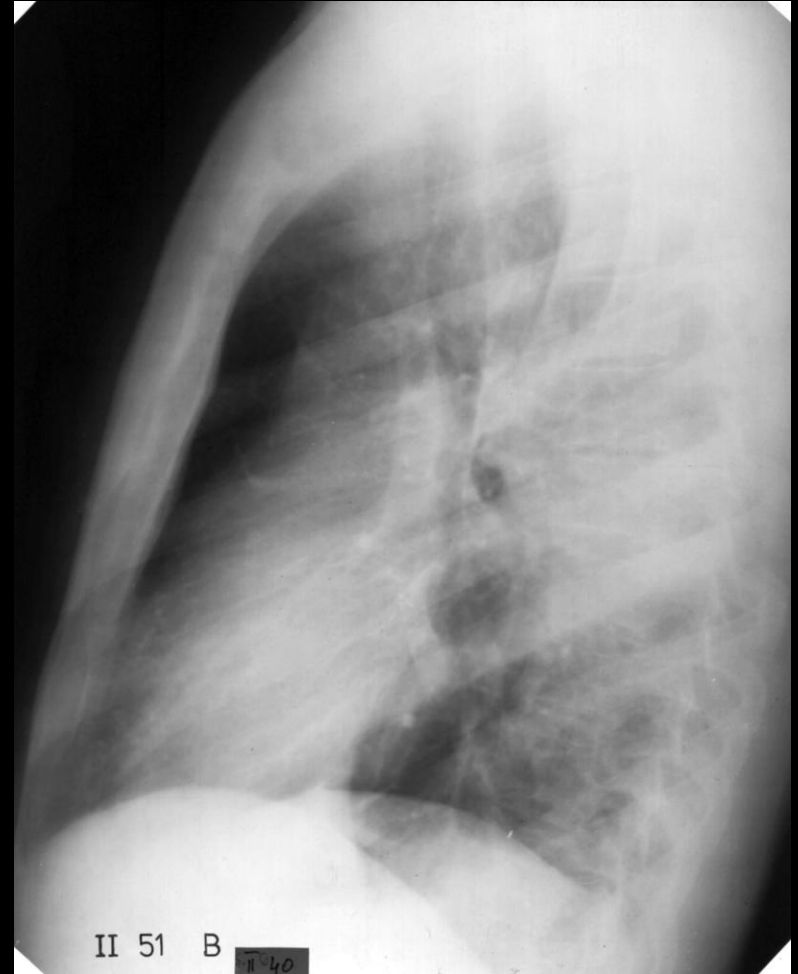
P: 9

L: 1-2

Segmental pneumonia



left lung - s. 6



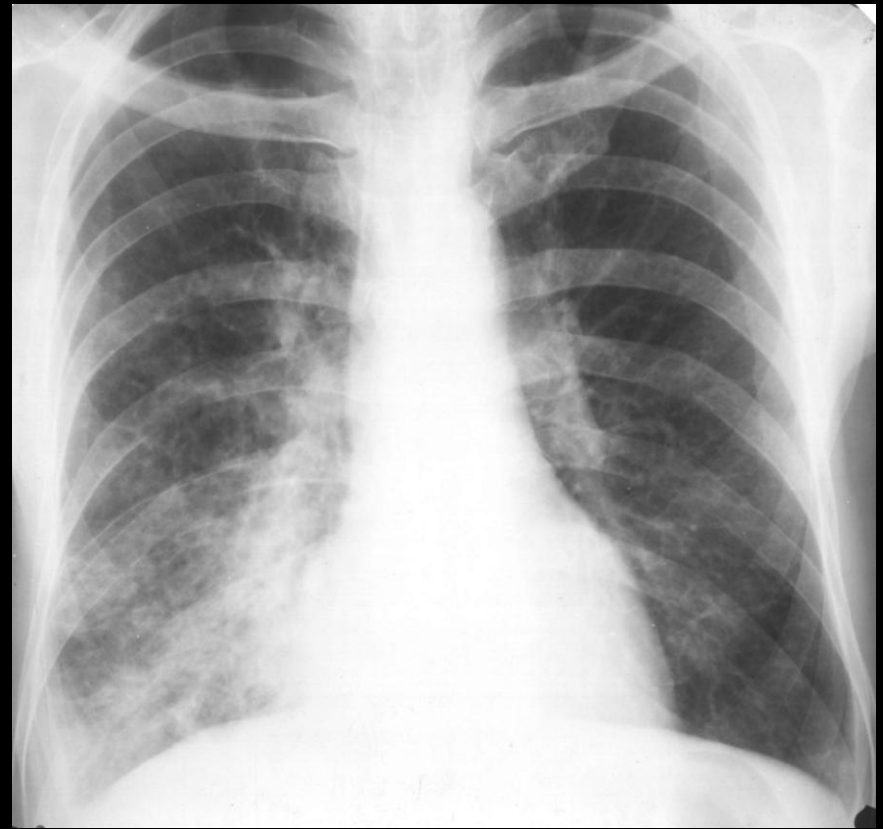
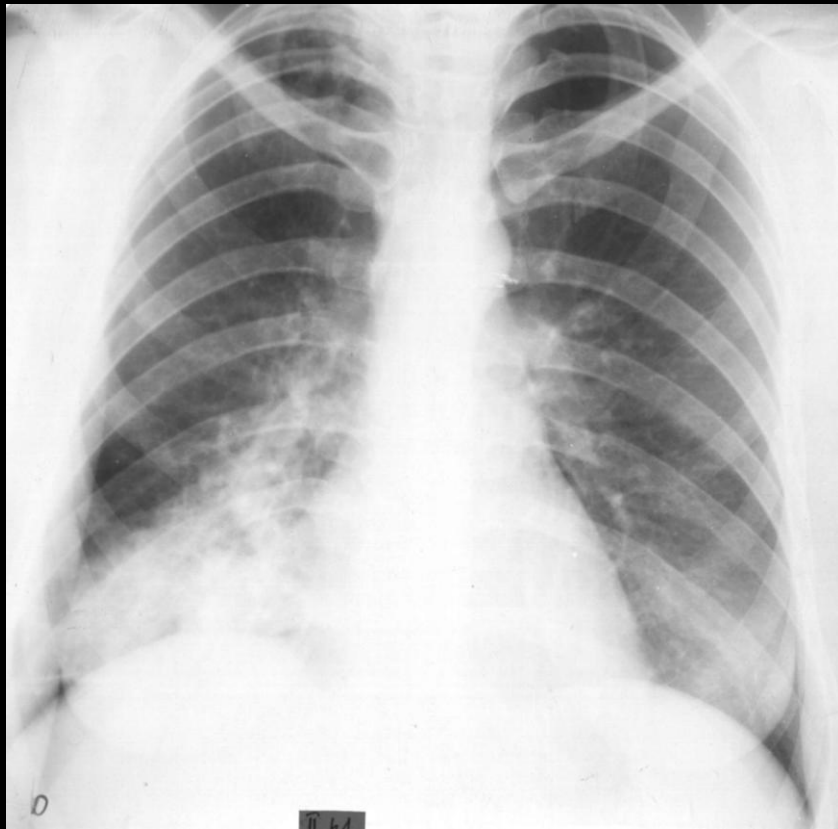
Bronchopneumonia

- Complication of influenza, against bronchiectasis, aspiration pneumonia (children, olders, postoperative)

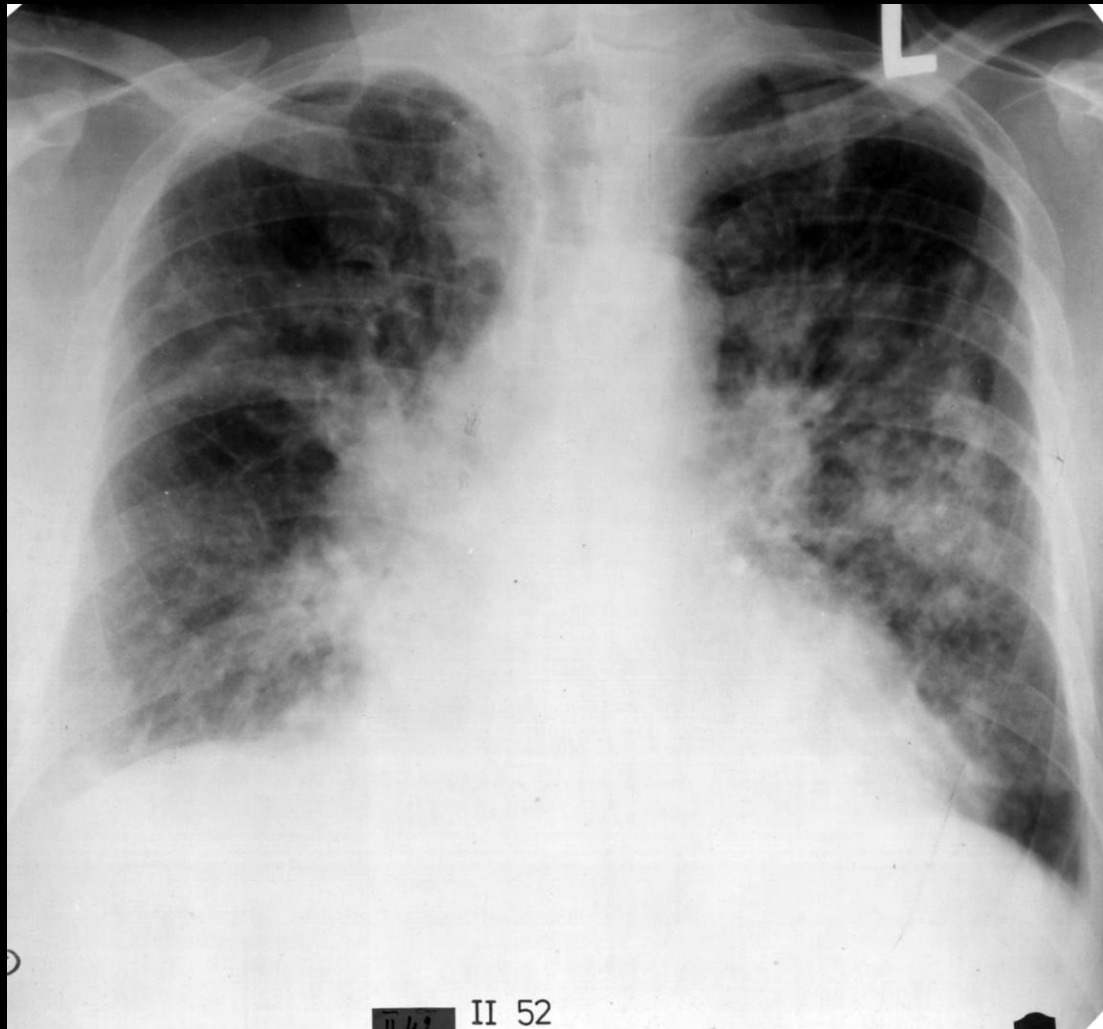
X-ray: single or multiple, diversiform, blurred outlines, merging shading, mainly in the lower lobes

