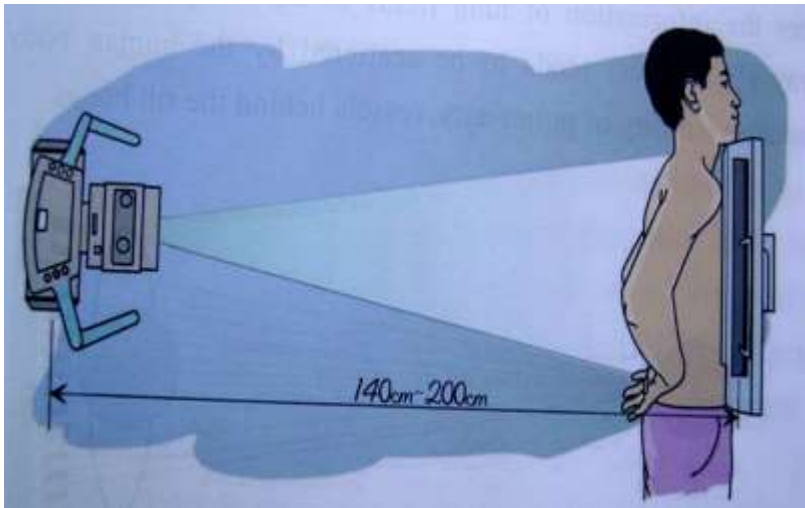


# Chest Imaging

## Chest imaging - techniques

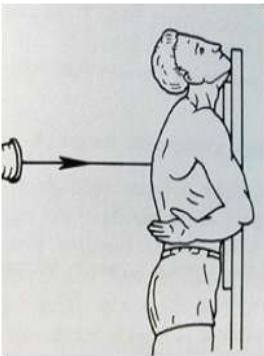
- Radiology
  - ▶ Conventional radiography (Chest X-ray)
    - PA (postero-anterior)
    - LL (lateral)
    - Spetial projections Oblique, supine AP, Lateral decubitus
  - ▶ Fluoroscopy
  - ▶ Contrast examinations
    - Bronchography
    - Pulmonary angiography
  - ▶ Conventional (linear) Tomography, Tomosynthesis
- Computed Tomography (CT)
- Nuclear Medicine
- Ultrasonography
- MRI

# Simple chest Radiograph



## Chest Radiograph

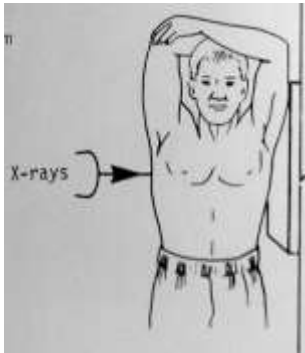
**PA projection** (posterior to anterior) – relation of X-ray beam to the patient (You can avoid PA/AP by describing all chest x ray films “frontal”)



# Chest Radiograph

## Left Lateral projection

- Minimizes magnification of heart (heart closest to film)



# Chest Radiograph

**Supine AP projection**



**Lateral decubitus projection**



# Chest Imaging

## Radiology

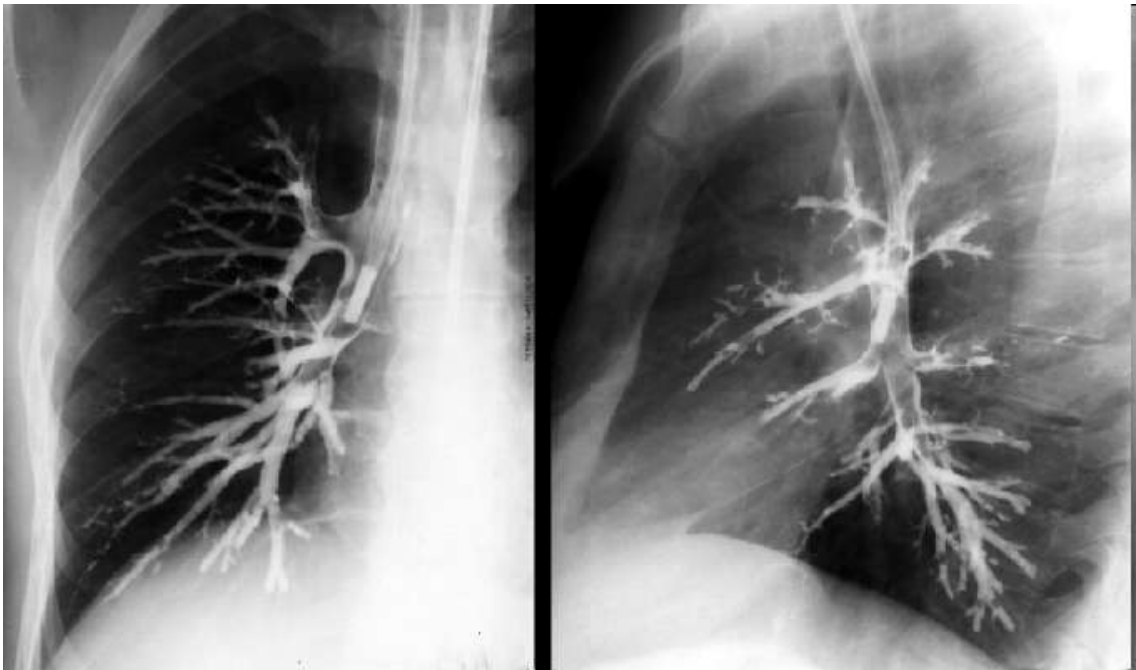
- **Contrast examinations**
  - **Bronhography**
  - **Pulmonary angiography**
  - **Air contrast studies** (not used anymore)
    - **Diagnostic pneumothorax**
    - **Diagnostic pneumomediastinum**

# Bronhography





### Bronhography



# Bronhography

General (bilateral)



selective (unilateral)



