Basic CHEST X-RAY interpretation

OBJECTIVES

- Describe a systematic method for interpretation of chest x-rays
- Recognize characteristics of normal CXR
- List findings to accurately identify common pathology in chest x-rays
- Learning how to describe abnormal findings
- Diagnose and identify the life-threatening conditions on CXR

CHEST RADIOGRAPH

- Ionizing radiation
- Most common modality of imaging
- Simple and inexpensive
- If properly interpreted
  can provide valuable clues.
  can avoid further unnecessary investigations.

STANDARD VIEWS

POSTEROANTERIOR VIEW (PA)

ANTEROPOSTERIOR VIEW (AP)

LATERAL VIEW

POSTEROANTERIOR (PA) VIEW

The standard frontal view of the chest

Refers to direction of x-ray beam

Positioning of the patient

Taken at a distance of SIX FEET

In deep inspiration at suspension

Breasts to be compressed against film

ANTEROPOSTERIOR (AP) VIEW

Patient in supine position

Used in very sick patients, infants or one who is unable to sit or stand

Direction of x-ray beam

At a distance of 100 cm {4 feet}

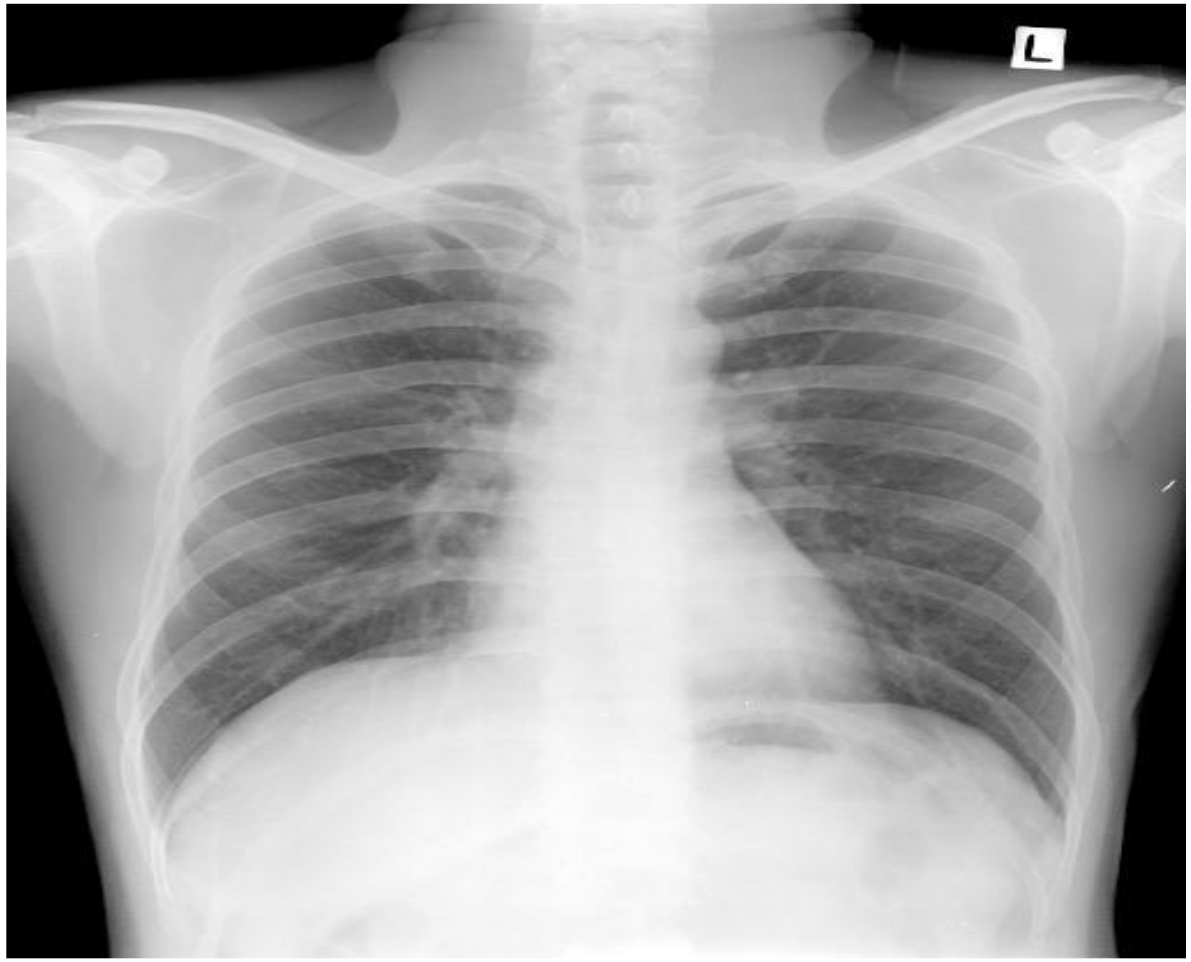
Greater magnification

Less sharpness of images

PA vs AP

PA	AP
Scapulae not overlapping lung fields	Scapulae overlapping lung fields
Clavicle is oblique overriding 1st rib	Clavicle is horizontal
Heart border clear	Heart border not clear
Cardiac magnification not seen	Cardiac magnification
Fundic air bubble seen	Fundic air bubble not seen

PA vs AP



LATERAL VIEW

Direction of X-ray beam

Not routinely used

TYPES OF DENSITIES

- Roughly speaking, only four different densities are detectable on plain films; air, fat, soft tissue and calcium

GAS – BLACK

WATER (soft tissue & fat)- GREY

MINERAL(CALCIFIC)- WHITE

- (five if you include contrast such as barium).

On all X-rays check the following:

Check patient details

First name, surname, date of birth, sex, date of examination, clinical history.

Check orientation, position and side description

Left, right, erect, ap, pa, supine, prone

Check for rotation

Measure the distance from the medial end of each clavicle to the spinous process of the vertebra at the same level, which should be equal

Check adequacy of inspiration

Nine pairs of ribs should be seen posteriorly in order to consider a chest x-ray adequate in terms of inspiration

Check penetration

One should barely see the thoracic vertebrae behind the heart

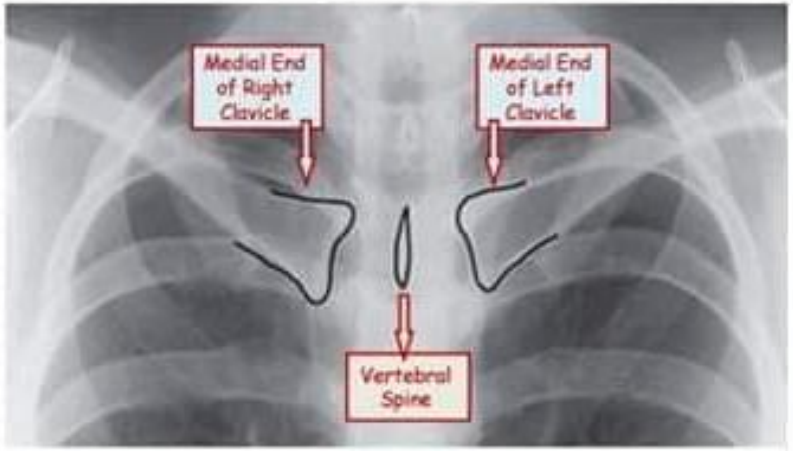
Check exposure

One needs to be able to identify both costophrenic angles and lung apices

CENTRALIZATION

Well Centralized Chest X-Ray:

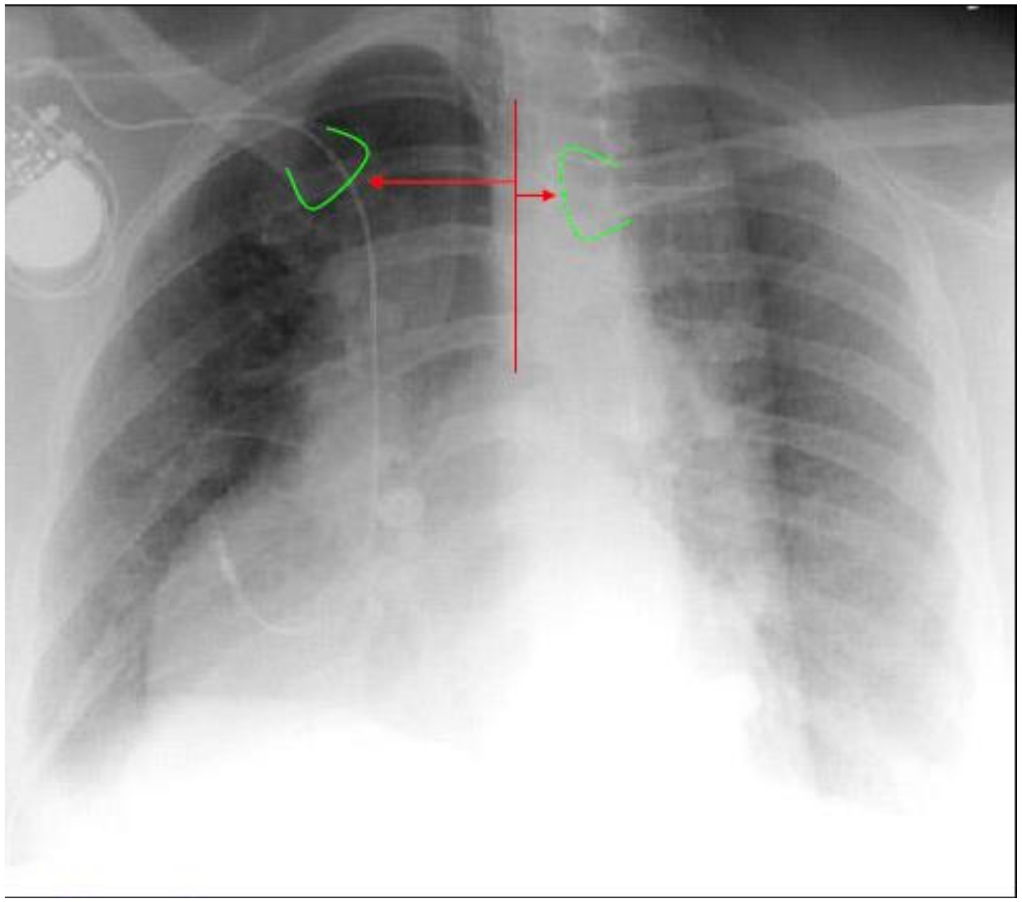
Means Distance From Vertebral Spine to Medial End of Right Clavicle is Equal to Distance From Vertebral Spine to Medial End of Left Clavicle.



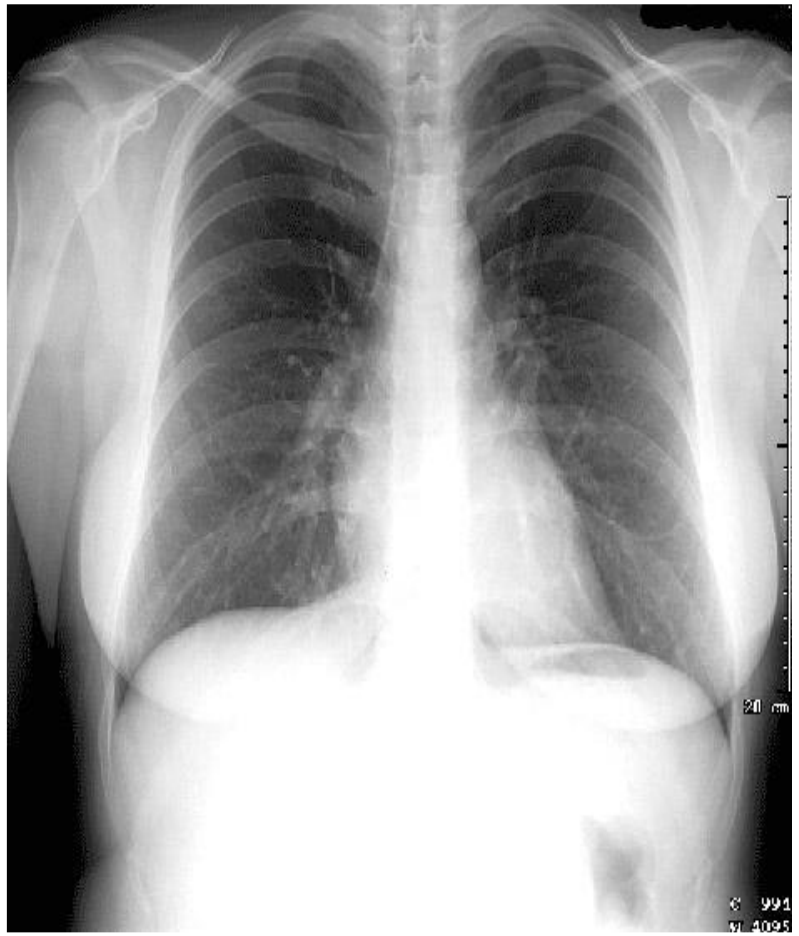
Not Centralized Chest X-Ray:

Also Called → Rotated Chest X Ray.
Means Distance From Vertebral Spine to Medial End of Right Clavicle is Not Equal to Distance From Vertebral Spine to Medial End of Left Clavicle.