- **Differentiation:** infarction, tuberculosis

Bronchopneumonia



Bronchopneumonia



Viral pneumonia

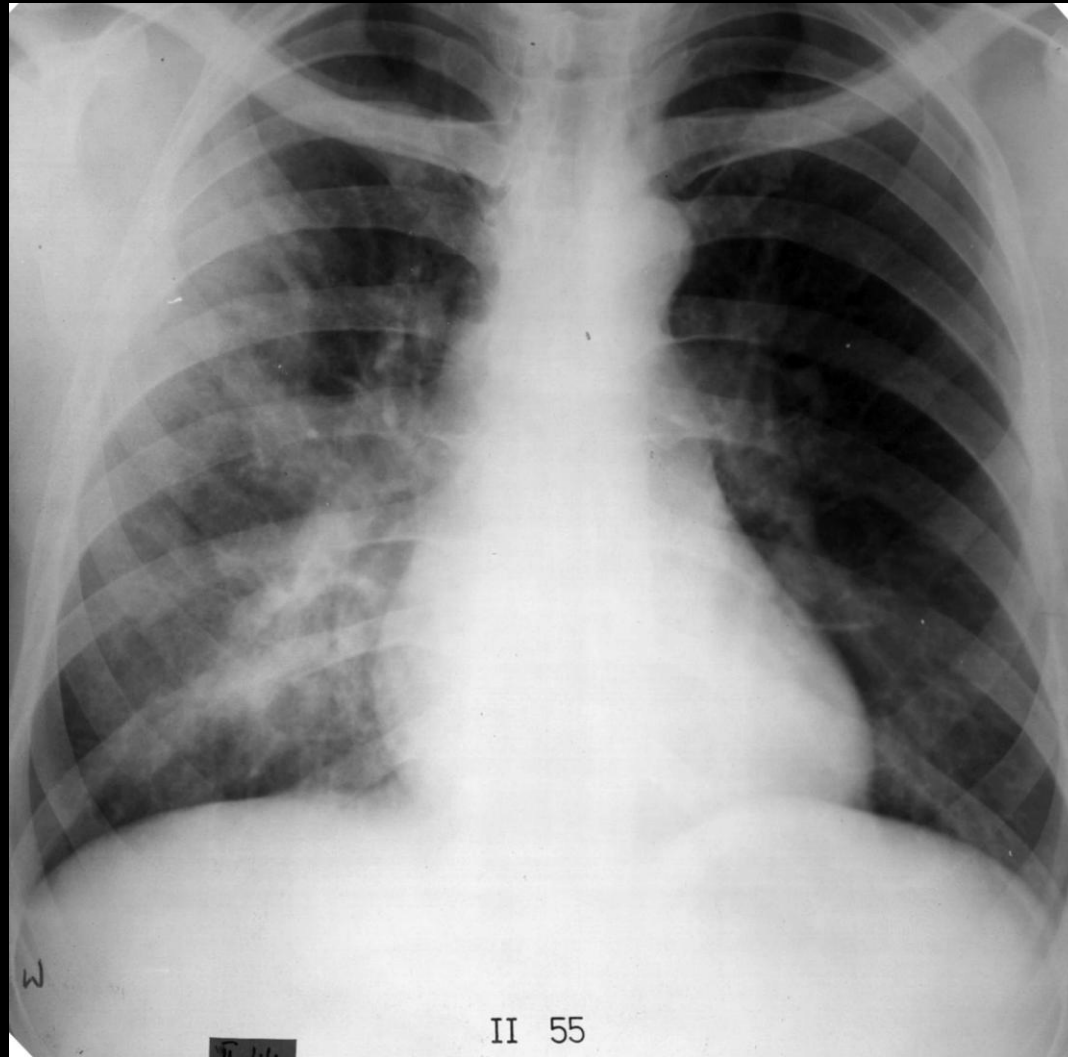
Clinically: rare auscultatory signs,
upper airways inflammation,
fever, headache and extremity ache

X-ray:

Poorly defined nodules and patchy areas of peribronchial ground-glass opacity and airspace consolidation with variable hyperinflation

- Lessened transparency of the lung fields
- Subsequently - inflammatory infiltrates

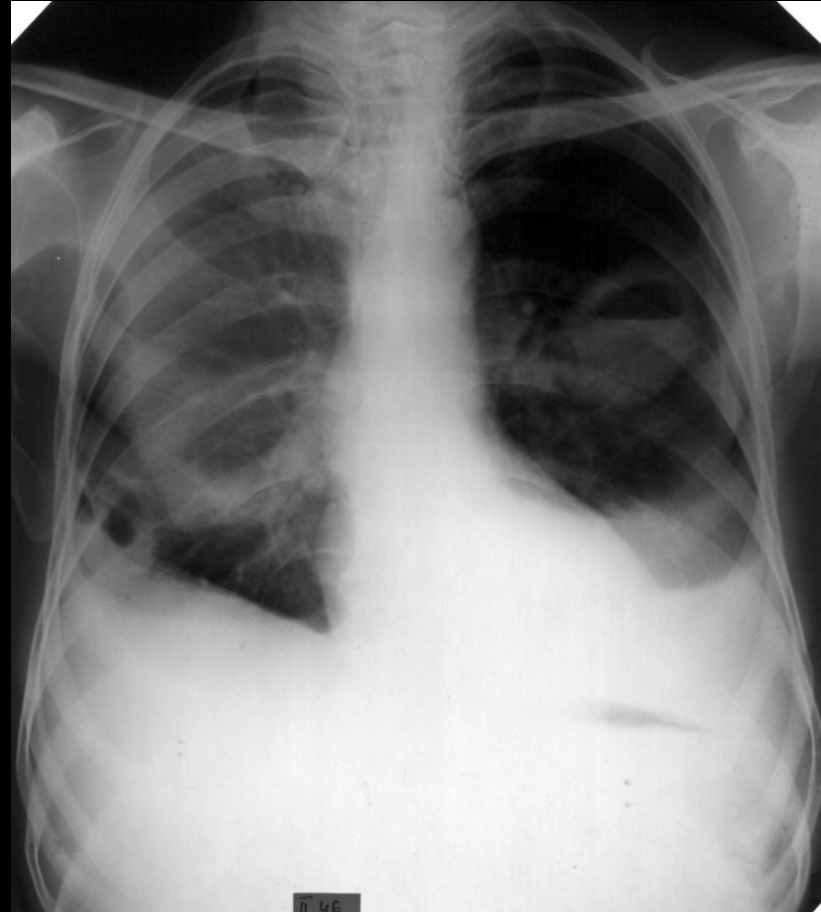
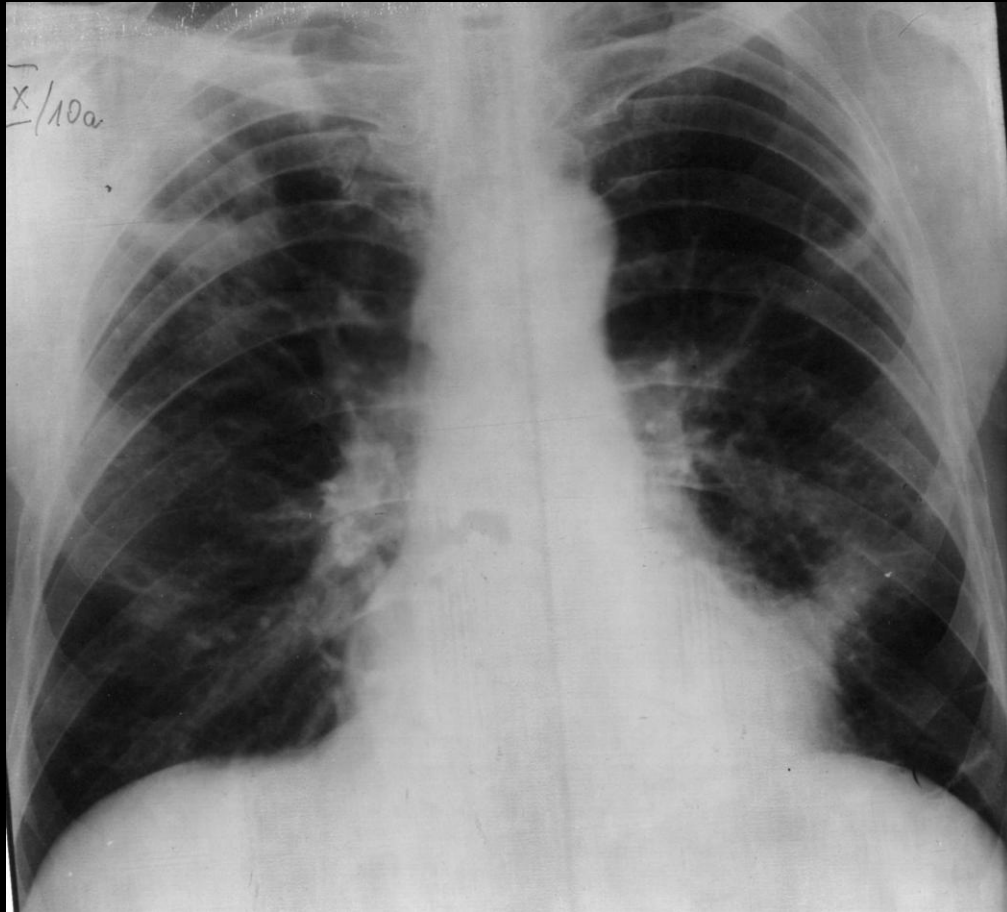
Viral pneumonia



Staphylococcal pneumonia

- Primary-seldom, frequently in bacterial sepsis (furuncle, otitis, tonsillitis, osteitis)
- **Clinically:** severe course – X-ray symptoms subsequent to turbulent clinical symptoms
- More often in children
- **X-ray:** heteromorphism, high variability,
 - interstitial changes,
 - round shadows, abscess, pleural effusion,
 - bullous emphysema, pneumothorax