# Bronhography



Bronchiectasis

### Pulmonary angiography



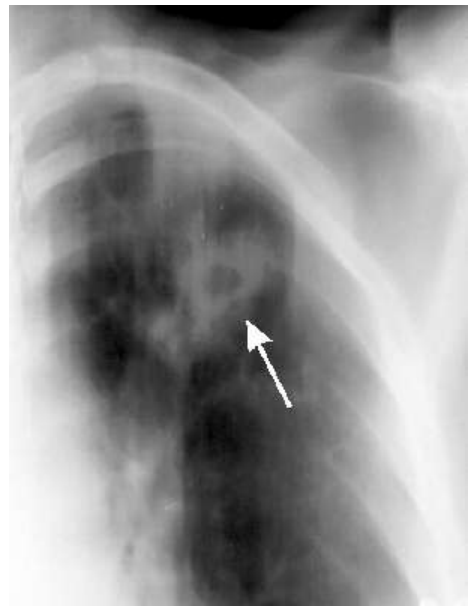
### Pulmonary angiography



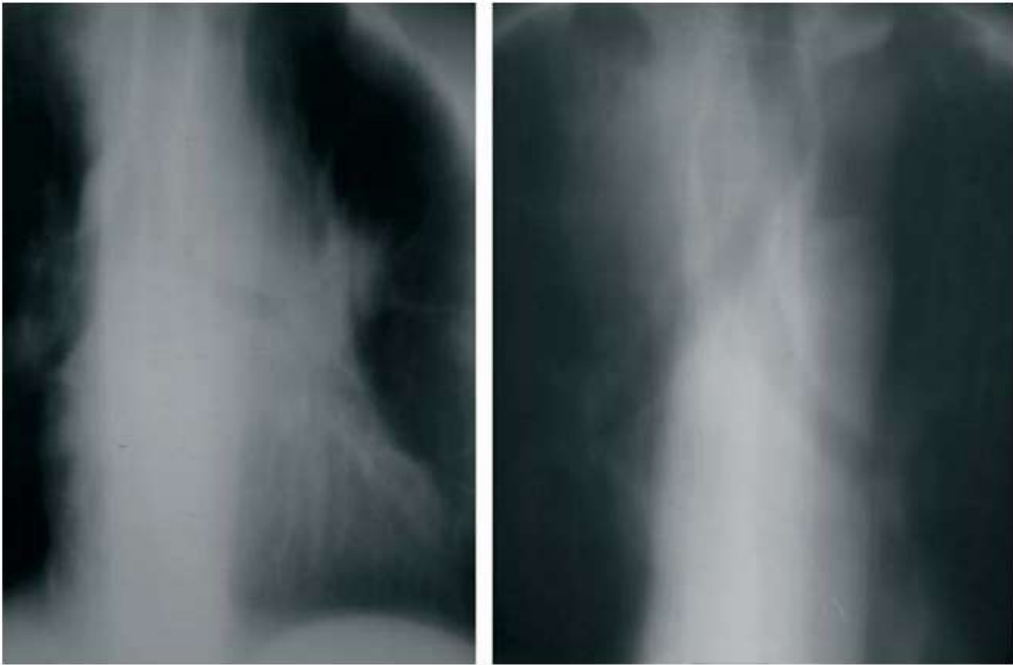
## Linear Tomography



Chest radiograph



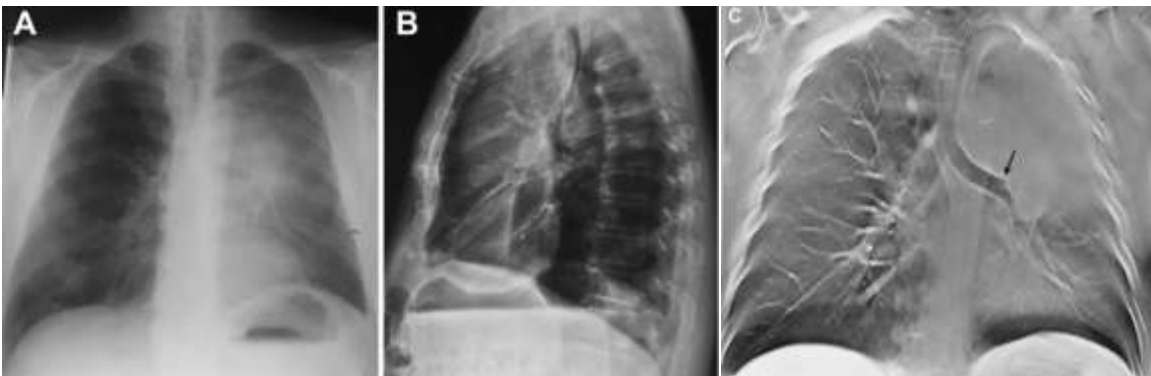
Linear Tomography



Linear Tomography of the mediastinum (different patients). Of all the structures visualized, the satisfactory sharpness is seen only at the level of the trachea.

# Tomosynthesis

- At present, linear tomography is almost no longer used, but its principle is the basis of the tomosynthesis method.
- In tomosynthesis, a series of linear tomographies are performed at a predefined depth, with a fixed distance between sections, in a single acquisition.
- The information is digitally processed, creating a high quality final image.





# Tomosynthesis



Chest radiograph

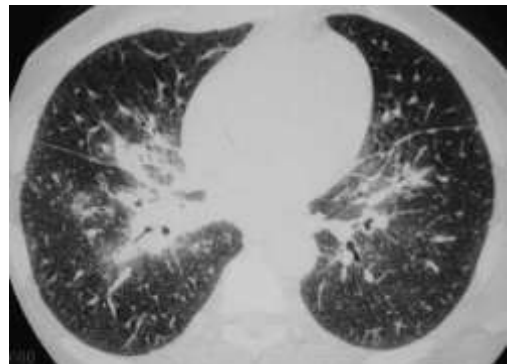
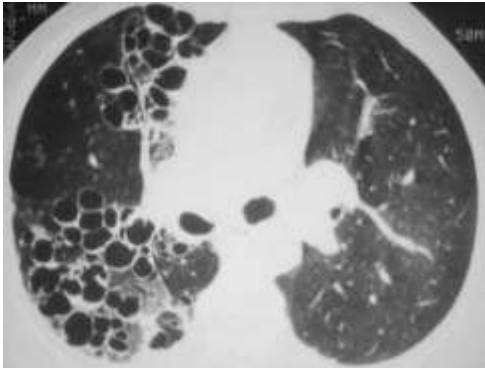
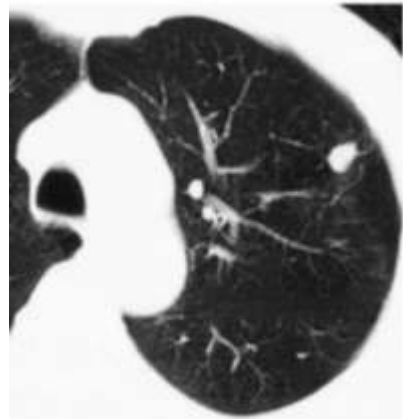
Tomosynthesis

# Computed Tomography

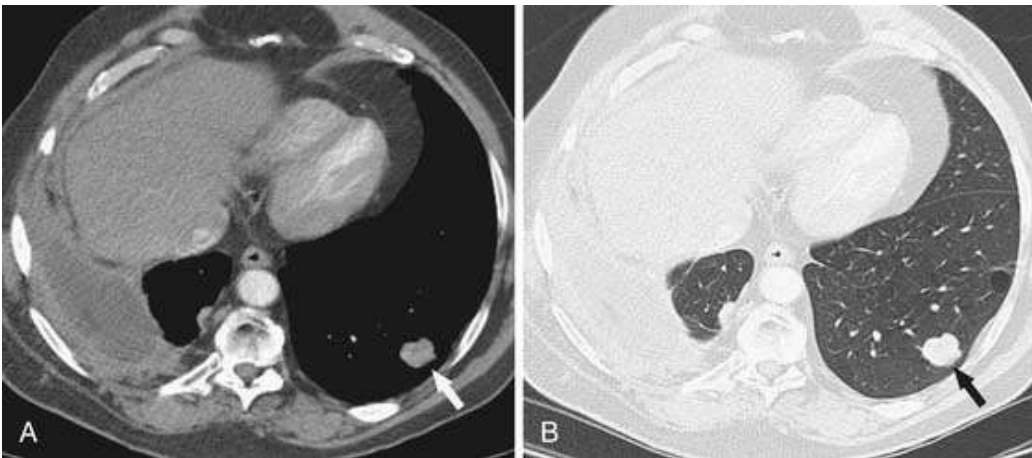
- Role of CT
  - Main further investigation for most radiographic abnormality (eg nodule/mass) or to exclude disease with normal chest radiograph
  - Main investigation in PE, dissection, cancer trauma etc.



# CHEST CT Axial plane



# CHEST CT Axial plane



## CHEST CT Coronal Reconstruction



## CHEST CT Coronal Reconstruction



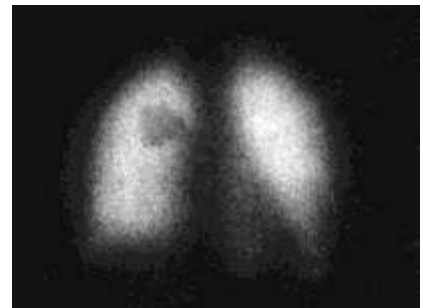
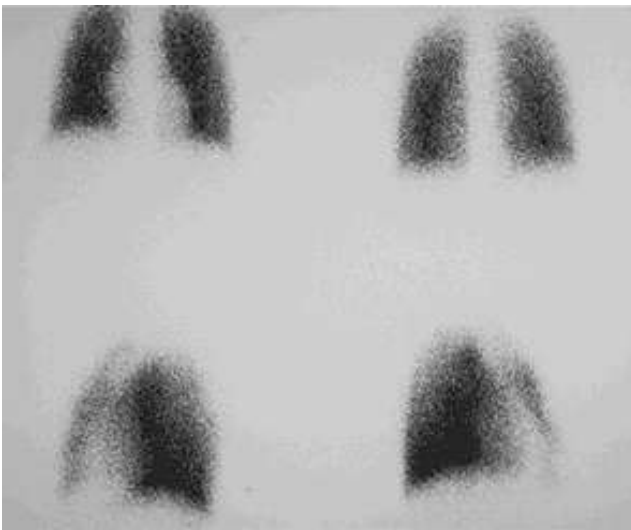
# Nuclear Medicine

- **Pulmonary ventilation scintigraphy**
  - assesses bronchi permeability (bronchi obstruction)
- **Pulmonary perfusion scintigraphy**
  - assesses permeability of pulmonary arteries (pulmonary thromboembolism)