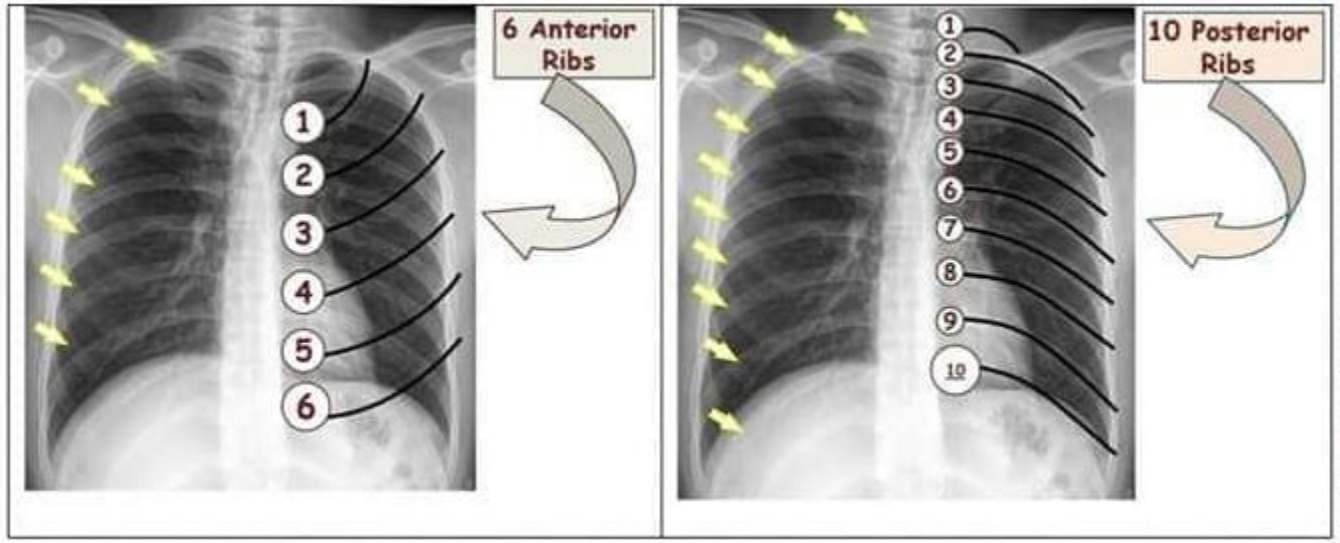
CENTRALIZATION



PENETRATION



INSPIRATORY vs EXPIRATORY

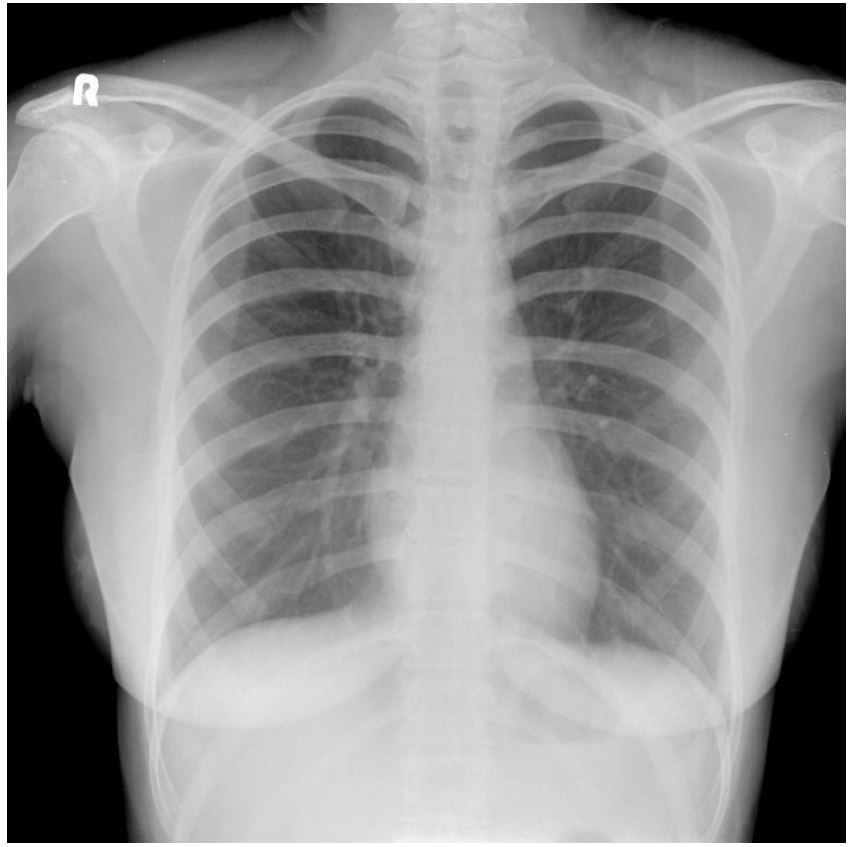


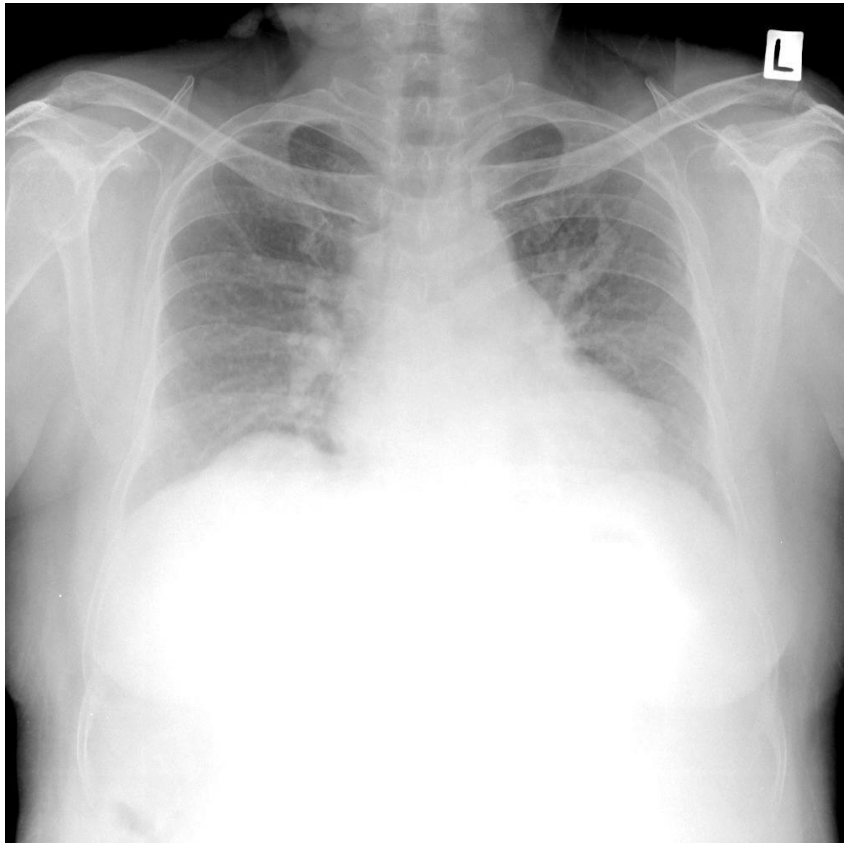
So;

If You Count 6 Anterior Ribs; That Means Chest X-Ray Taken In Full Inspiration.
If You Less than 6 Anterior Ribs; That Means X-Ray Not Take In Full Inspiration.
If You More than 6 Anterior Ribs; That Means Hyper-Inflated Chest X-Ray.

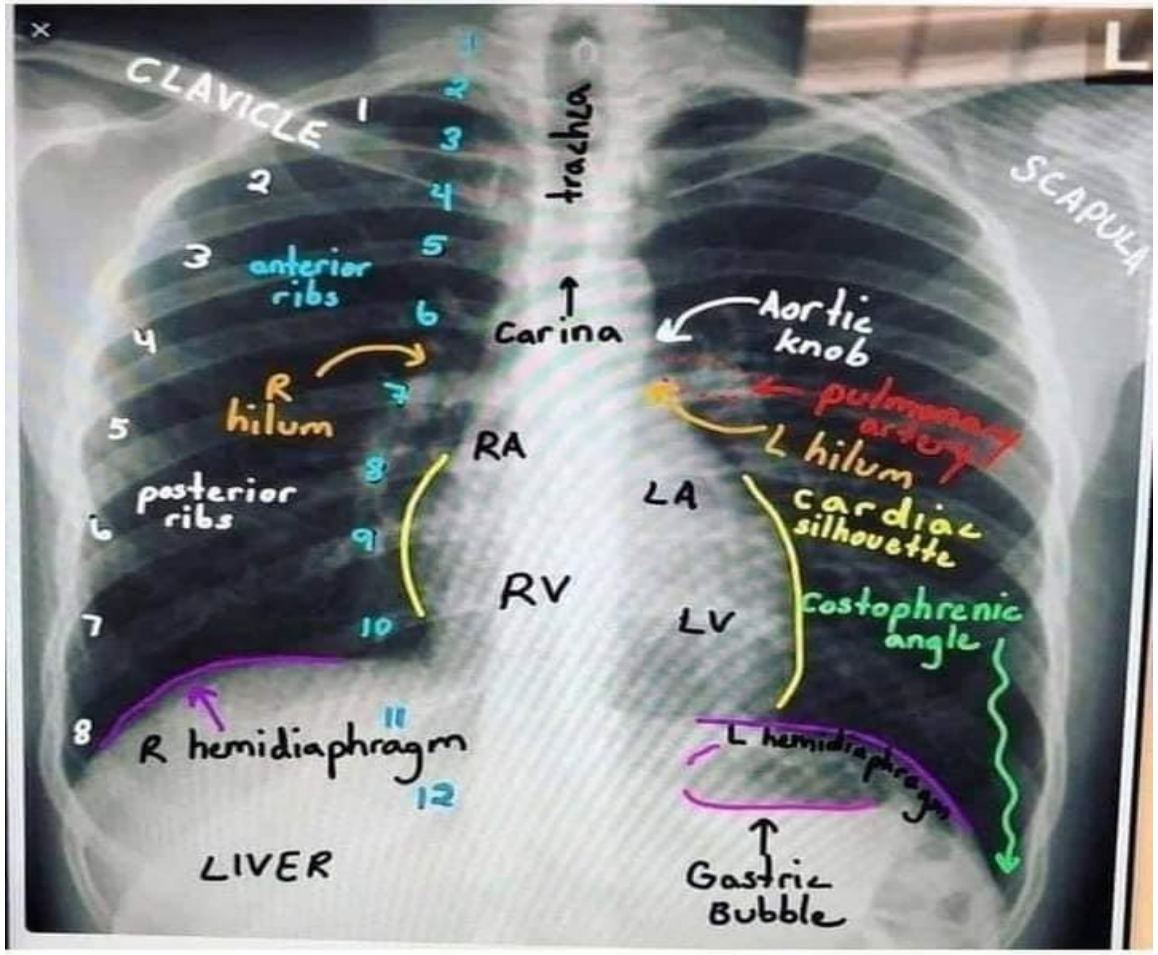
Note:
Chest X-Ray Can Be Taken During Expiration in Case of:
1. Small Pneumothorax.
2. Foreign Body Aspiration.