Staphylococcal pneumonia



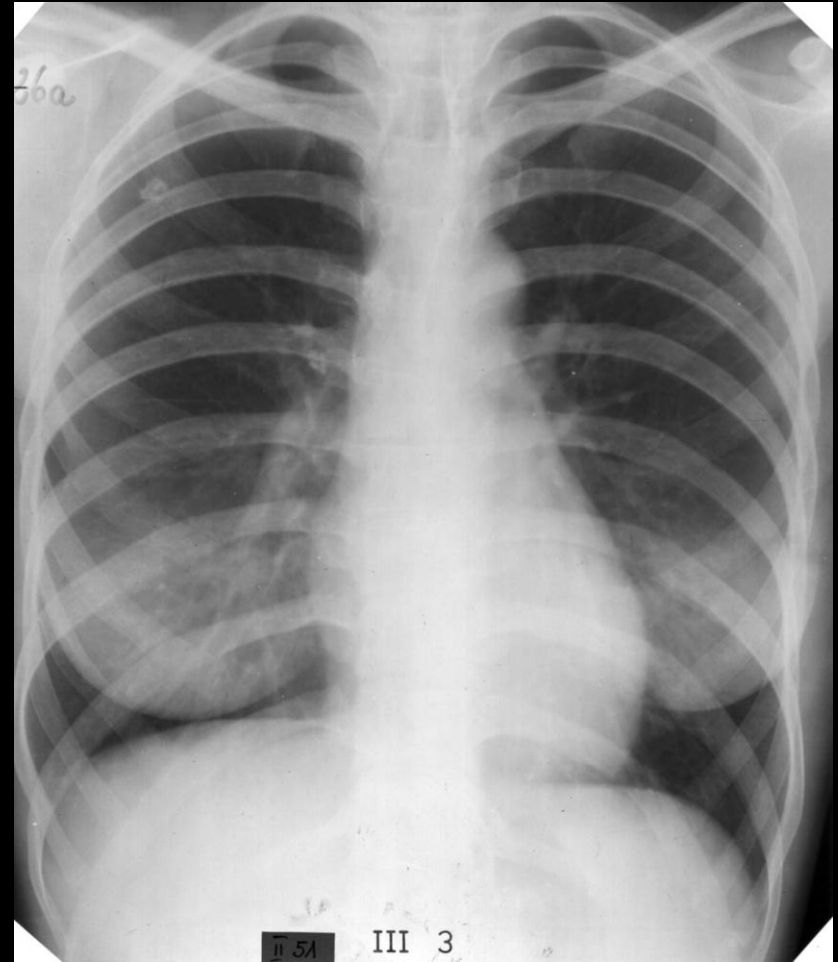
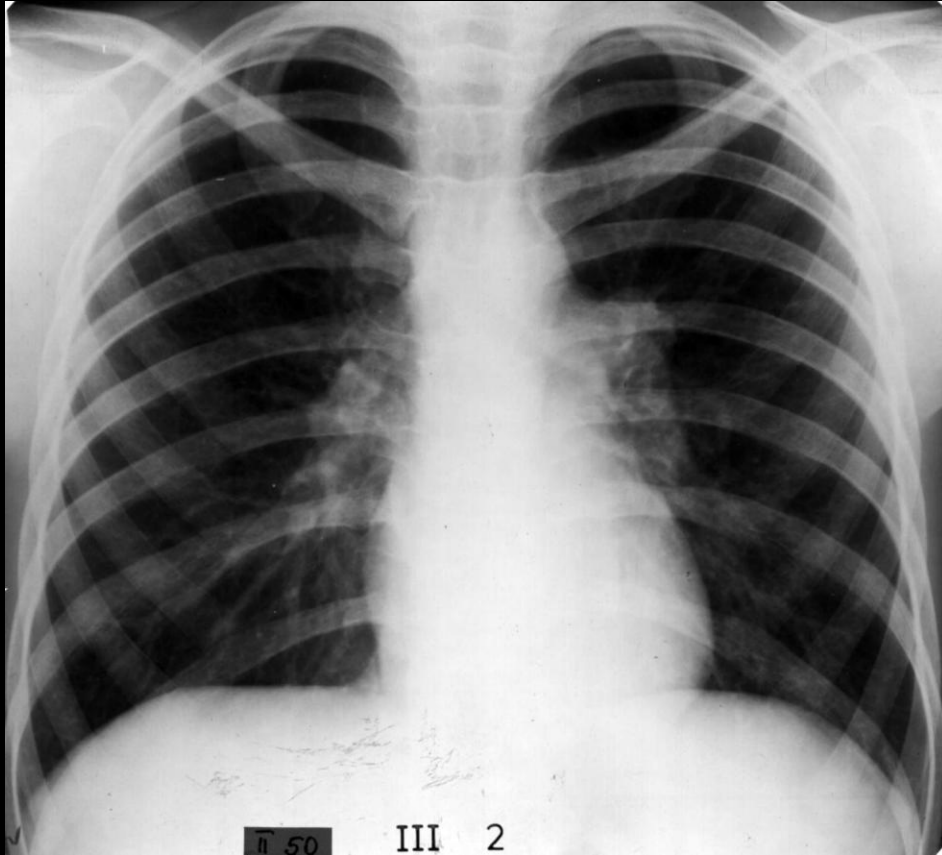
Pulmonary tuberculosis

- Effusive changes (infiltration of pulmonary tissue, consolidation)
- Tuberculous granuloma
- Both types of changes with tendency to caseation and necrosis, creating cavities
- Healing – the resorption of infiltration and the development of fibrous changes and calcification

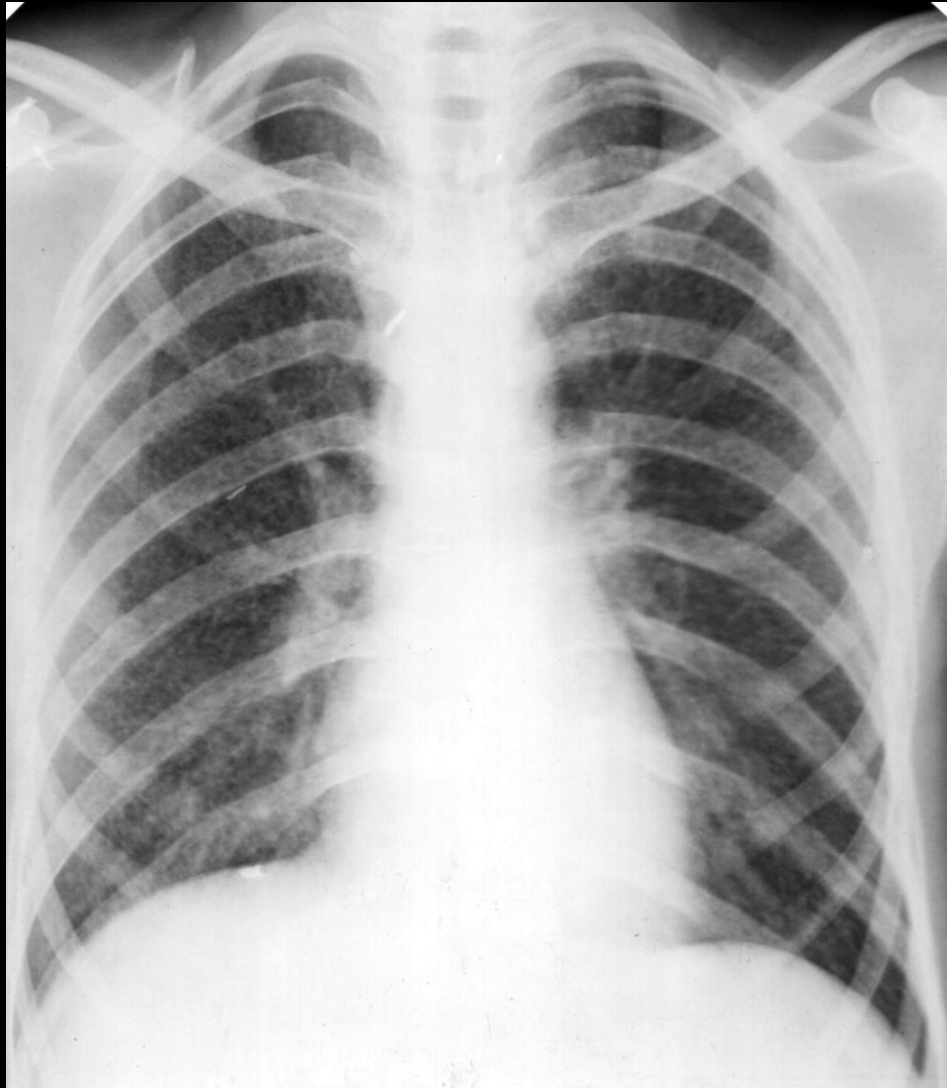
Pulmonary tuberculosis - types

- Primary tuberculosis without changes in organs
- Primary tuberculosis with consolidation and lymphadenopathy
- Acute miliary tuberculosis
- Subacute tuberculosis – disseminated and chronic
- Nodular and fibro-nodular tuberculosis
- Infiltrative tuberculosis
- Caseous pneumonia
- Chronic, fibro-cavernous pulmonary tuberculosis
- Cirrhosis of pulmonary tuberculosis
- Tuberculous empyema