## Chest Imaging

### Nuclear Medicine

- Pulmonary ventilation scintigraphy
- Pulmonary perfusion scintigraphy





# Thrombembolism of pulmonary artery



**Perfusion scintigraphy**

Cold nodes

# Ultrasound

- Limited use in thorax (non cardiac) due to air in lungs
- Assess pleural effusions
- Mainly used for procedures

# Ultrasonography

## Pleural metastasis

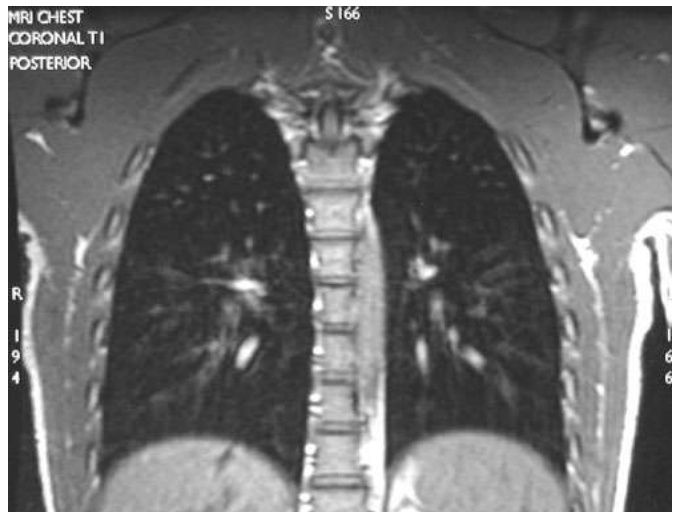


## Pleural effusion



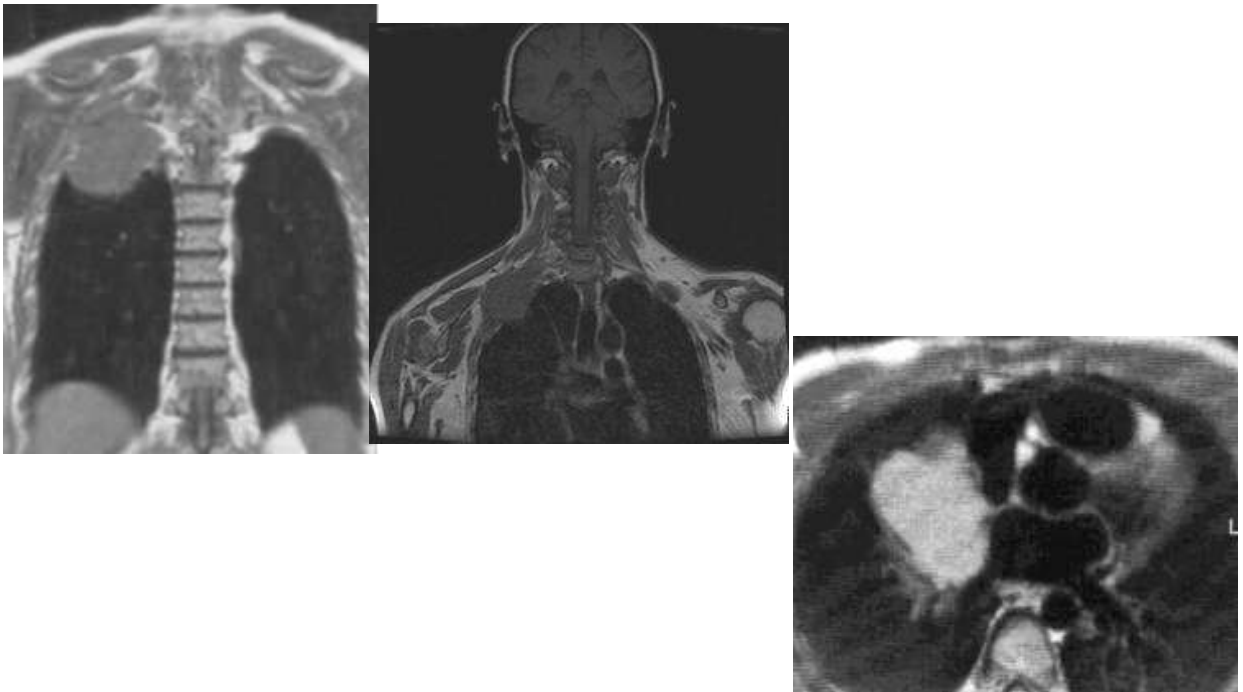
# MRI

- Multiple planes
- No radiation
- Common Indication
  - Pancoast tumour
  - Brachial plexus
  - Cardiac
  - Vascular (aorta)
- Usually targeted examination (unlike CT)