INSPIRATORY vs EXPIRATORY

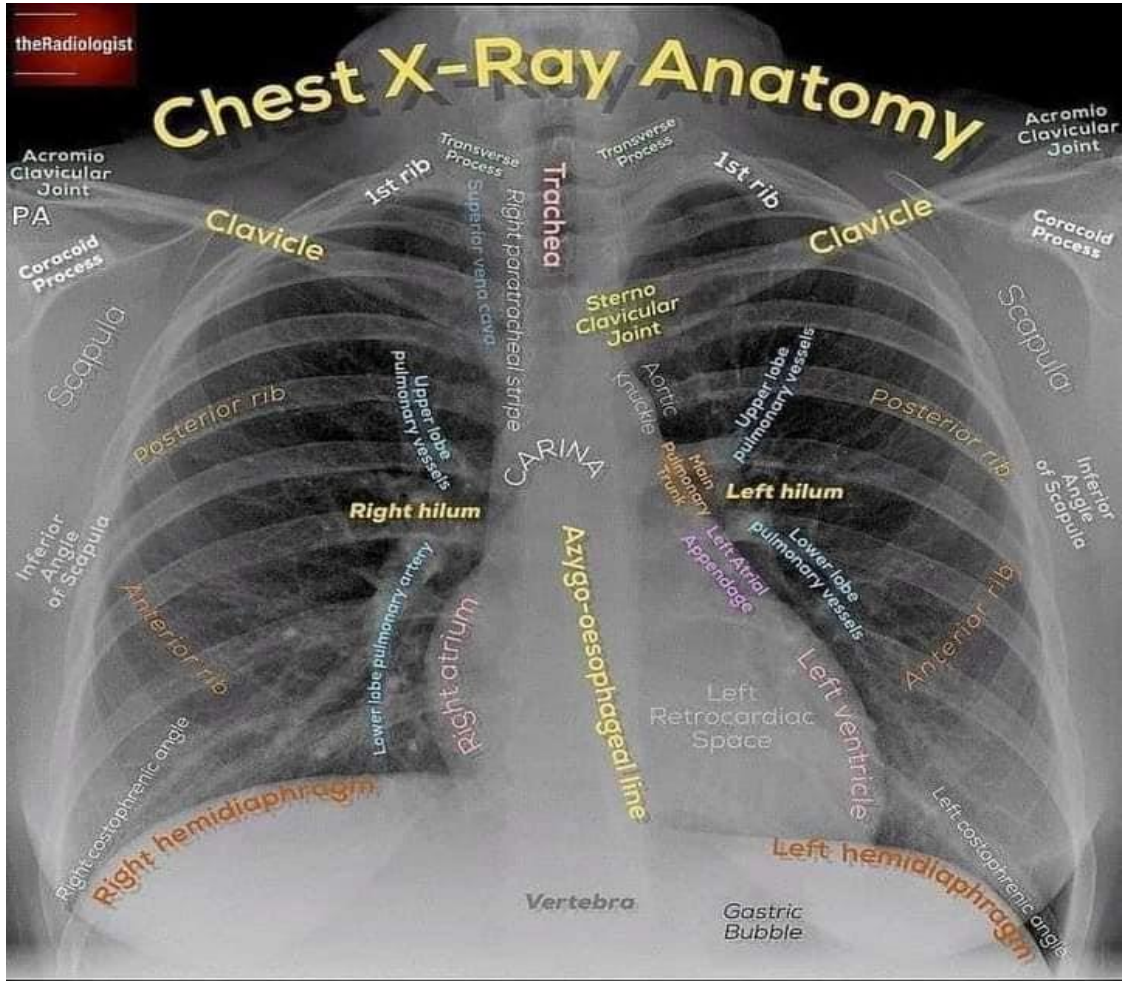




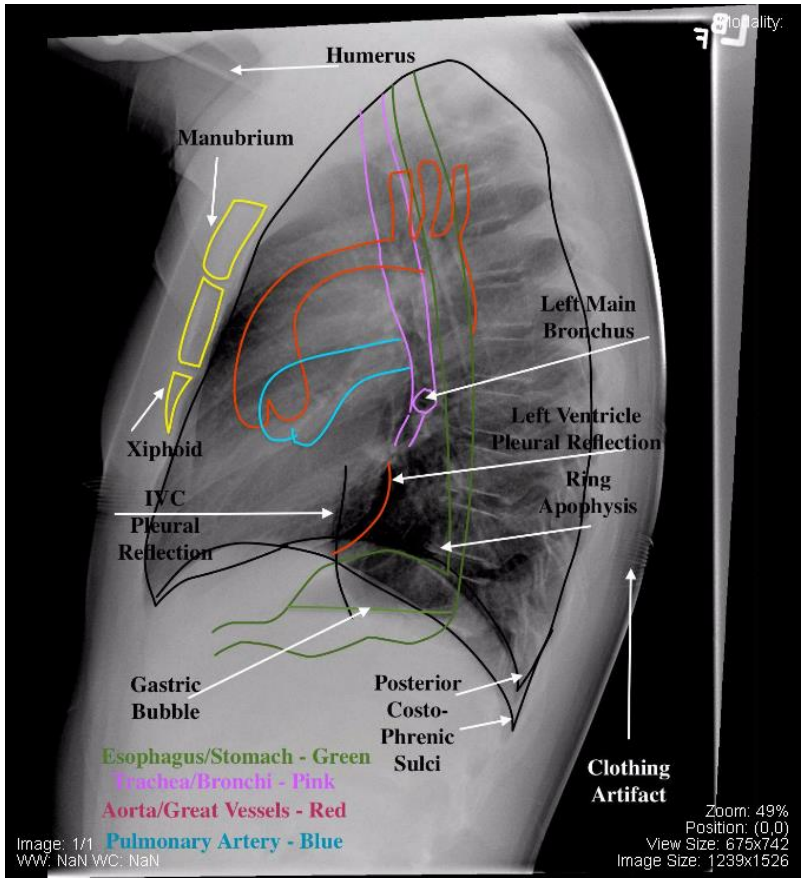
VIEWING PA FILM

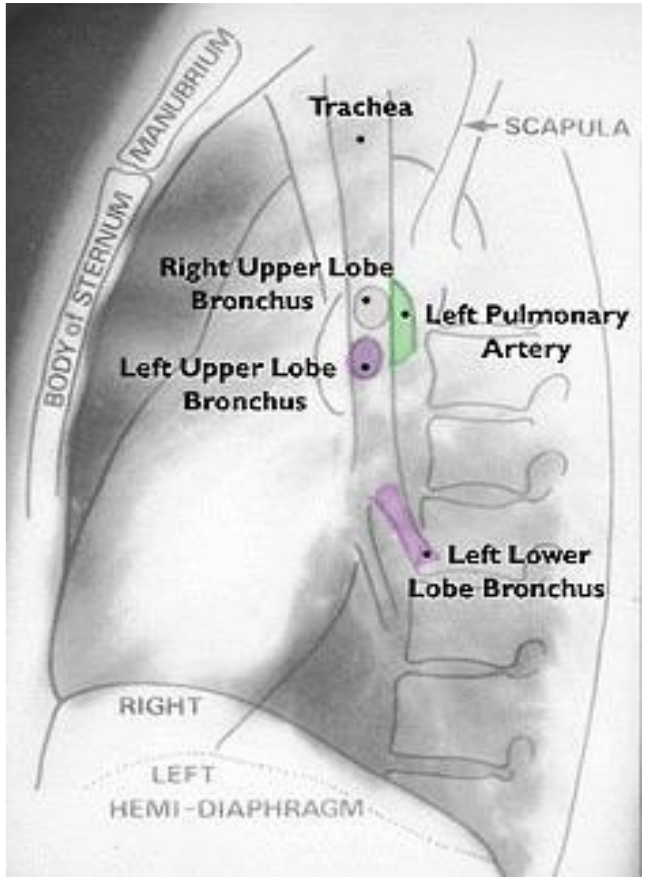


VIEWING PA FILM



VIEWING THE LATERAL FILM





A - Airway

Ensure trachea is visible and in midline

- Trachea gets **pushed away** from abnormality, eg pleural effusion or tension pneumothorax
- Trachea gets **pulled towards** abnormality, eg atelectasis
- Trachea normally narrows at the vocal cords

View the carina, angle should be between 60 –100 degrees

- Beware of things that may **increase this angle**, eg left atrial enlargement, lymph node enlargement and left upper lobe atelectasis
- Follow out both main stem bronchi

Check for tubes, pacemaker, wires, lines foreign bodies etc

- If an endotracheal tube is in place, check the positioning, the distal tip of the tube should be 3-4cm above the carina

B – Bones

Check for fractures, dislocation, subluxation, osteoblastic or osteolytic lesions in clavicles, ribs, thoracic vertebras.