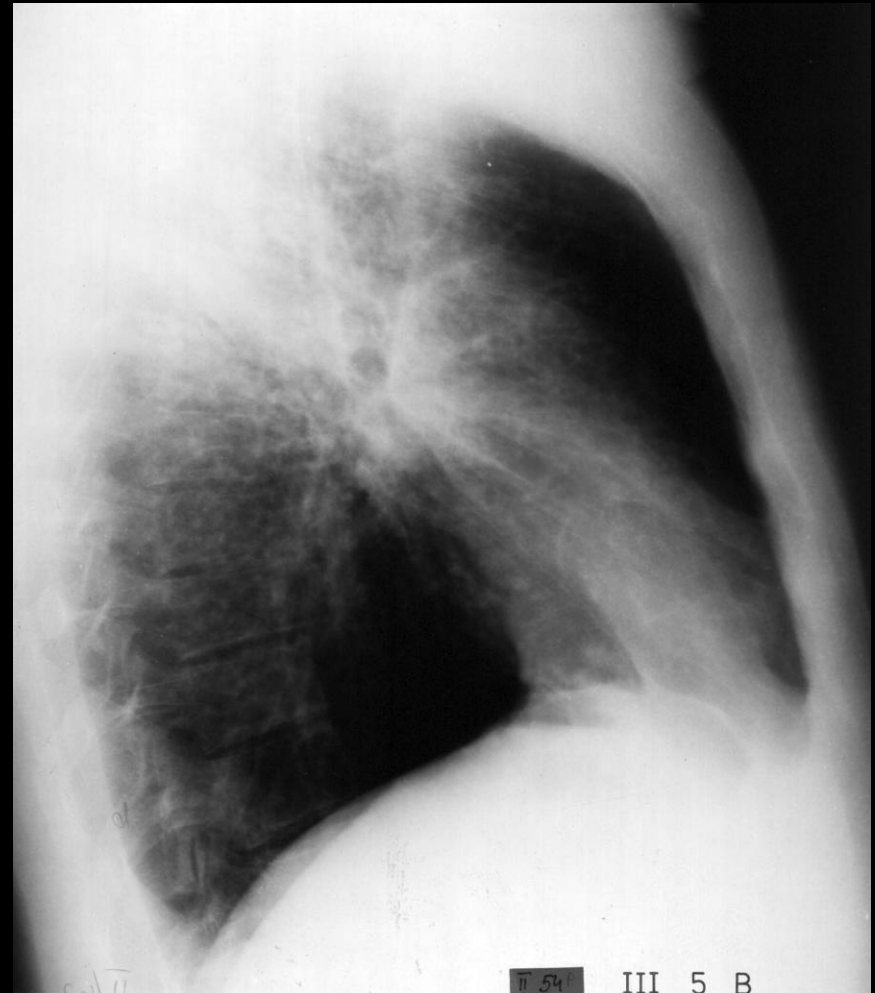
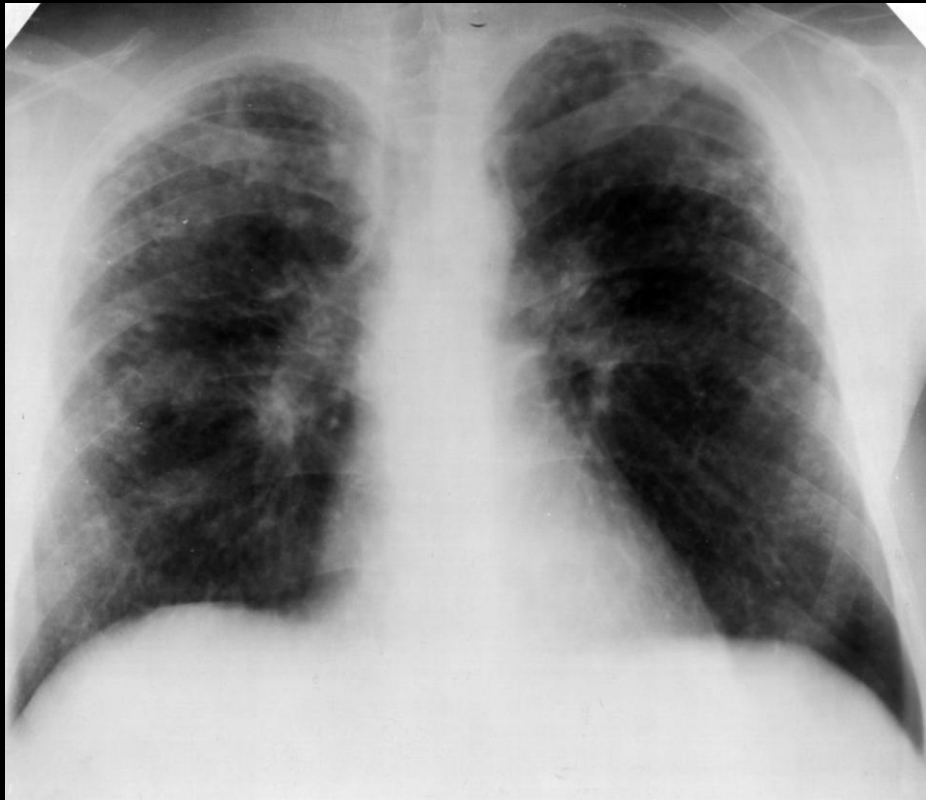
Primary tuberculosis with consolidation and lymphadenopathy



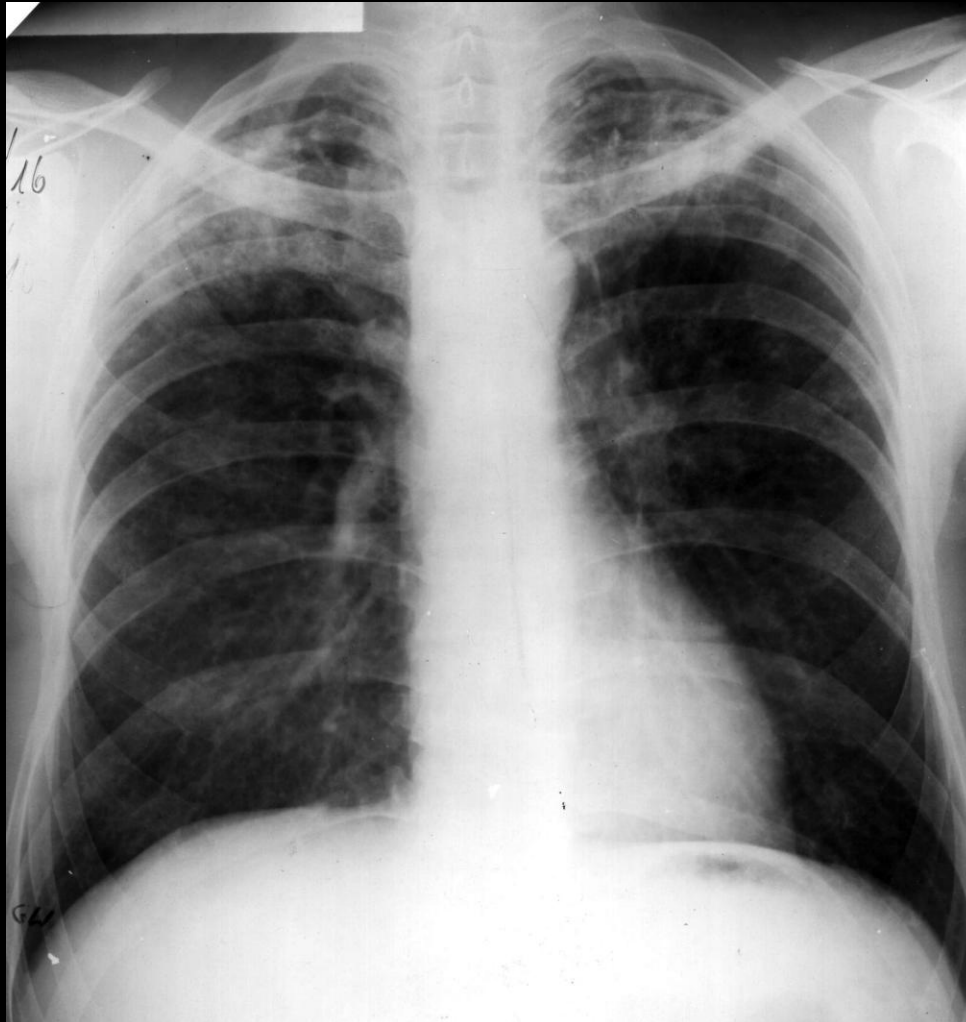
Miliary tuberculosis



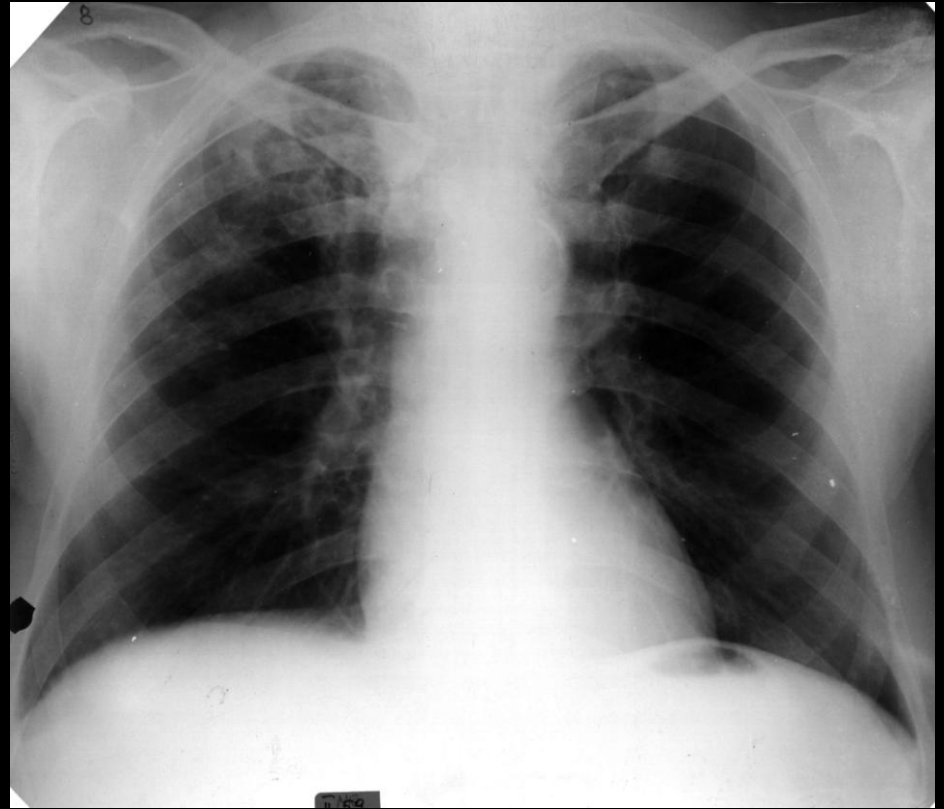
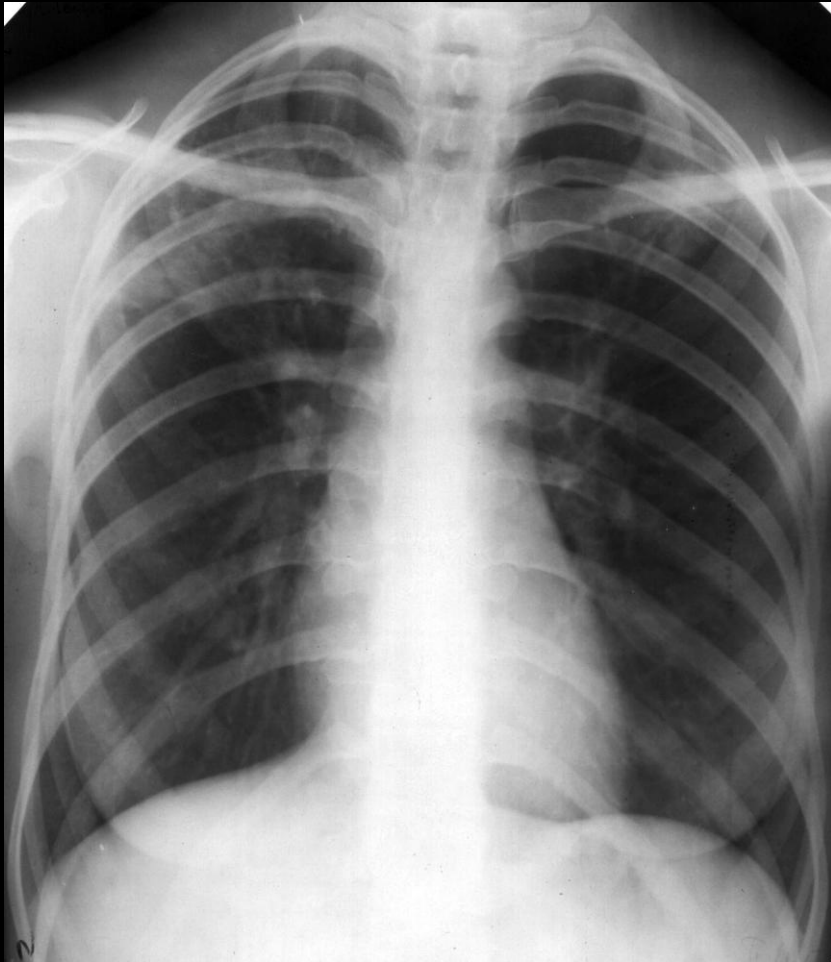
Subacute tuberculosis – disseminated and chronic