Coronal

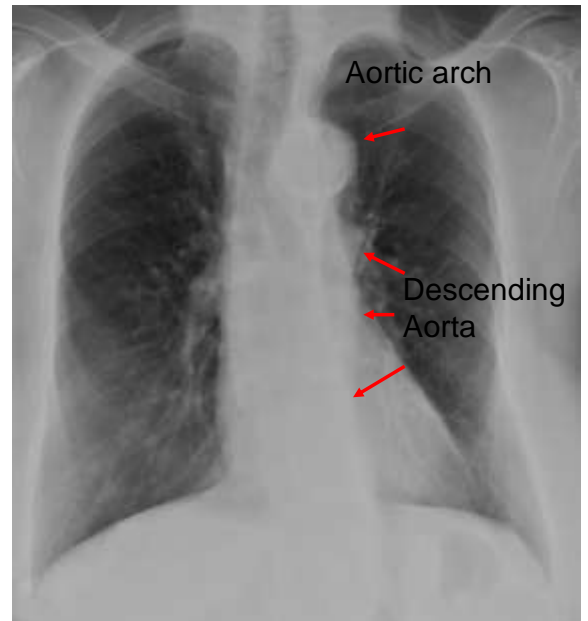
## MRI of the Chest



**MRI of Aorta**



**PA view chest X-ray**

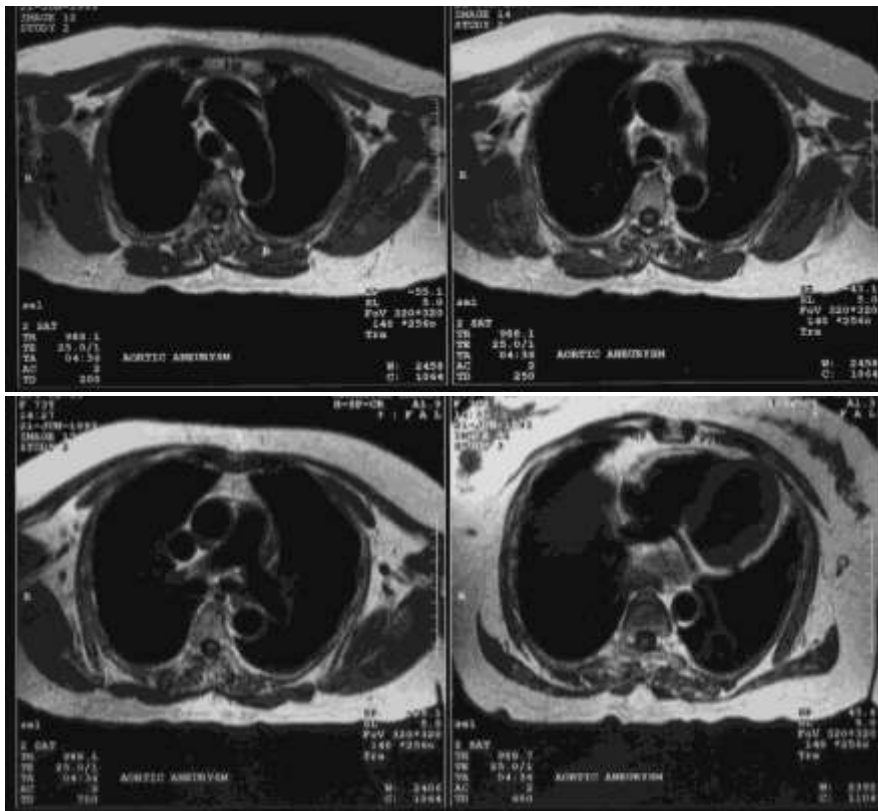


**MRI of Aorta**

**LL view chest X-ray**



## MRI of the Chest





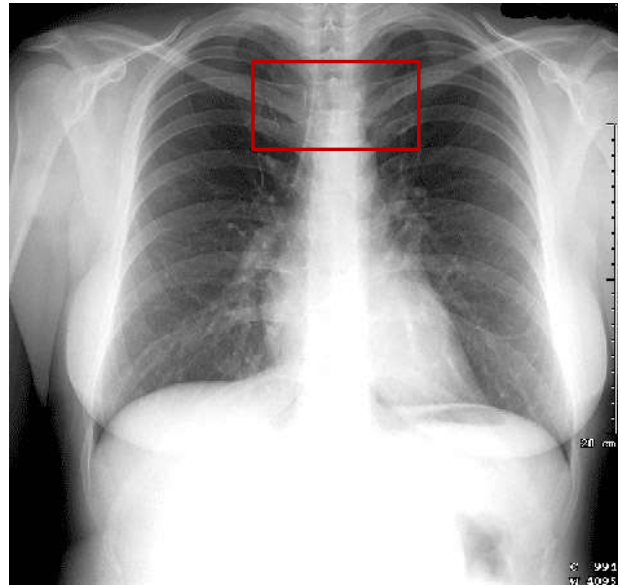
## Steps (order) of radiograph reading and reporting

- **1 Patient information**
  - name, date of birth, sex, old films
- **2 Imaging technique data**
  - time of image acquisition, radiograph, projection (view), contrast materials and other medications administered
- **3 Quality control**
  - rotation (is the film centered?)
  - penetration (is it exposed properly?)
  - inspiration (is it a good inspiration film?)
- **4 Observations, description of findings**
  - soft tissues, bony structures
  - mediastinum
  - diaphragms, costophrenic angles
  - lung fields
- **5 Summary (impression, conclusion)**

## Rotation

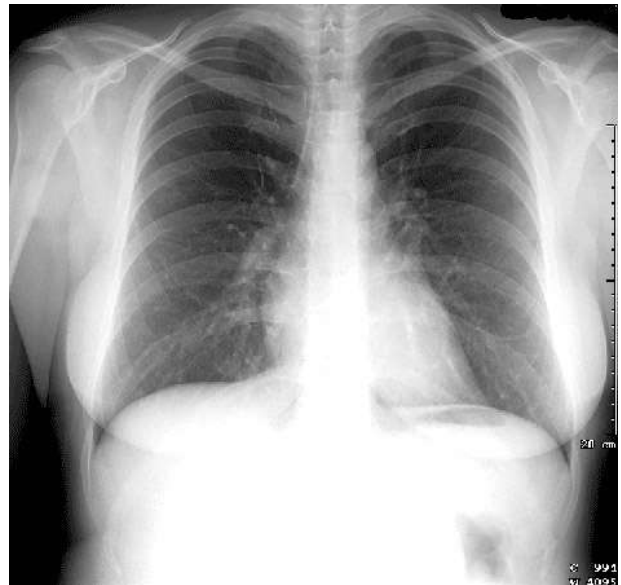


Clavicular heads are equidistant from the spinous process of the thoracic vertebrae (midline)

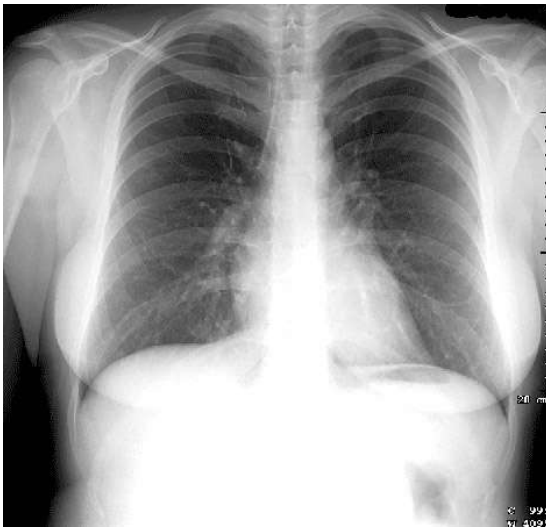


## Penetration

Adequate penetration of mediastinum (high quality radiograph) – the vertebral bodies should just be visible through the heart



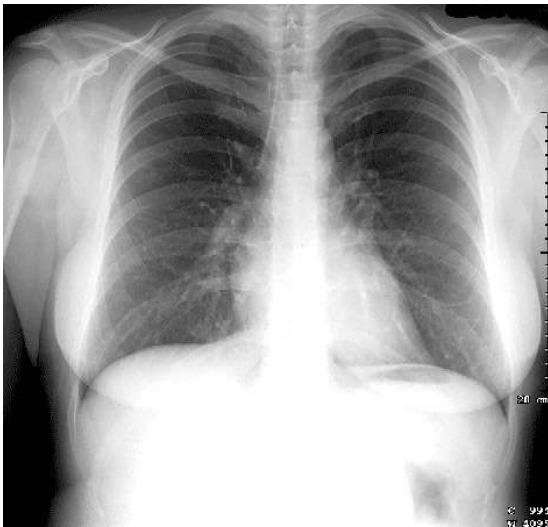
**Normal penetration  
PA film**



**Overpenetrated  
PA film**



**Normal penetration  
PA film**

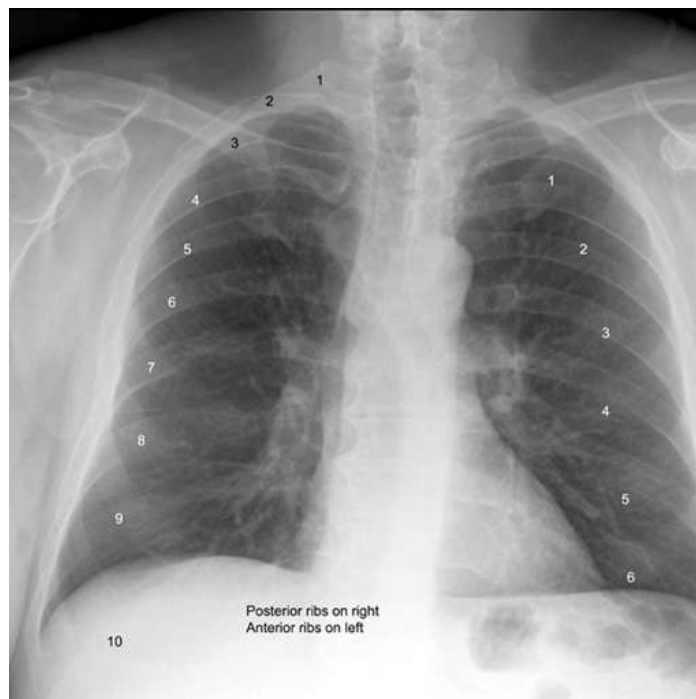


**Underpenetrated  
PA film**



## Inspiration

The diaphragm should be found at about the level of the 10th posterior rib or 6th anterior rib on good inspiration