Spine and humerus including osteoarthritic changes

At this time also check the **soft tissues** for subcutaneous air, **foreign bodies** and **surgical clips**

Check the vertebral bodies and the sternum for fractures or other osteolytic changes

C - CARDIAC AND MEDIASTINUM

RIGHT MEDIASTINAL BORDER

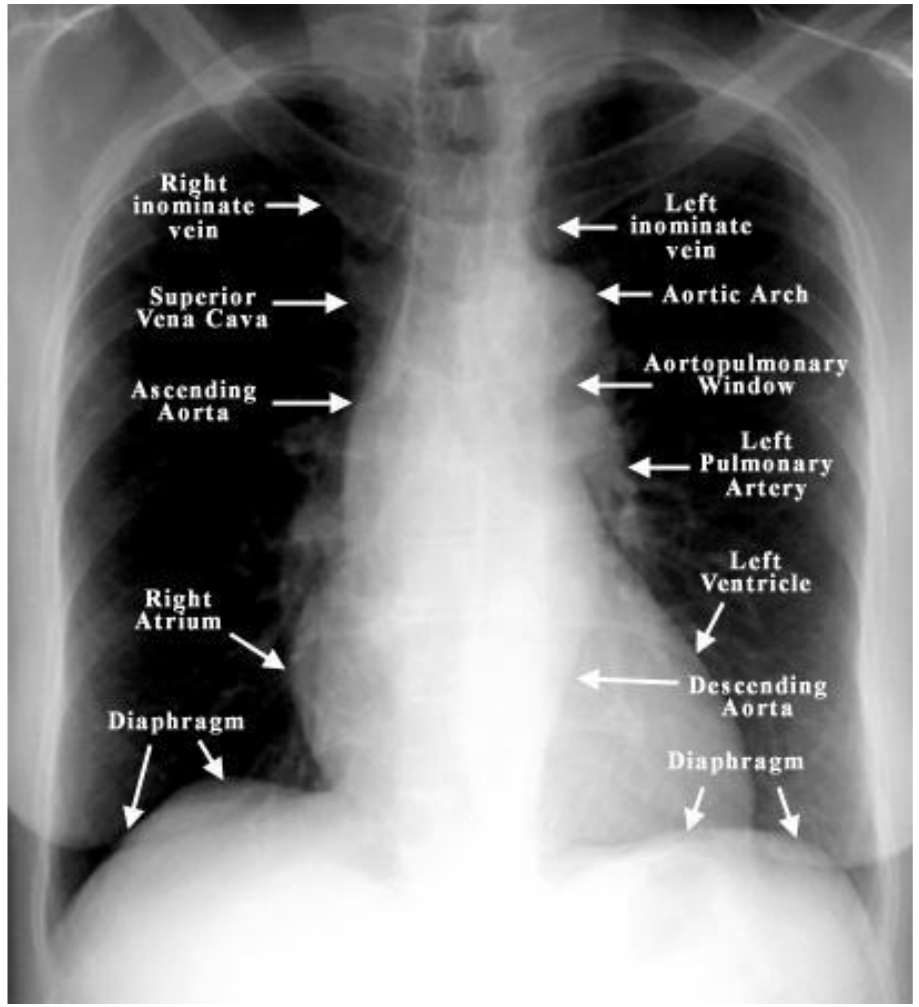
LEFT MEDIASTINAL BORDER

AORTIC KNUCKLE

CHECK FOR WIDENED MEDIASTINUM

- Mass lesions (eg tumor, lymph nodes)
- Inflammation (eg mediastinitis, granulomatous inflammation)
- Trauma and dissection (eg hematoma, aneurysm of the major mediastinal vessels)

SIZE OF HEART: CARDIOTHORACIC RATIO



C - CARDIAC AND MEDIASTINUM

Check heart size and heart borders

Appropriate or blunted
Thin rim of air around the heart, think of pneumomediastinum

Check aorta

Widening, tortuosity, calcification

Check heart valves

Calcification, valve replacements

Check SVC, IVC, azygos vein

Widening, tortuosity

Check for enlargement of the right ventricle and right atrium (retrosternal and retrocardiac spaces)

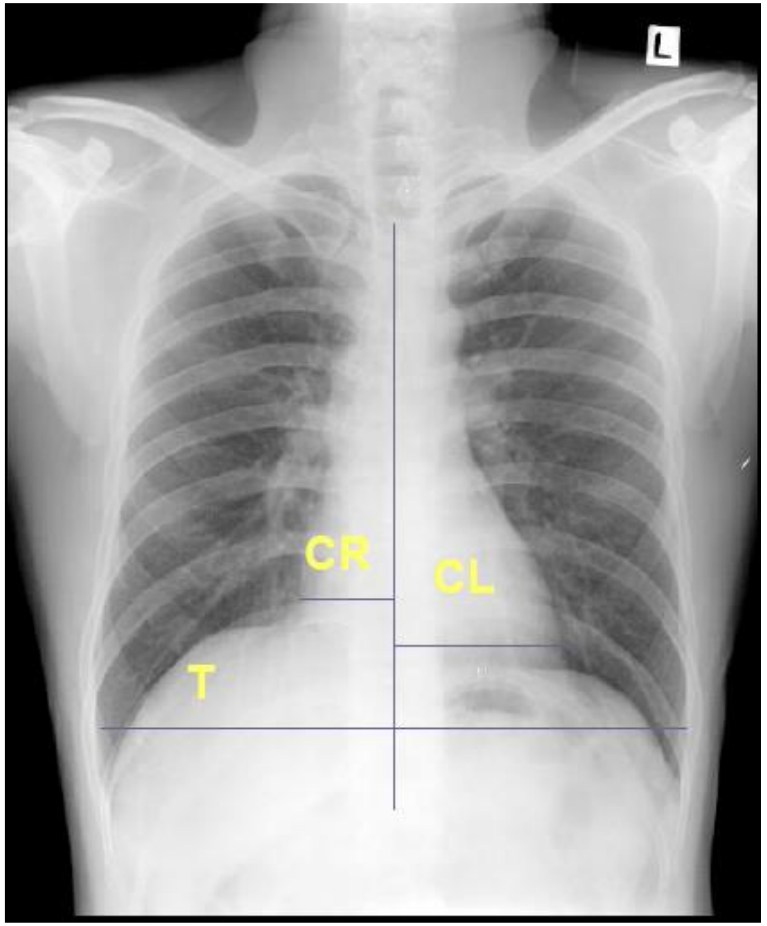
Cardio Thoracic Ratio

CT RATIO = CR + CL / T

CR + CL = TRANSVERSE CARDIAC DIAMETER

T = TRANSVERSE THORACIC DIAMETER

A normal measurement is 0.42-0.50.



D - DIAPHRAGM

LOCATION

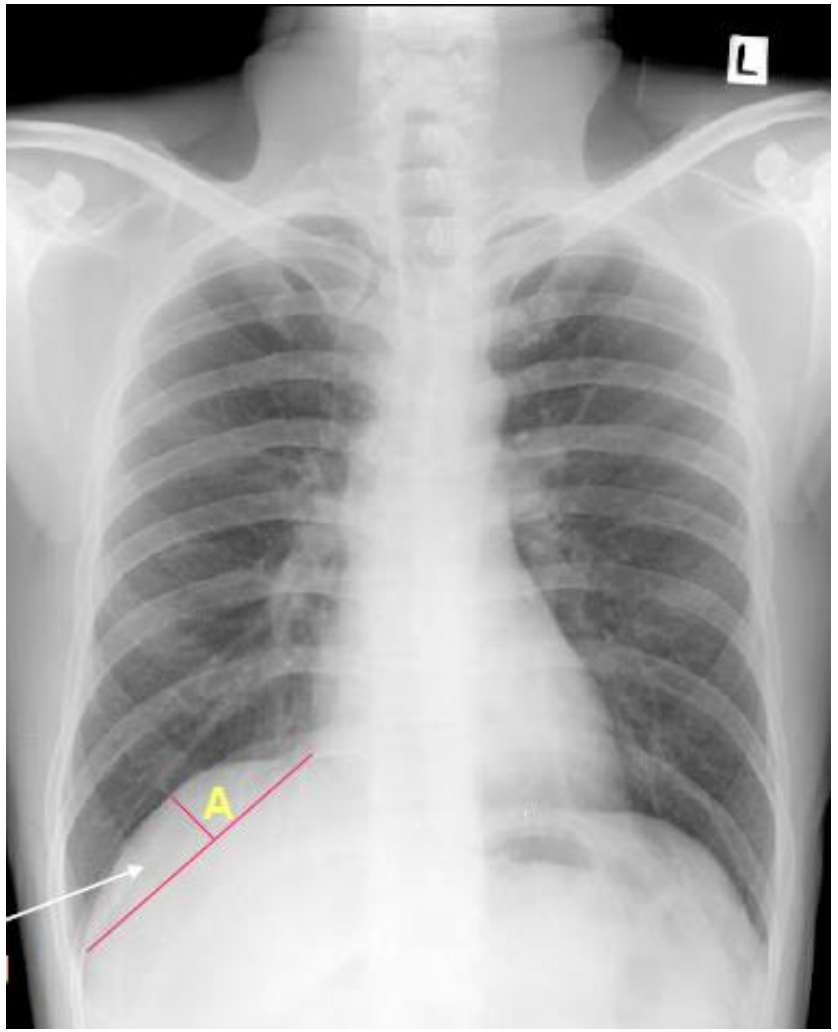
Right hemidiaphragm

- Should be higher than the left
- **If much higher**, think of effusion, lobar collapse, diaphragmatic paralysis
- **If you cannot see parts of the diaphragm**, consider infiltrate or effusion