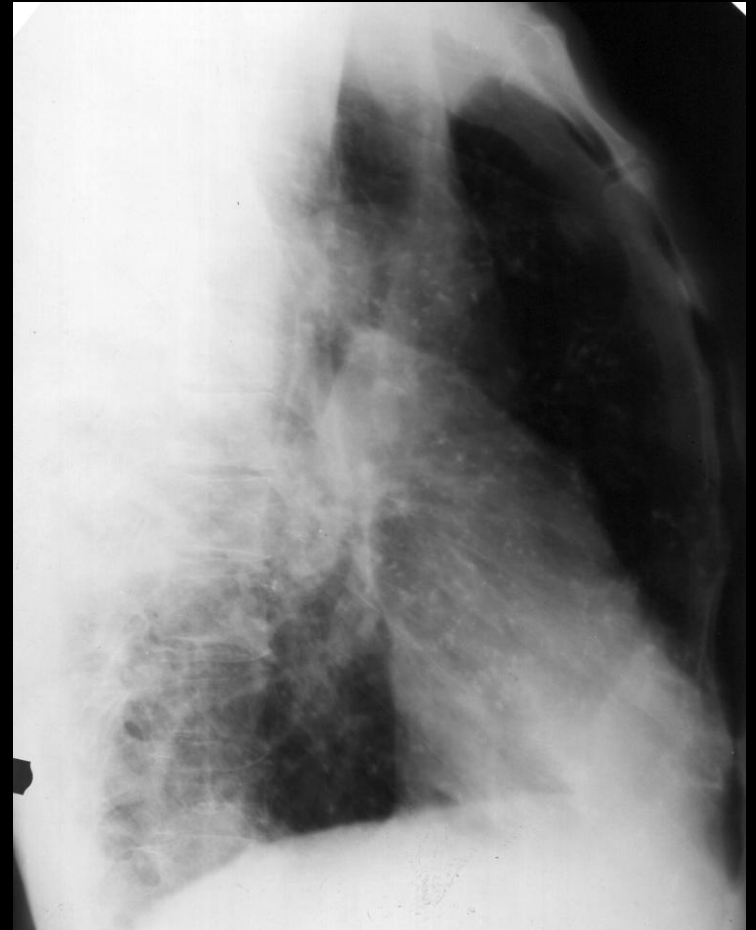
Nodular and fibro-nodular tuberculosis



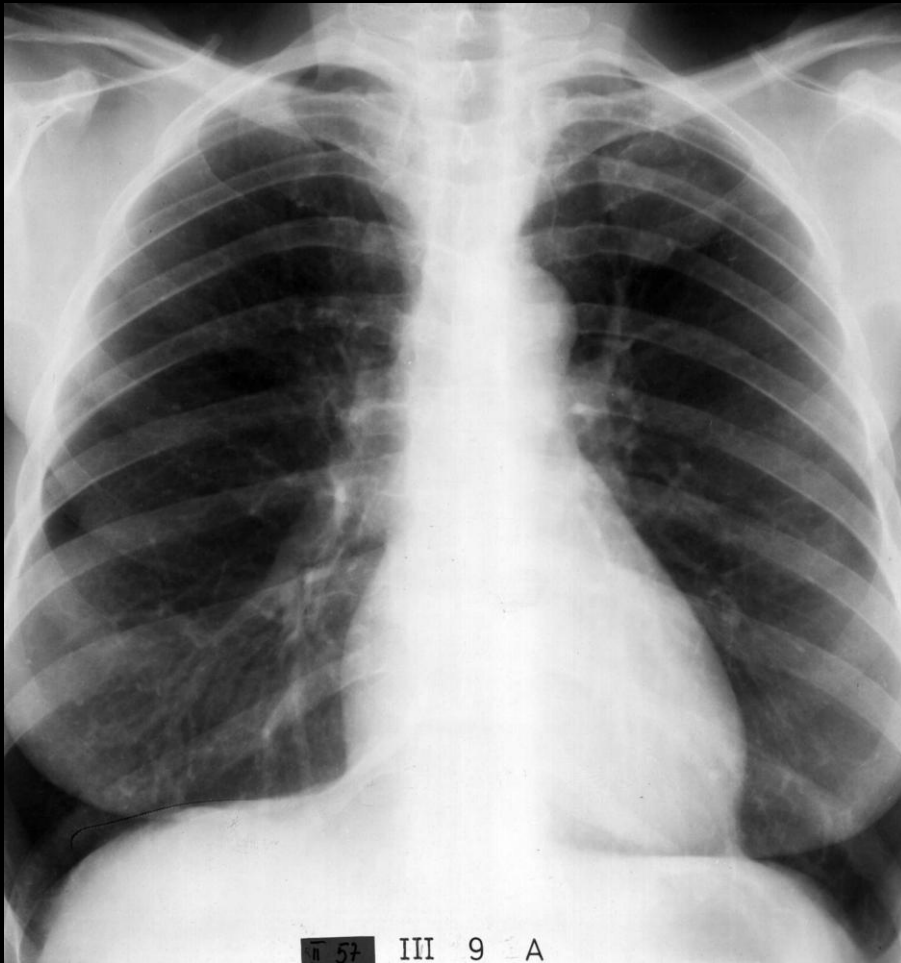
Infiltrative tuberculosis



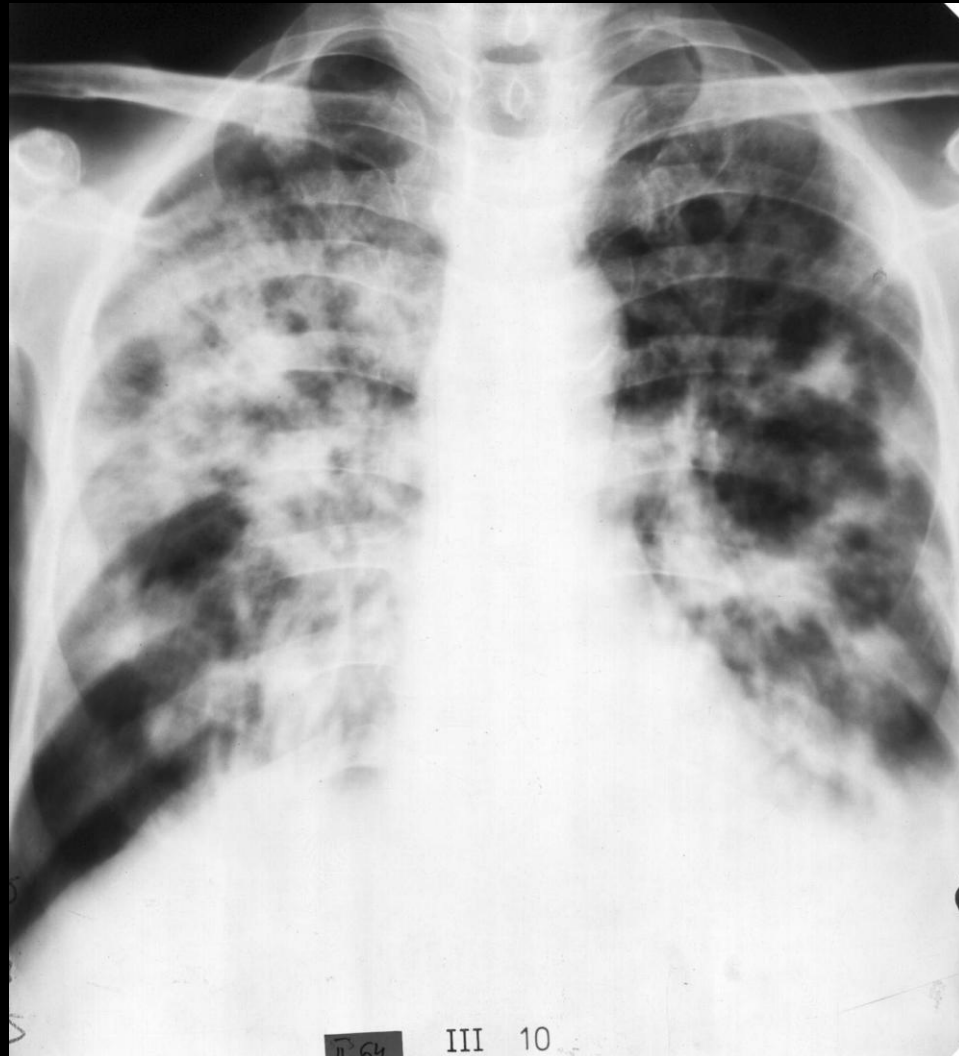
Infiltrative tuberculosis



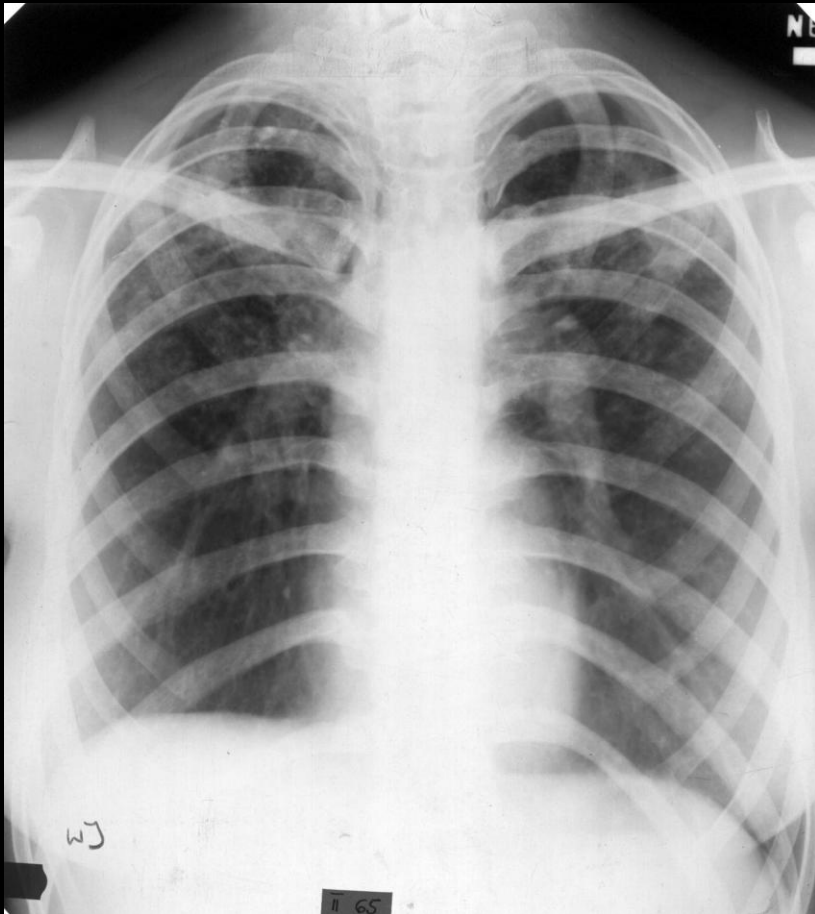
Infiltrative tuberculosis



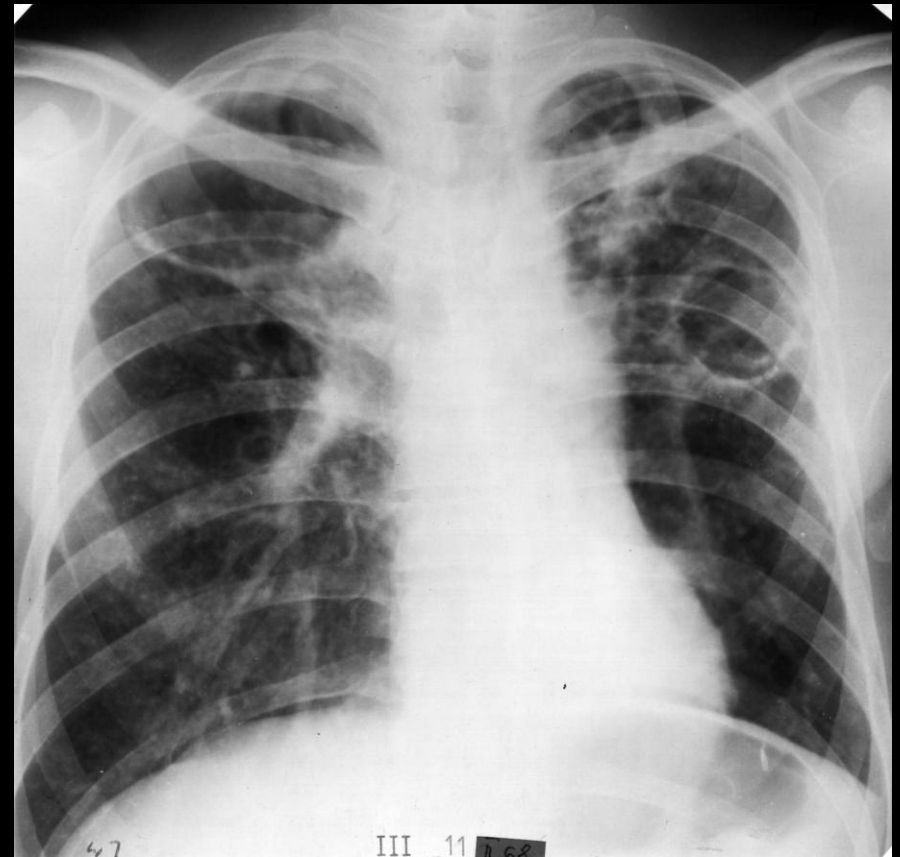
Caseous pneumonia



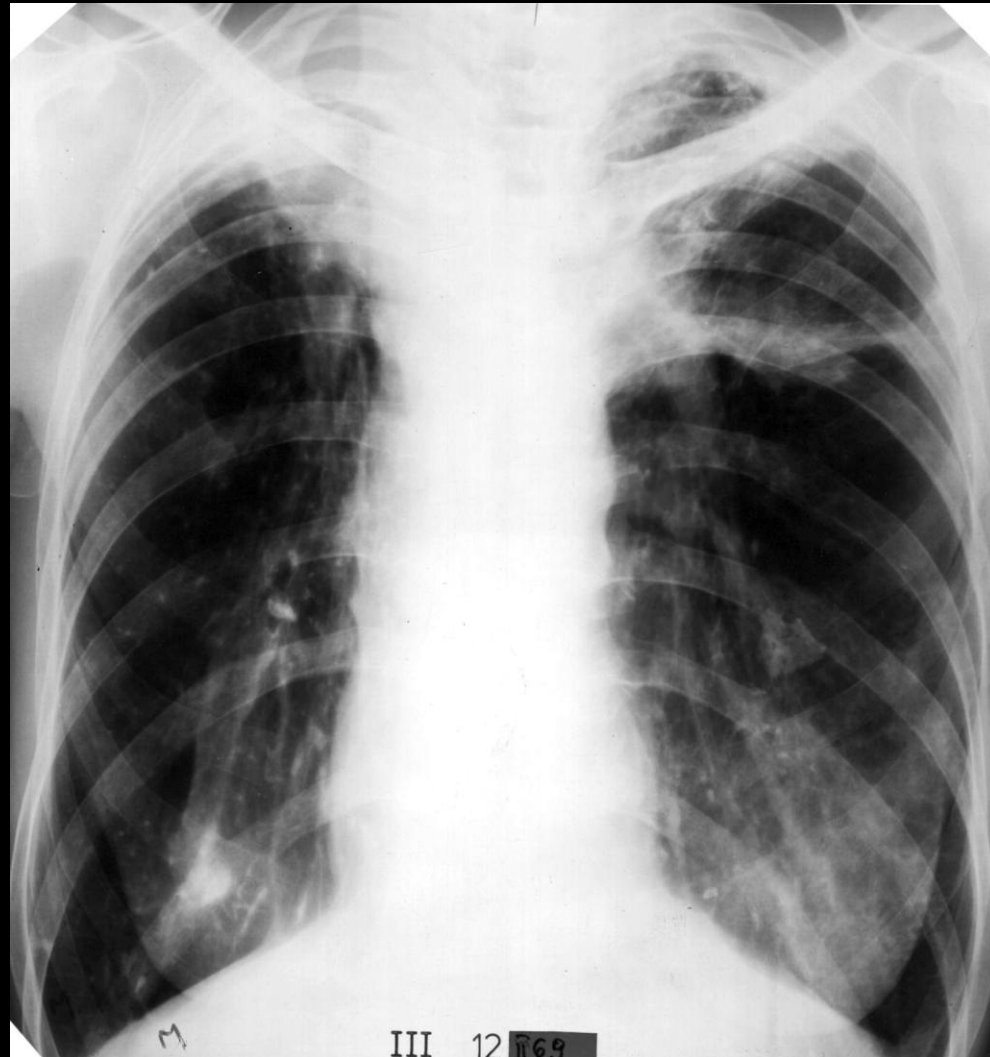
Chronic, fibro-cavernous pulmonary tuberculosis



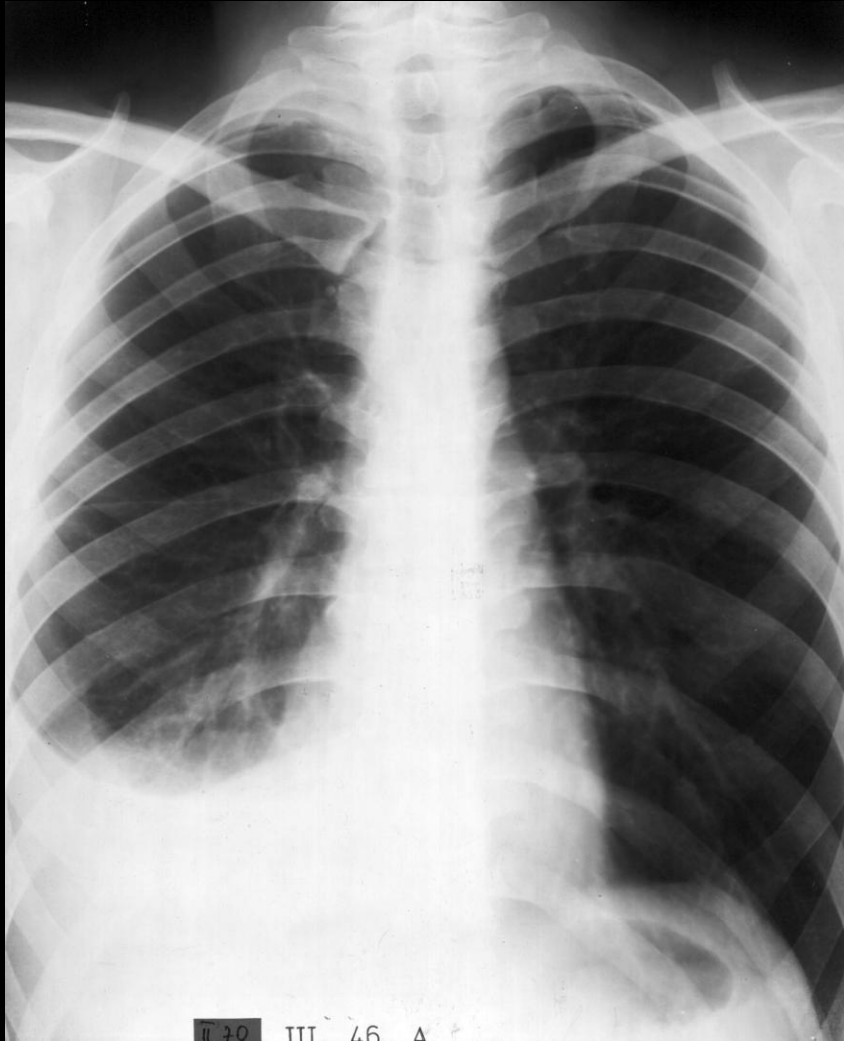
Chronic, fibro-cavernous pulmonary tuberculosis



Cirrhosis of pulmonary tuberculosis



Tuberculosis empyema



Bronchiectases

- Inborn or acquired, irreversible damage to the bronchial wall with a diameter expansion of bronchi and coexisting inflammation
- Causes: chronic bronchitis, lung cirrhosis specific and nonspecific, atelectasis, wall underdevelopment (inborn)
- Clinically: cough, purulent sputum, hemoptysis recurrent pneumonia, shortness of breath
- Imaging methods- X-ray, HRCT