## Sex of Patient

Female



Male



# Chest Radiograph

## Radiological anatomy - chest wall

### Bony structures

- Ribs
- Clavicles
- Vertebrae
- Sternum
- Scapulae
- Humerus

### Soft tissue structures

- Muscular
- Fat tissue

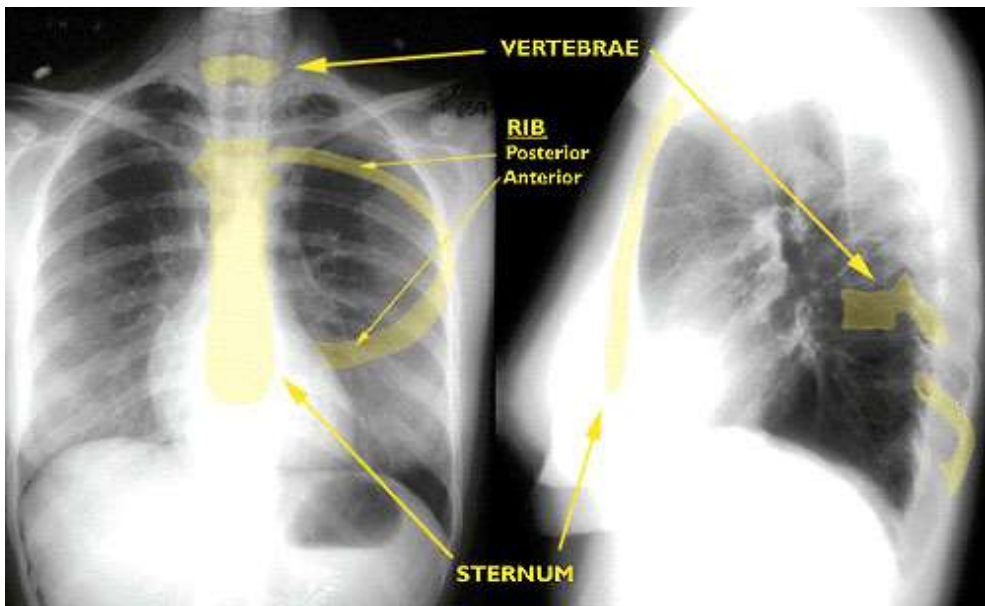




# Chest Radiograph

## Radiological anatomy - chest wall

Bony structures

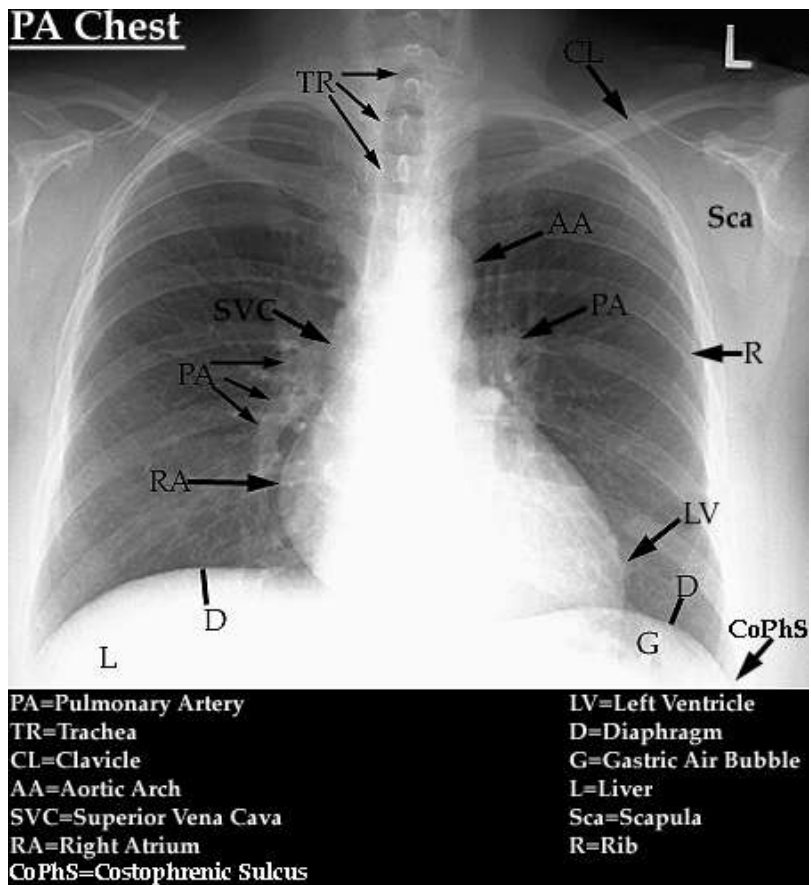


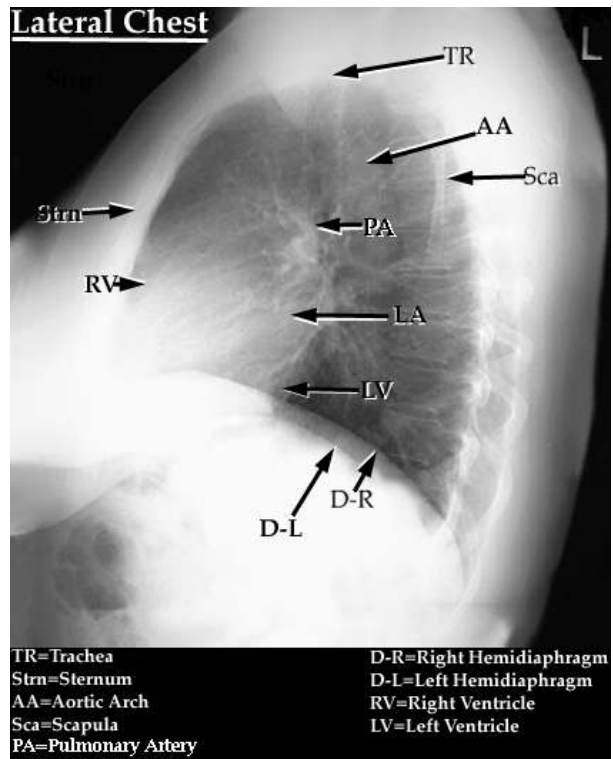
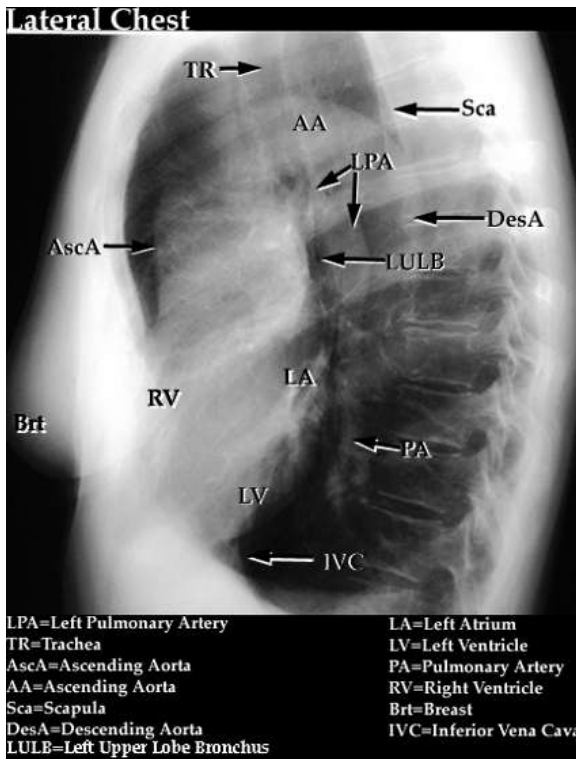
# Chest Radiograph

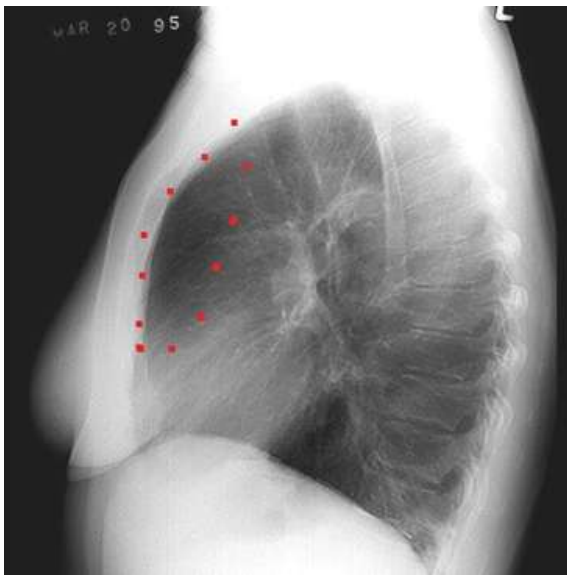
## Radiological anatomy – internal chest structures

- Heart
- Mediastinum
- Trachea
- Diaphragm
- Pleura
- Costo-phrenic angles
- Pulmonary hilum
- Pulmonary pattern  
(vasculature)