SHAPE

- Diaphragm tenting
  - Collapse
  - Hepatomegaly
  - Sub diaphragmatic abscess
- Diaphragm flattened
  - COPD

Free air under the diaphragm

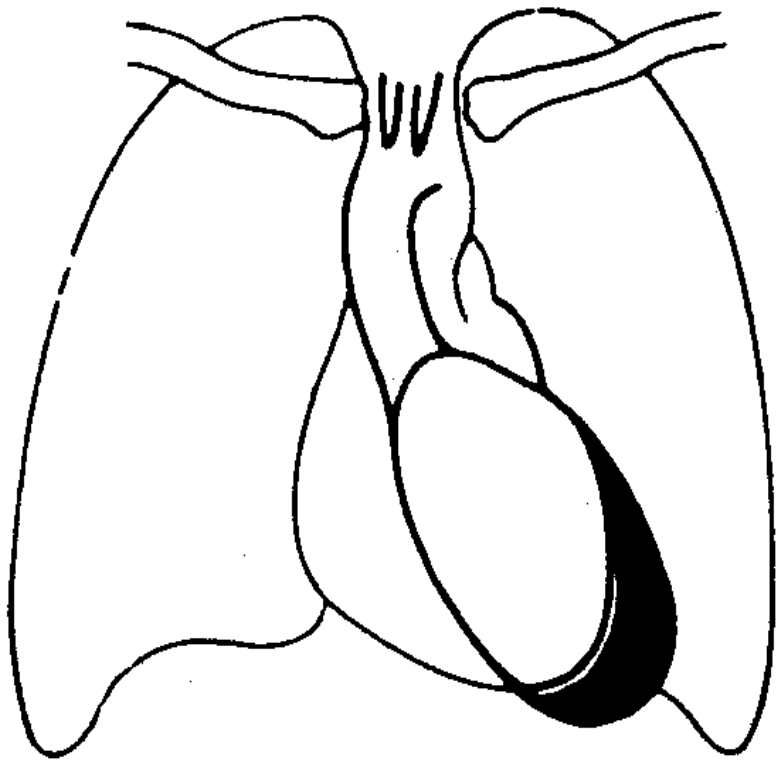


COSTOPHRENIC ANGLES

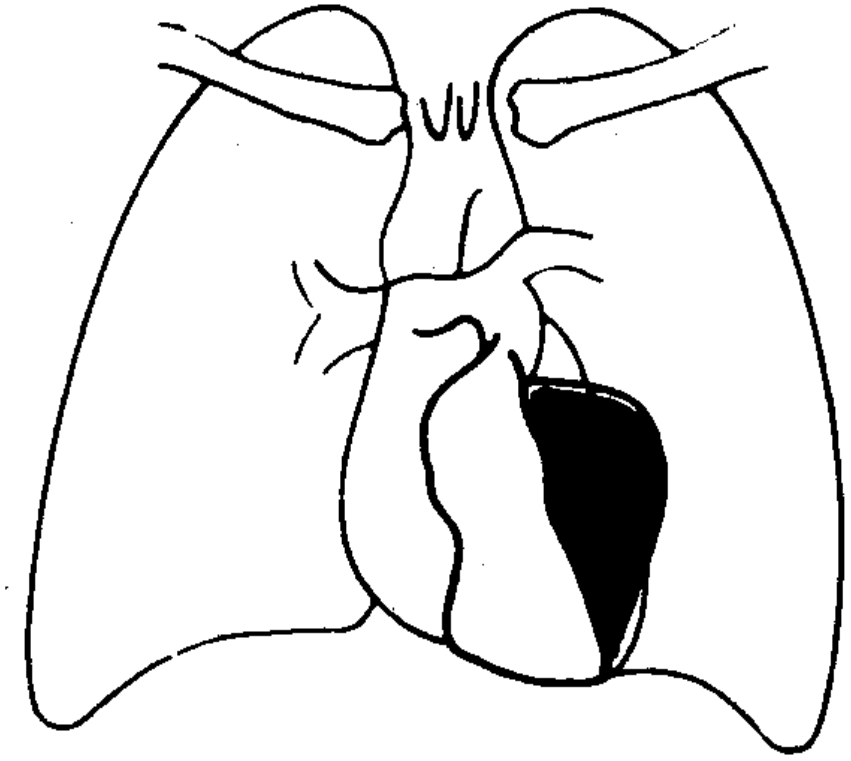
Look for VISIBILITY and SHARPNESS

BLUNT angles

CARDIOPHRENIC ANGLE



LVH



RVH

E – Effusion

Effusions

Look for blunting of the costophrenic angle (homogenous and crescent shape)

Check out the pleura

Thickening, loculations, calcifications and pneumothorax

Check to see the fissures here as well – both major fissures and the horizontal may be found in the lateral view

At 50 ml ➔ lateral CXR
At 200 ml ➔ PA
At 500 ml ➔ obscure the hemidiaphragm

F – Fields (Lung fields)

Check for infiltrates

- Identify the location of infiltrates by use of known radiological phenomena, eg loss of heart borders or of the contour of the diaphragm
- Remember that right middle lobe abuts the heart, but the right lower lobe does not
- The lingula abuts the left side of the heart

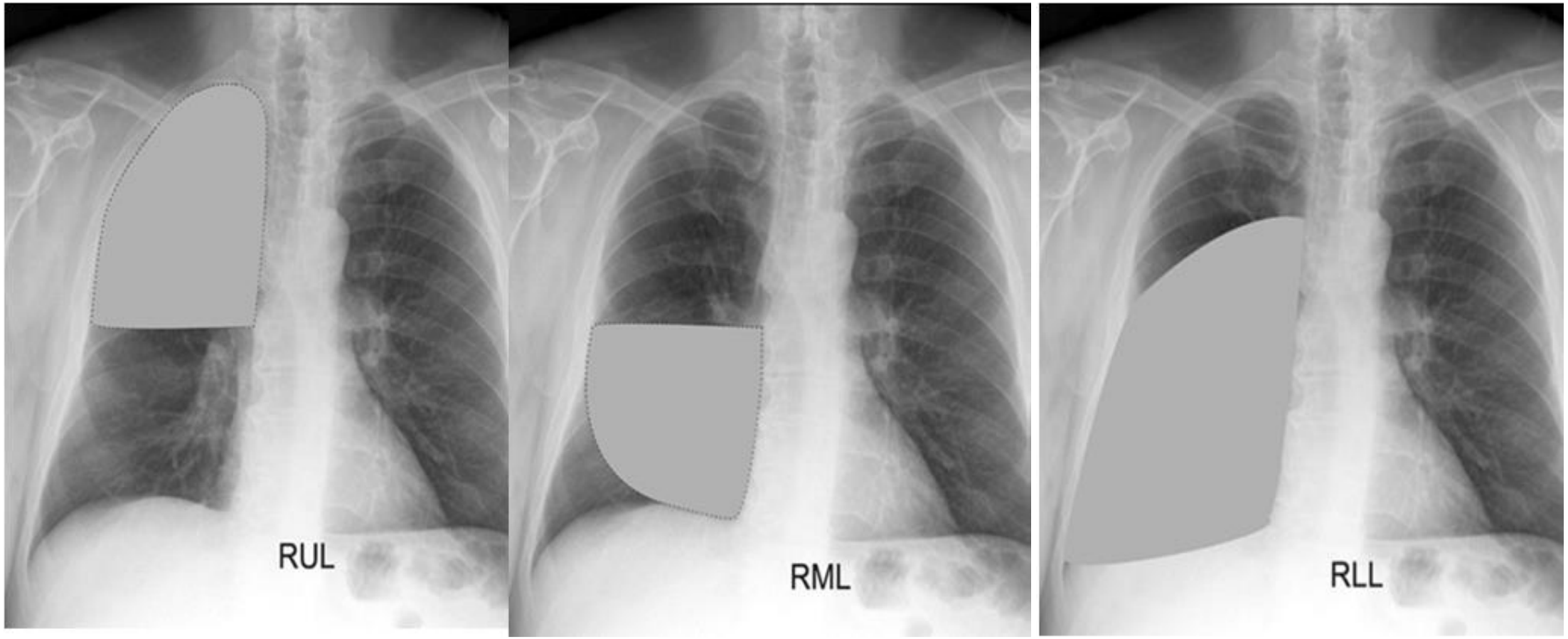
Identify the pattern of infiltration

- Interstitial pattern (reticular) versus alveolar (patchy or nodular) pattern
- Lobar collapse
- Look for air bronchograms, tram tracking, nodules, Kerley B lines