Bronchiectases

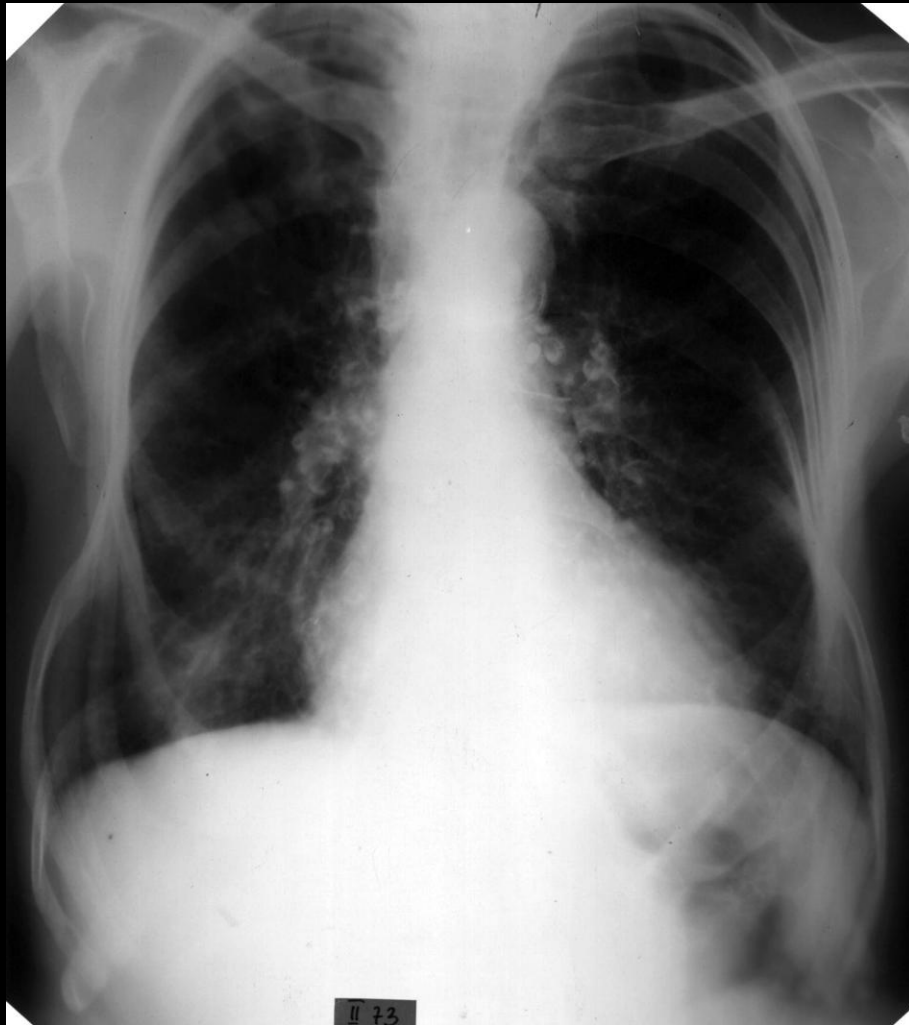


Bronchiectases

Chest x-rays are usually abnormal, but are inadequate in the diagnosis or quantification of bronchiectasis:

- tram-track opacities
- air-fluid levels
- increase in bronchovascular markings
- bronchi may appear as ring shadows
- pulmonary vasculature appears ill-defined, thought to represent peribronchovascular fibrosis

Bronchiectasis



Bronchiectasis



Bronchiectases

CT and HRCT especially excels at demonstrating the airways, and is able to a greater or lesser degree to distinguish some of the various underlying causes:

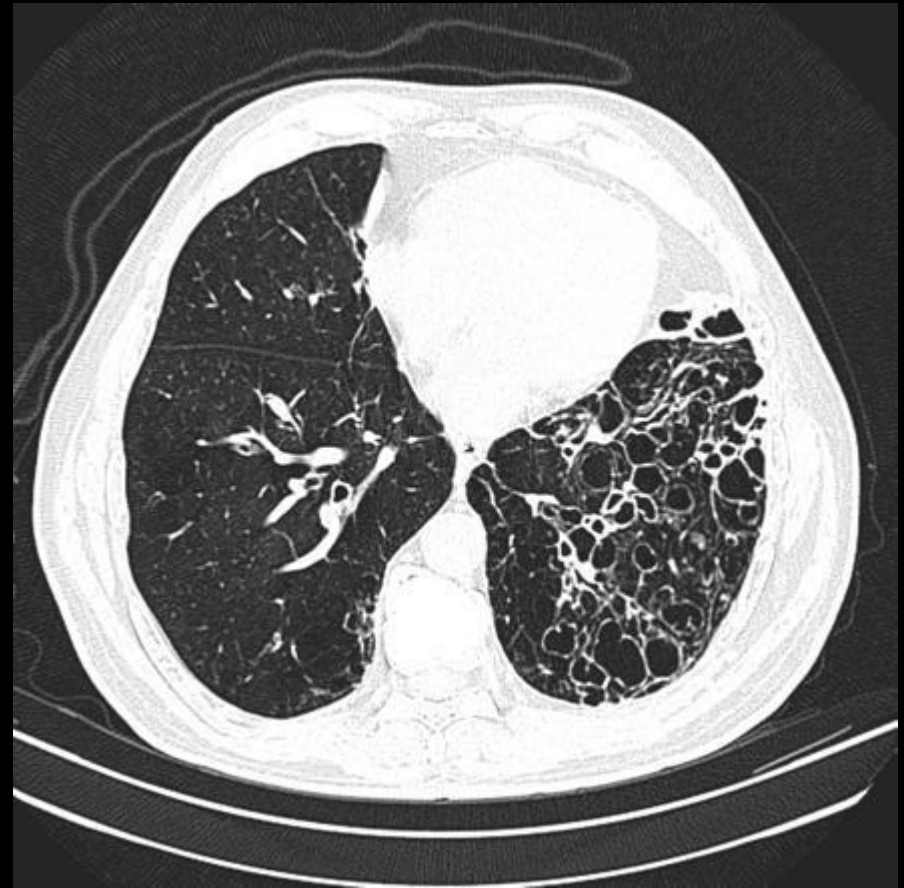
- bronchus visualised within 1cm of pleural surface
- lack of tapering
- increased bronchoarterial ratio
- bronchial wall thickening
- pulmonary parenchyma air-trapping and mosaic perfusion