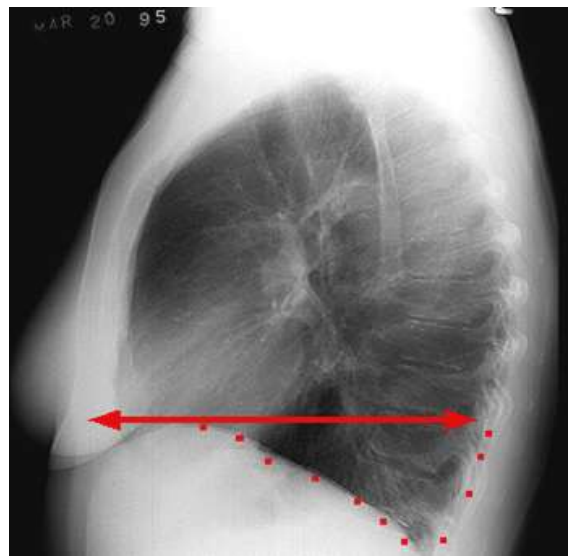








Retro sternal space



Retro cardiac space

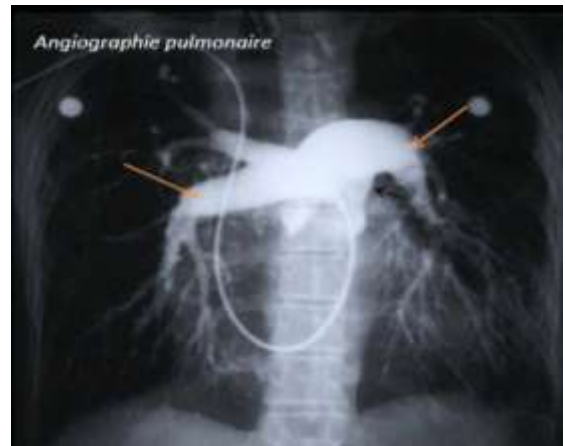
## Diaphragm and Pleural Surfaces

- Diaphragm
  - Dome-shaped
  - Costophrenic angles
- Normal pleural is not visible
- Interlobar fissures



## Lung Hila

- Hilum
  - Pulmonary arteries
  - Pulmonary veins



## Lung Fields

- Lungs
  - Linear and fine nodular shadows of pulmonary vessels
- Blood vessels
- 40% obscured by other tissue

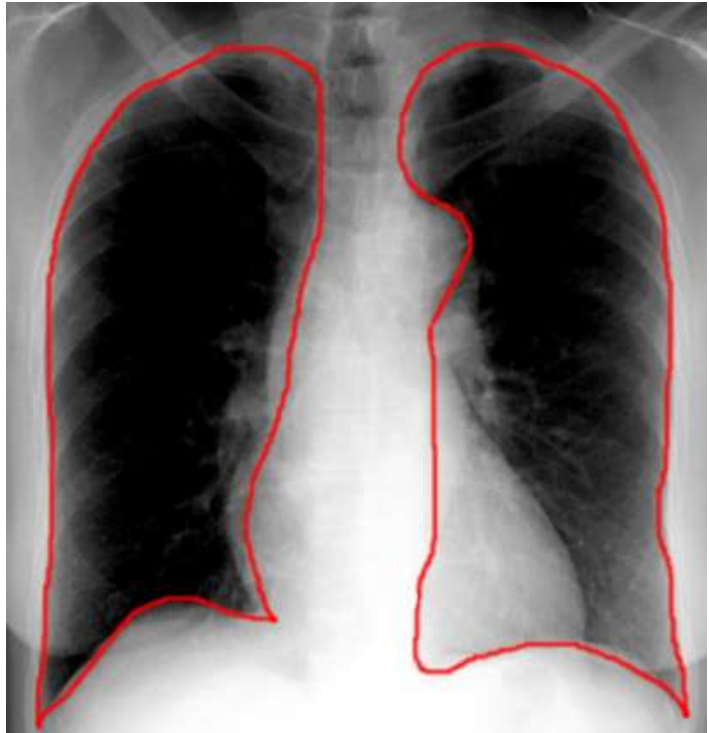




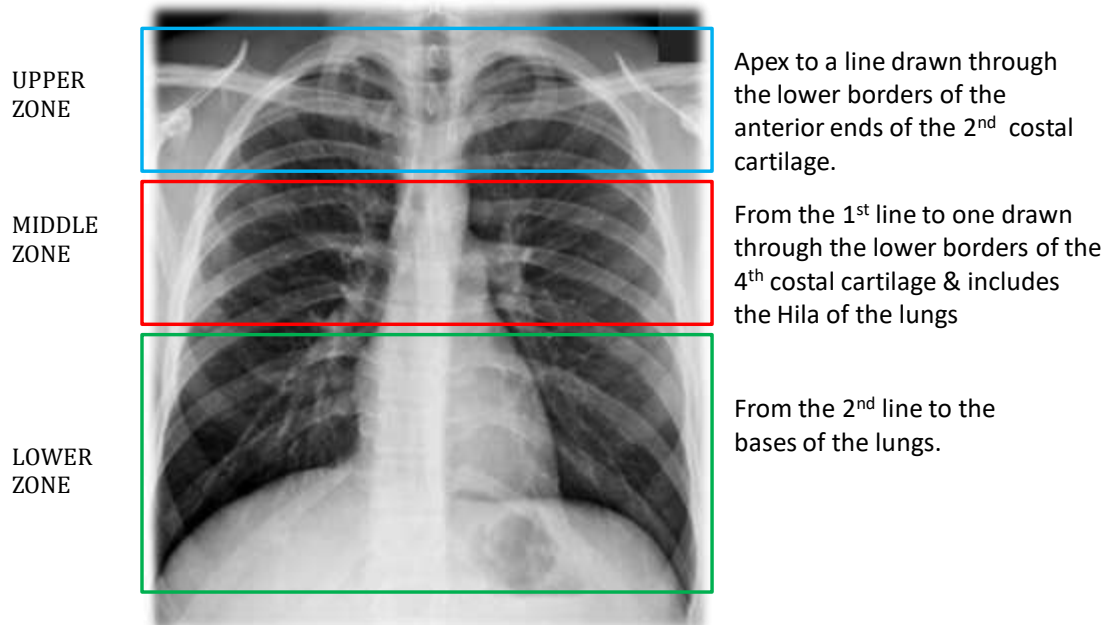
# Chest Radiograph

## Radiological anatomy

- Lung fields
  - Right
  - Left

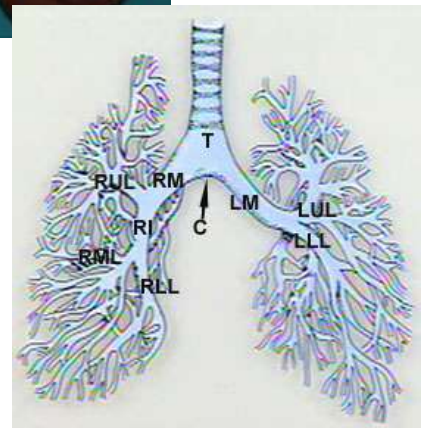
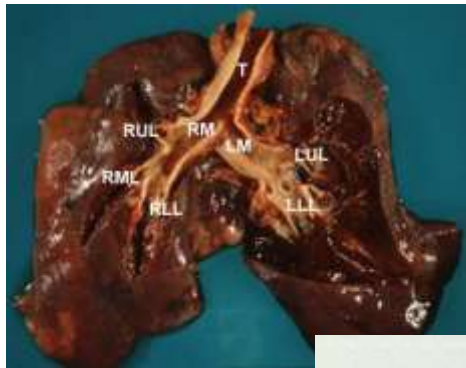


## ZONES OF THE CHEST RADIOGRAPH



# Lung Anatomy

- Trachea
- Carina
- Right and Left Pulmonary Bronchi
- Secondary Bronchi
- Tertiary Bronchi
- Bronchioles
- Alveolar Duct
- Alveoli



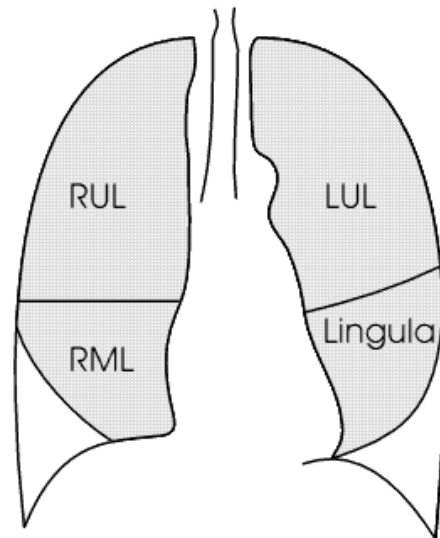
# Lung Anatomy

- Right Lung
  - Superior lobe
  - Middle lobe
  - Inferior lobe
- Left Lung
  - Superior lobe
  - Inferior lobe