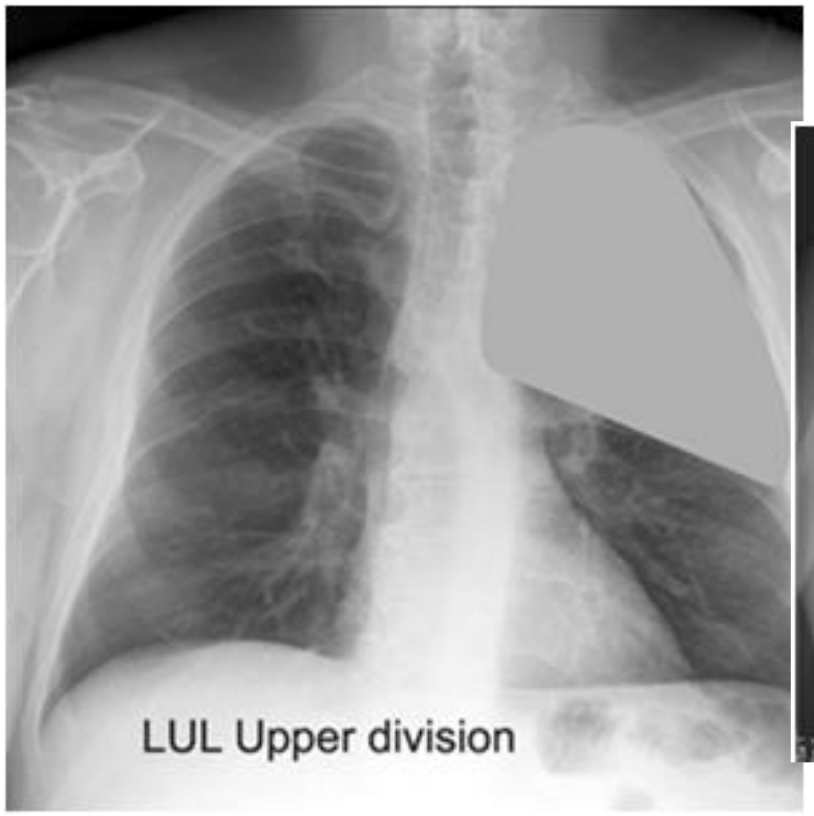
Check for granulomas, tumor and pneumothorax

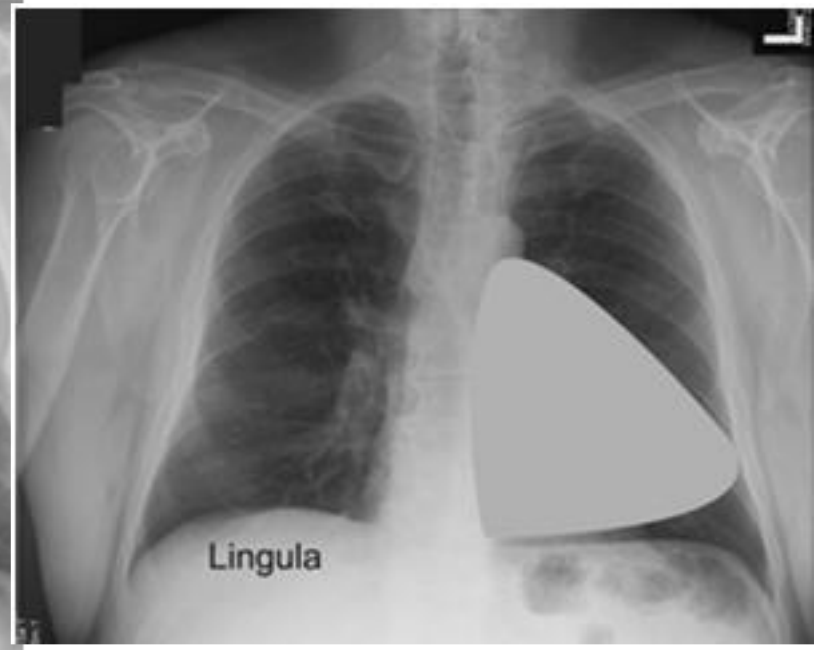
Pay special attention to the lower lung lobes and the apices.

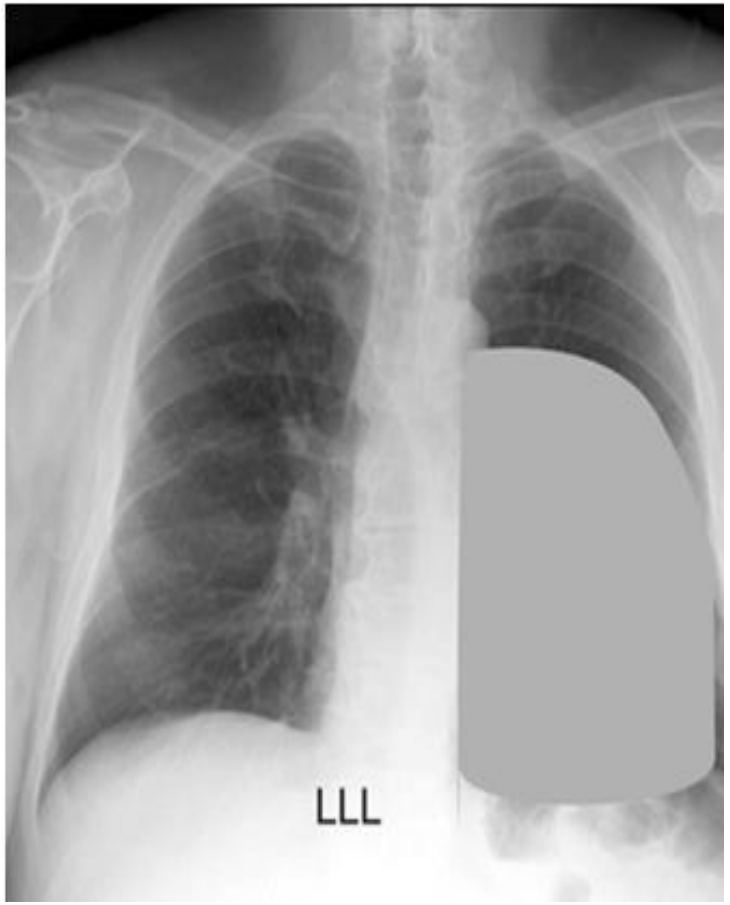
Lung fields



Lung fields







THE LUNG FIELDS

DIVIDED into 3 Zones:

UPPER: above 2nd rib
MID: 2dr to 4th rib
LOWER: below 4th rib

COMPARE both the lung fields

DISTRIBUTION of lung markings

Left Lung Characters:	Right Lung Characters:
1. Presence of Aortic Knuckle. 2. Presence of Apex (Left Ventricle) of the Heart. 3. Presence of Gases of the Stomach.	Normally the Base of Right Lung is Elevated More than Left Lung; Because of Right Dome Diaphragm is Higher than Left Dome of Diaphragm.

G – Gastric Air Bubble

Check correct **position**

Beware of **hiatus hernia**

Look for **fee air**

Look for **bowel loops** between diaphragm and liver

H – Hilum

Check the **position** and **size** bilaterally

Left hilum higher than the right in 97% of subjects

Should be of equal density and similar size on either sides

Enlarged lymph nodes

Calcified nodules

Mass lesions

Pulmonary arteries, if greater than 1.5cm think about possible causes of enlargement