HRCT-bronchiectasis

–*ring symptom*



HRCT-tubular bronchiectasis



HRCT-tubular and saccular bronchiectasis

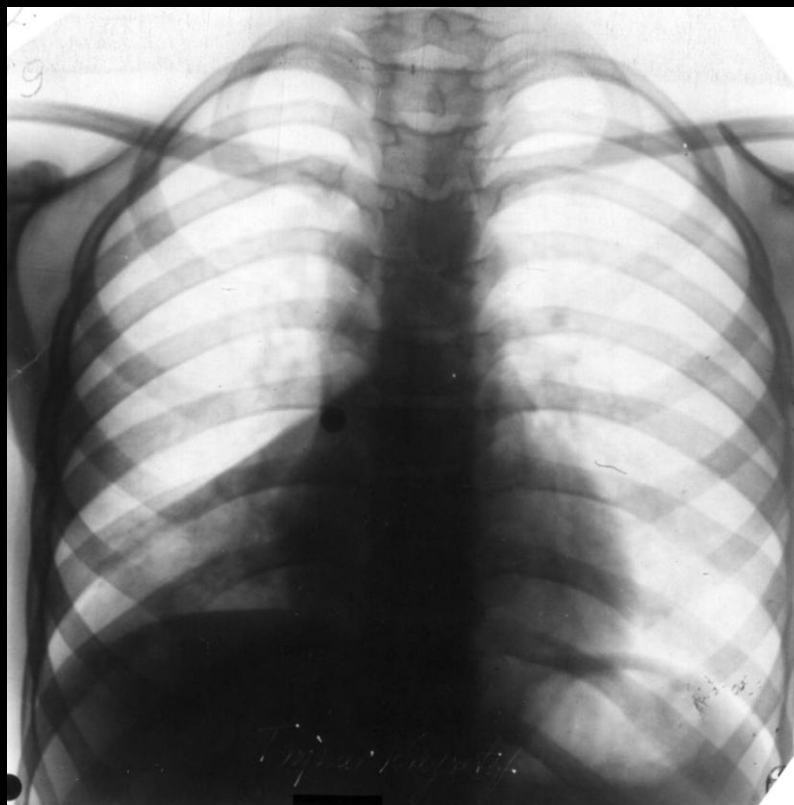


Atelectasis

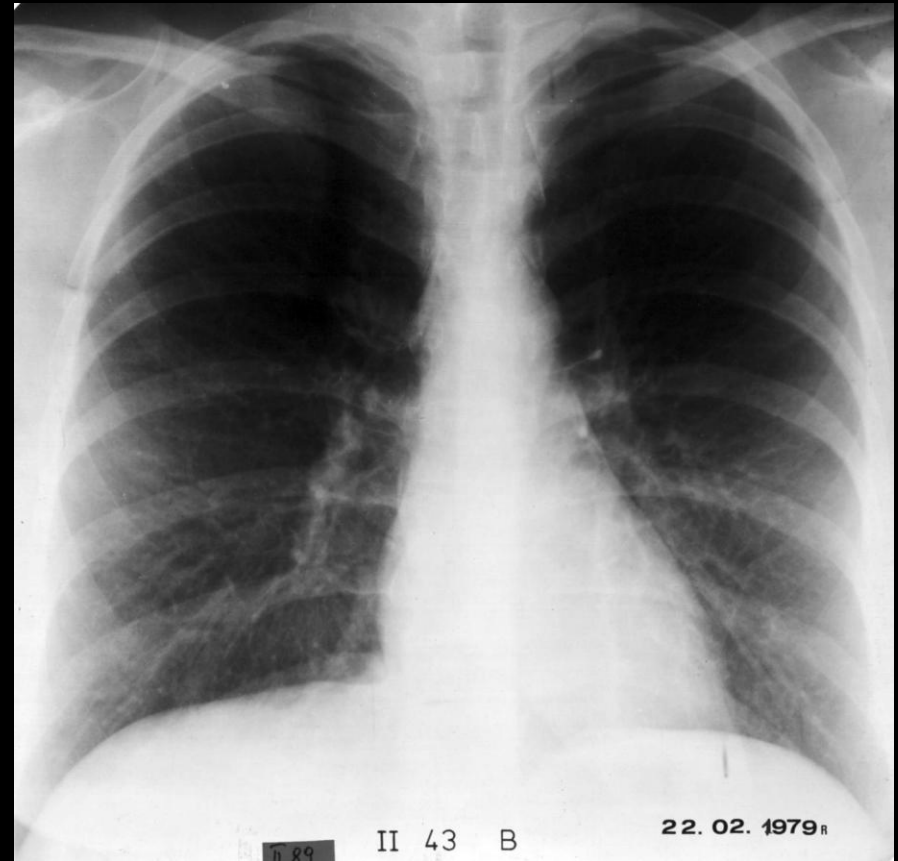
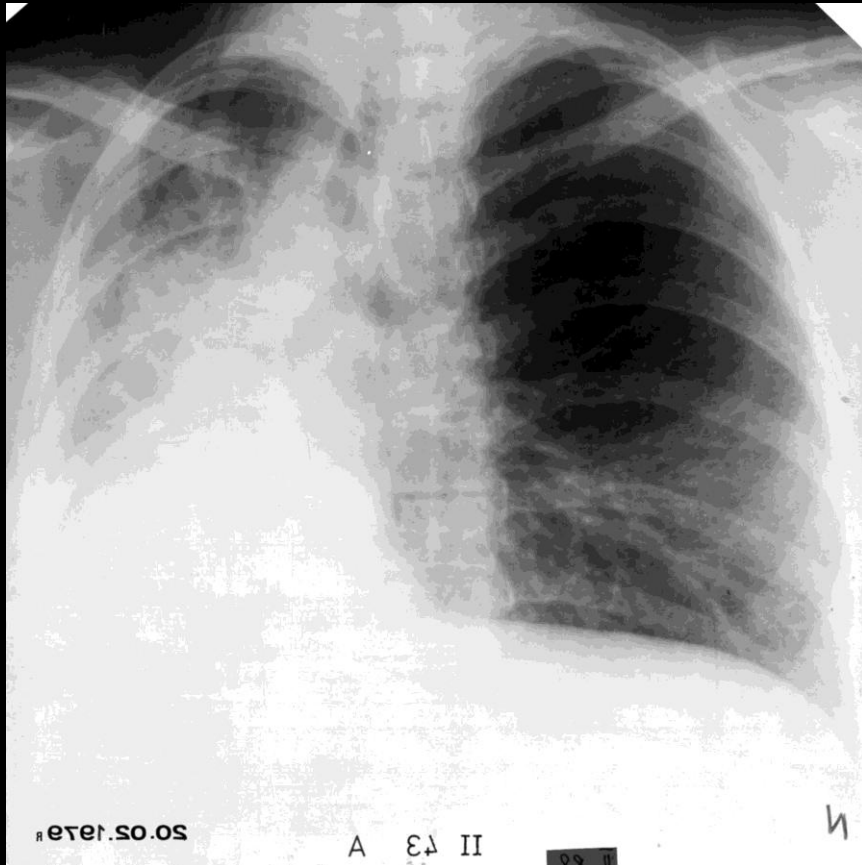
Atelectasis is the result of loss of air in a lung or in the part of the lung with subsequent volume loss due to airway obstruction (carcinoma, mucus plugging, compression of large lymph nodes) or compression of the lung by pleural fluid or a pneumothorax.

Chest X-ray – sharply defined opacity, without airbronchogram, with volume loss, displacement of diaphragm, fissures, hili or mediastinum and intercostal narrowing.

Foreign body

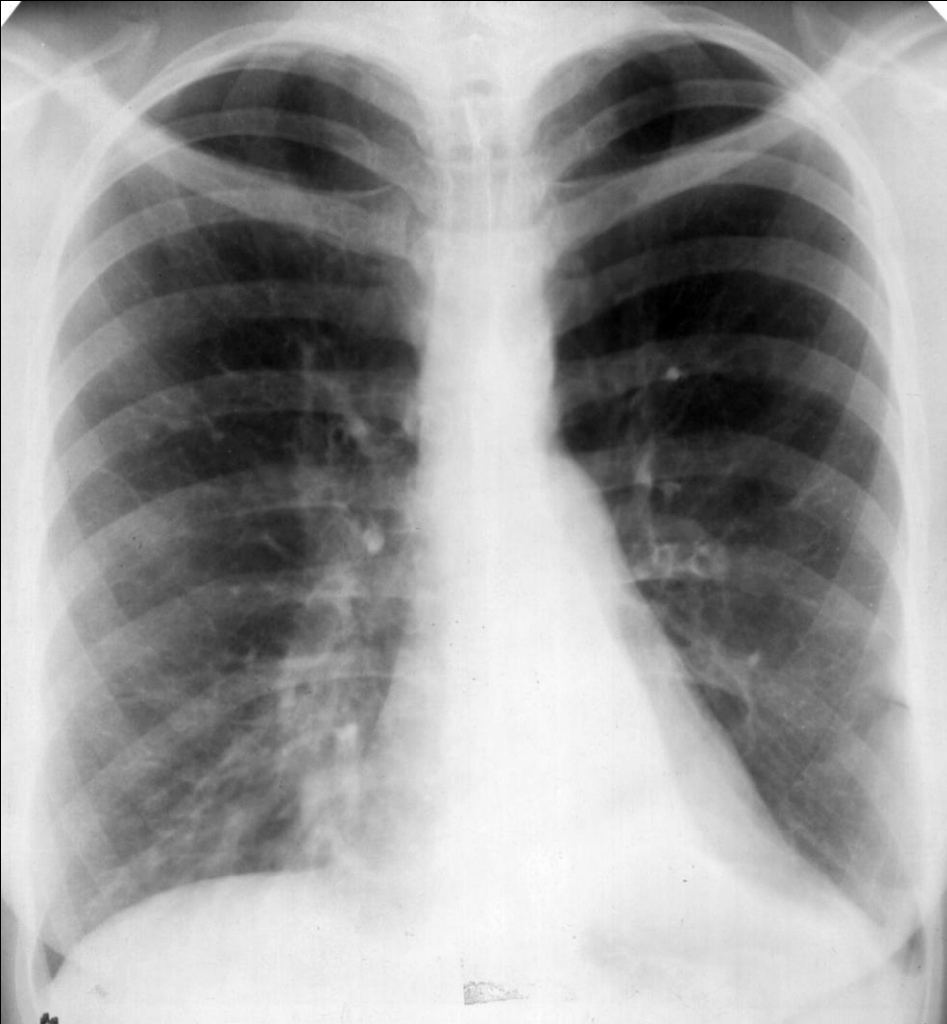


Atelectasis

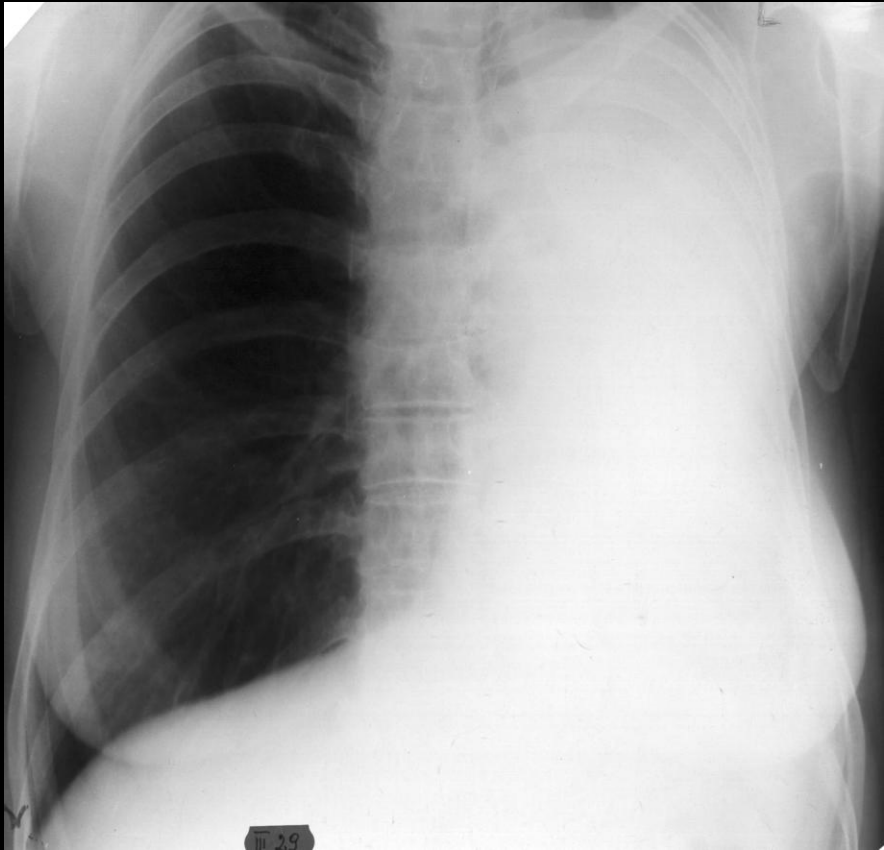


The chest X-ray before and after removing of mucus plugging

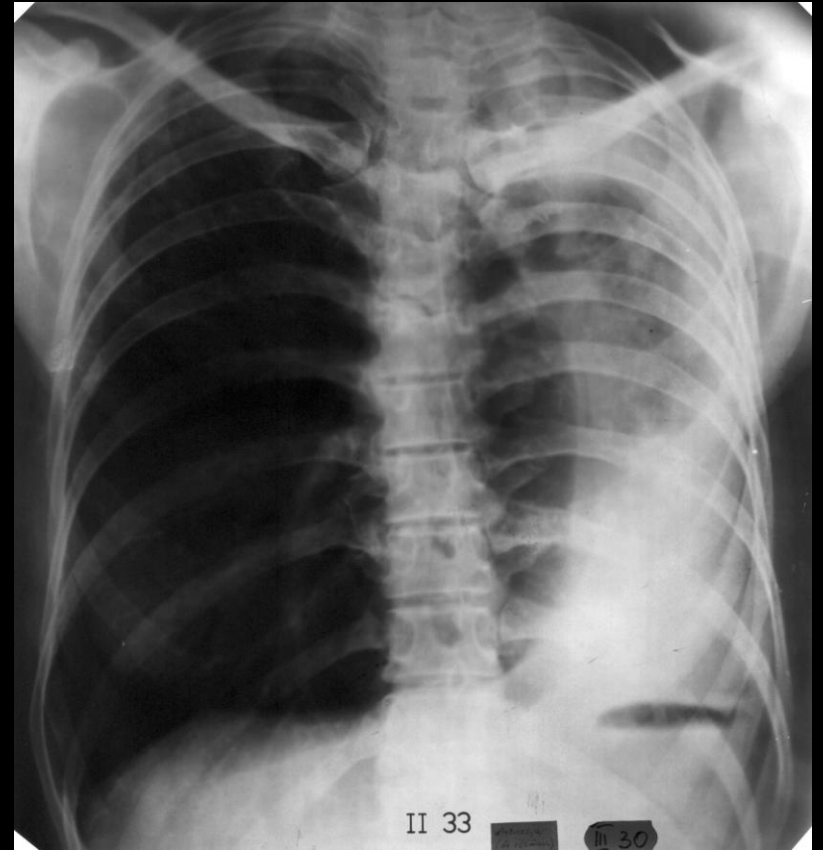
Atelectasis



Left lower lobe atelectasis



Secondary atelectasis
– central cancer of the lung



Lung agenesis