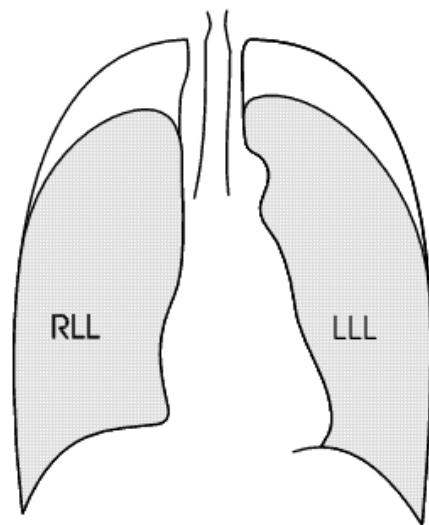
# Lung Anatomy on Chest X-ray

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



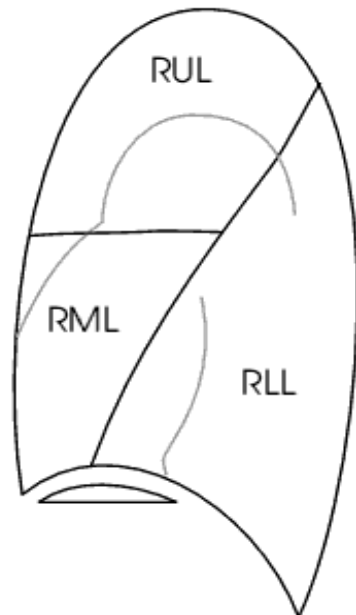
# Lung Anatomy on Chest X-ray

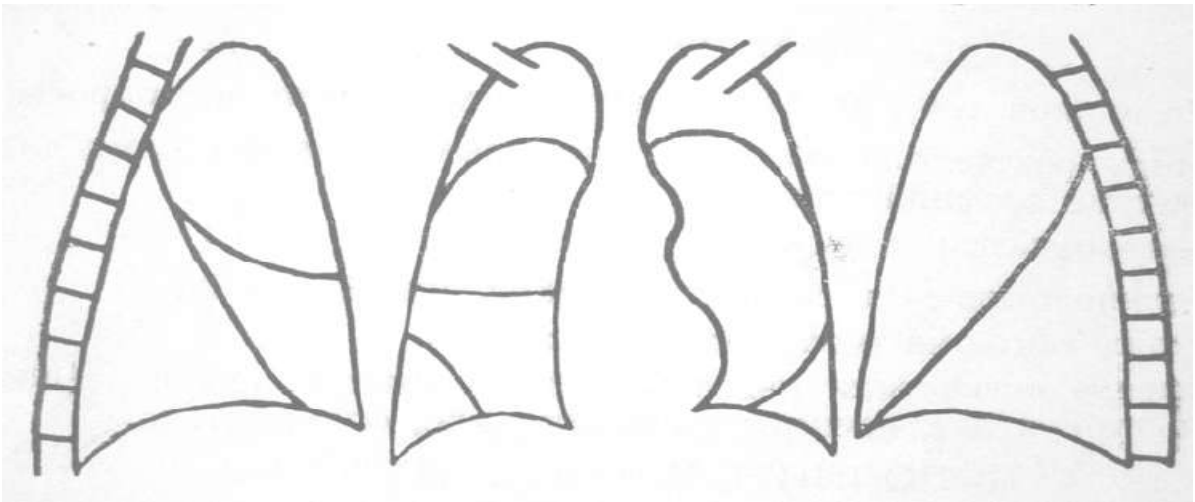
- PA View:
  - Extensive overlap
  - Lower lobes extend high
- Lateral View:
  - Extent of lower lobes



# Lung Anatomy on Chest X-ray

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

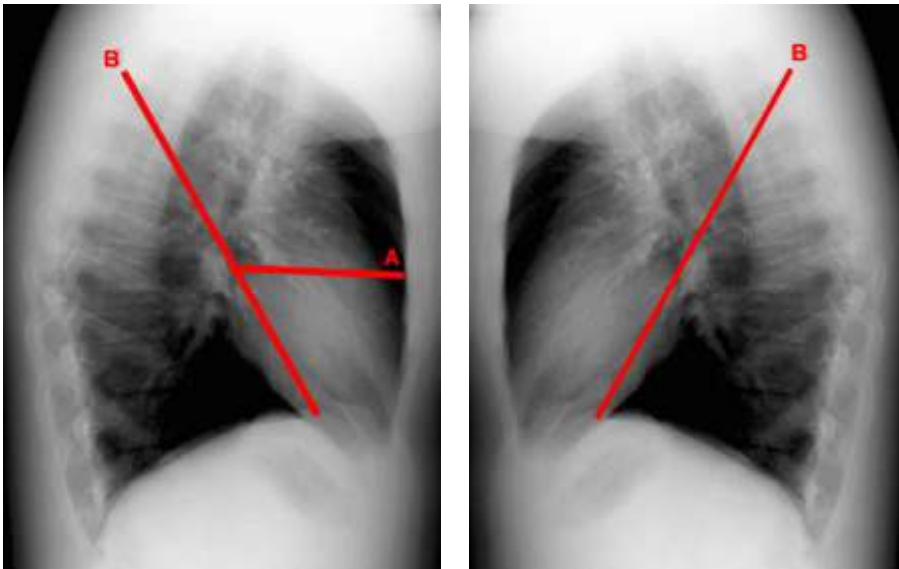






# Chest Radiograph

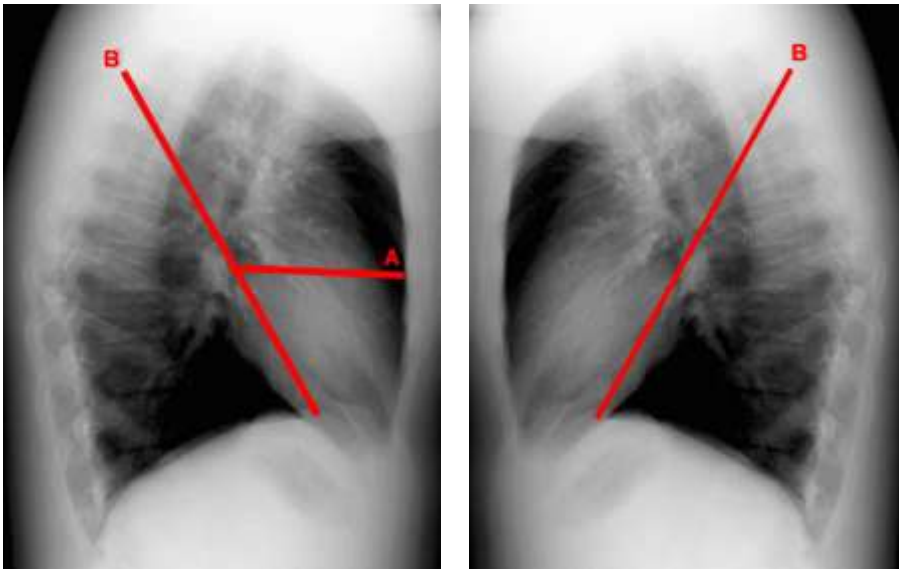
## Oblique fissure



passes obliquely downwards from the T4/T5 vertebrae through the hilum ending at the anterior third of the diaphragm

# Chest Radiograph

## Horizontal fissure



passes horizontally from the **midpoint** of the **hilum** to the **anterior chest wall**

# Chest Radiograph

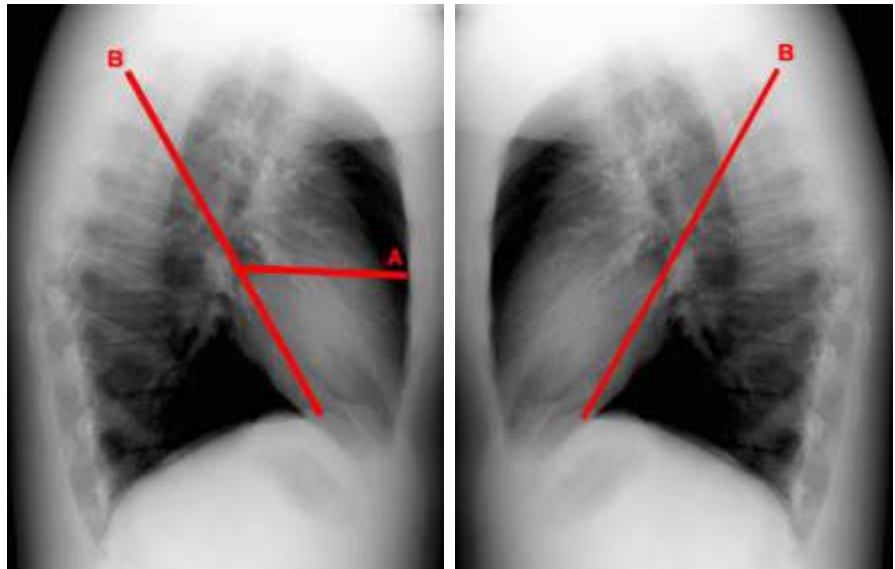
## Radiological anatomy

### Lungs. Lobs

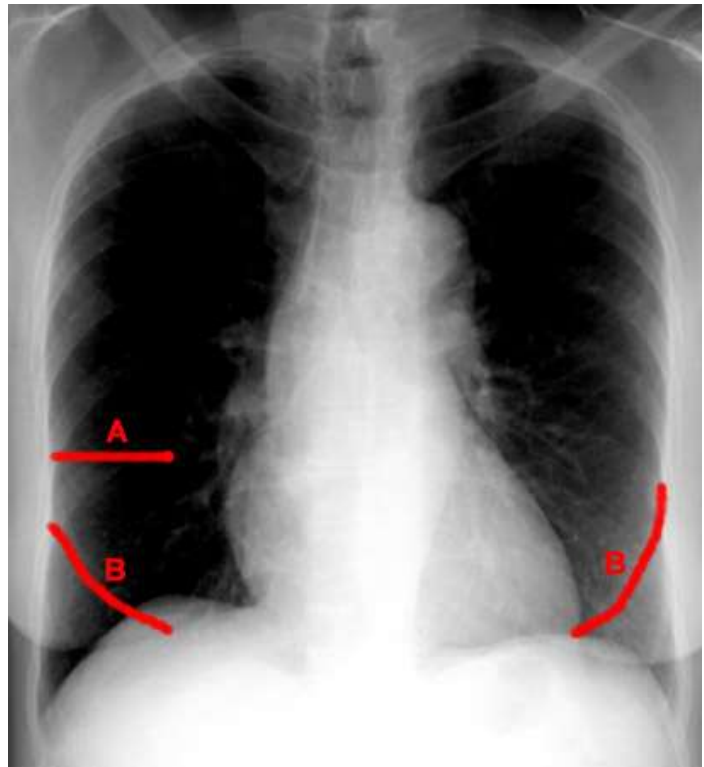
- On right
  - SR
  - MR
  - IR
- On left
  - SL
  - IL

### Fissures

- Horizontal
- Oblique



# Fissures



# **Chest Radiograph**

## **Radiological anatomy**

### **Right Lung**

- **Superior lobe:**
  - 1 - apical;
  - 2 - posterior;
  - 3 - anterior
- **Middle lobe:**
  - 4 - lateral;
  - 5 - medial
- **Inferior lobe:**
  - 6 - superior (apical);
  - 7 - medial basal;
  - 8 - anterior basal;
  - 9 - lateral basal;
  - 10 - posterior basal

# **Chest Radiograph**

## **Radiological anatomy**

### **Left Lung**

#### **– Superior lobe:**

- 1 - apical;
- 2 - posterior;
- 3 - anterior;
- 4 - superior lingular;
- 5 - inferior lingular

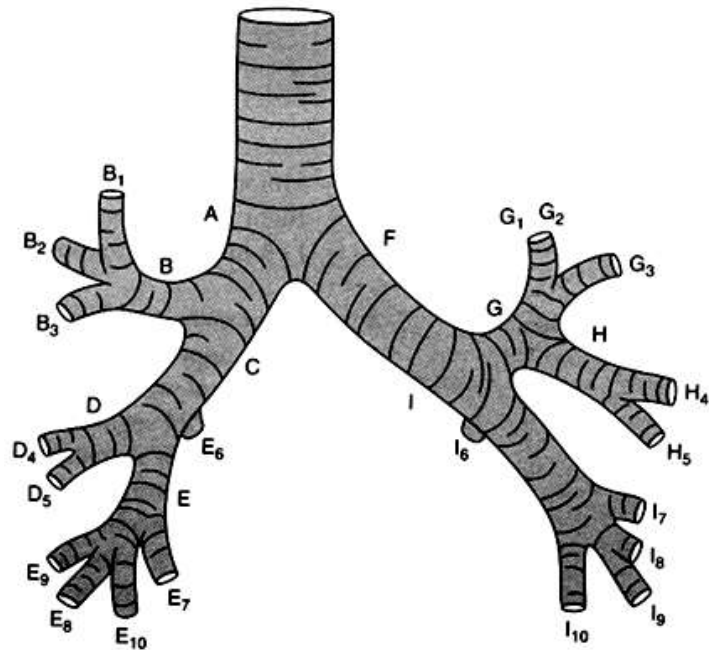
#### **– Inferior lobe:**

- 6 - superior (apical);
- 8 - anterior basal;
- 9 - lateral basal;
- 10 - posterior basal

# Chest Radiograph

## Radiological anatomy

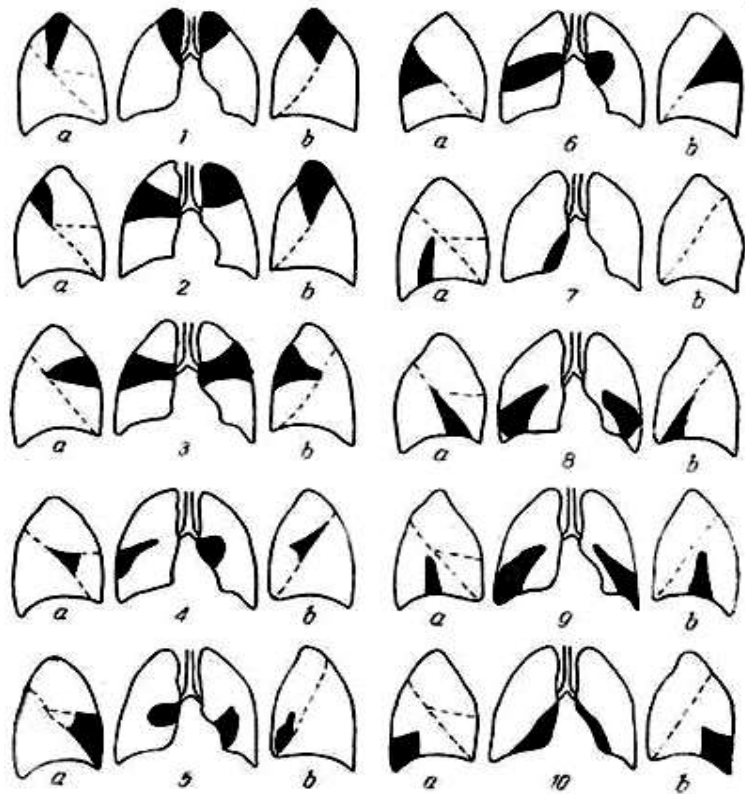
- Lungs
  - Segments



## Chest Radiograph

### Radiological anatomy

- **Lungs**
  - **Segments**
  - a – right lung
  - b – left lung
  - 1-10 – segments





## **Normal pulmonary pattern (pulmonary vasculature, pulmonary picture)**

- Is formed by pulmonary arteries and veins
- Dichotomic division of vessels
- The diameter of each vessel is 2 times less than the diameter of the previous
- Pulmonary pattern is more evident in the inferior regions
- Pulmonary pattern is no more seen at the distance of 1,5-2 cm from the chest wall



## Steps (order) of radiograph reading and reporting

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