THE HIDDEN AREAS

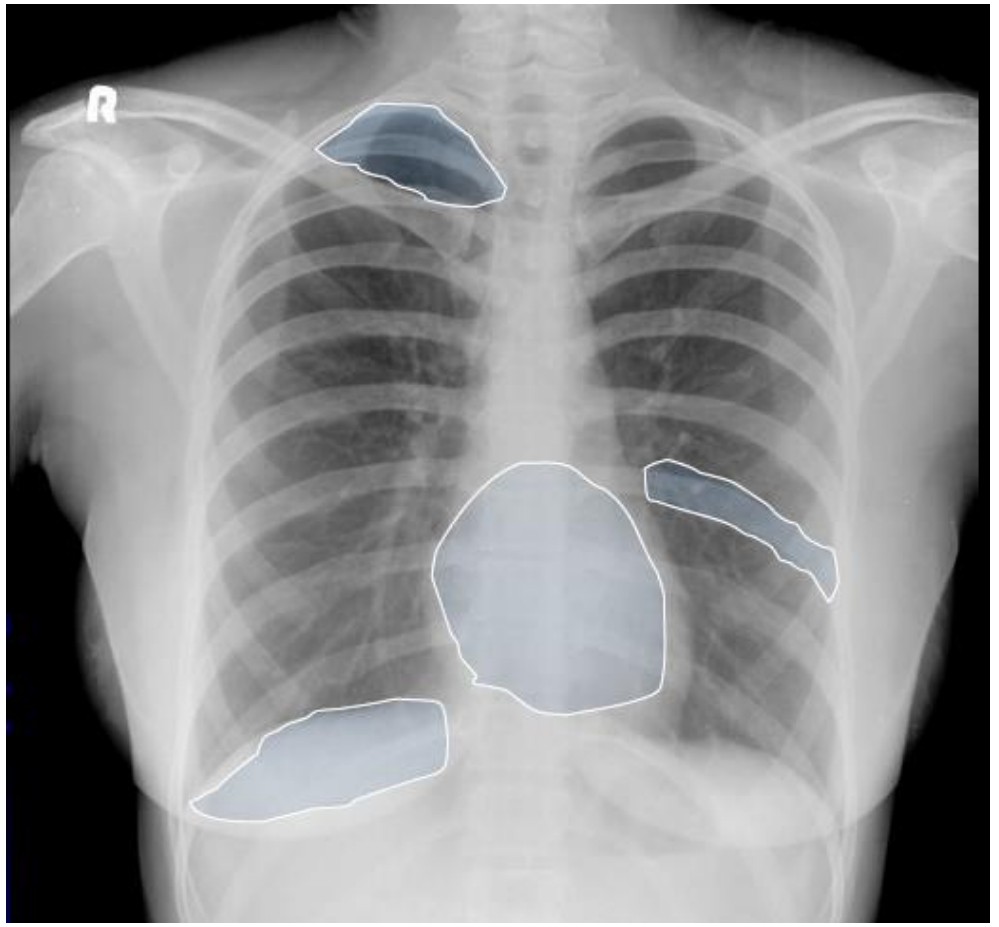
THE APICES

RETROCARDIAC AREA

SUBDIAPHRAGMATIC AREAS

PARTS OBSCURED BY BONES

Caution with nipple shadows, which may mimic intrapulmonary nodules



SUPPORT DEVICES

Endotracheal tube / Tracheostomy tube

Nasogastric tube

Central venous catheter

Pulmonary artery catheter

Cardiac pacemaker

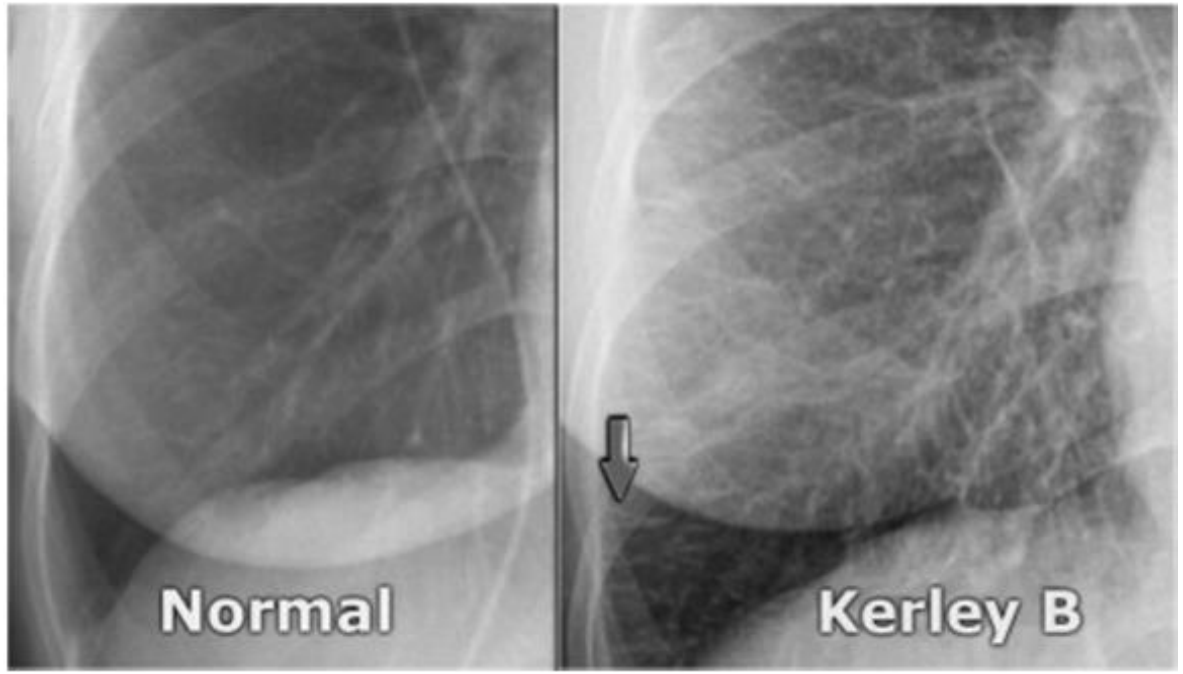
Pleural drainage tubes

Kerley B lines

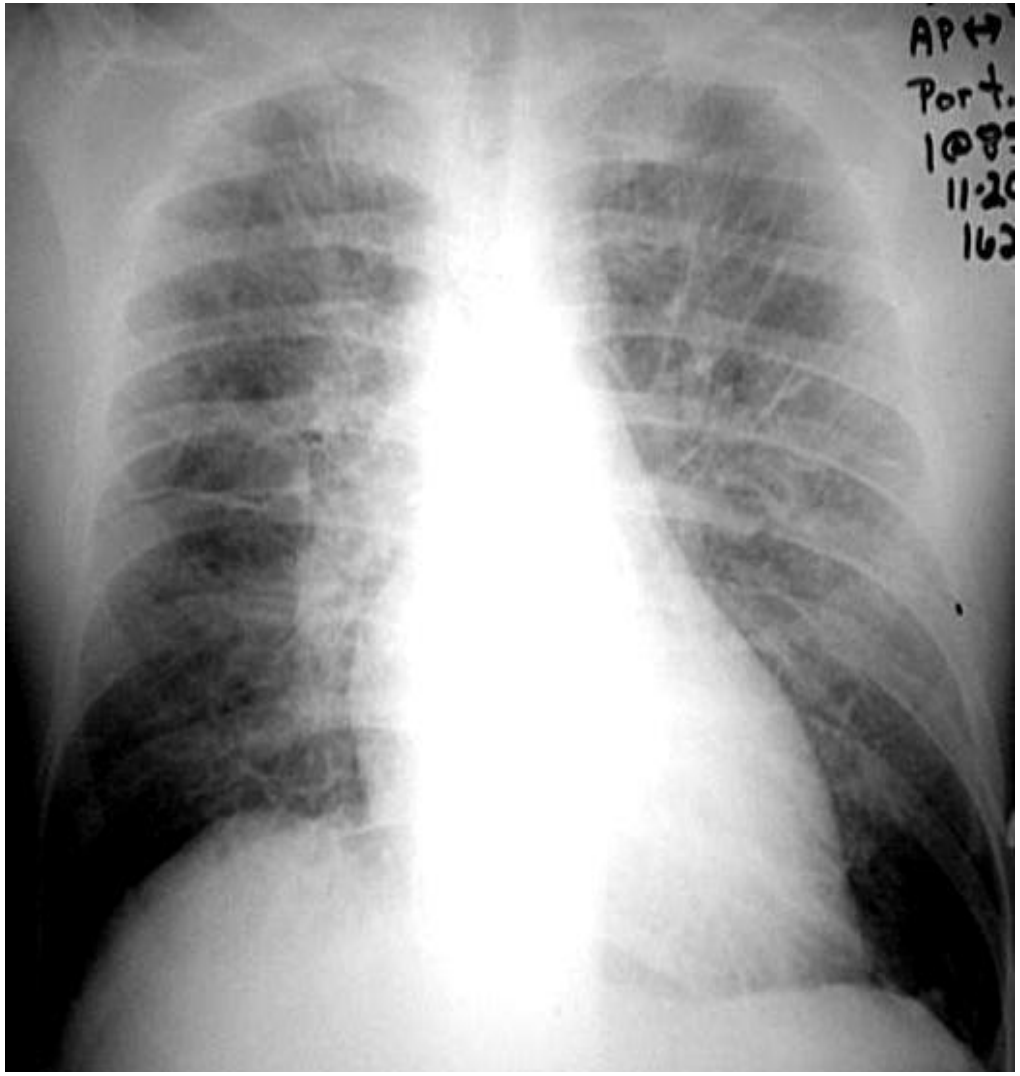
Short 1-2 cm white lines at lung periphery. They are perpendicular to the pleural surface and extend out to it.

Distended interlobular septa - secondary to interstitial edema.

Cardiomyopathy & interstitial pulmonary edema



BRONCHOVASCULAR MARKINGS



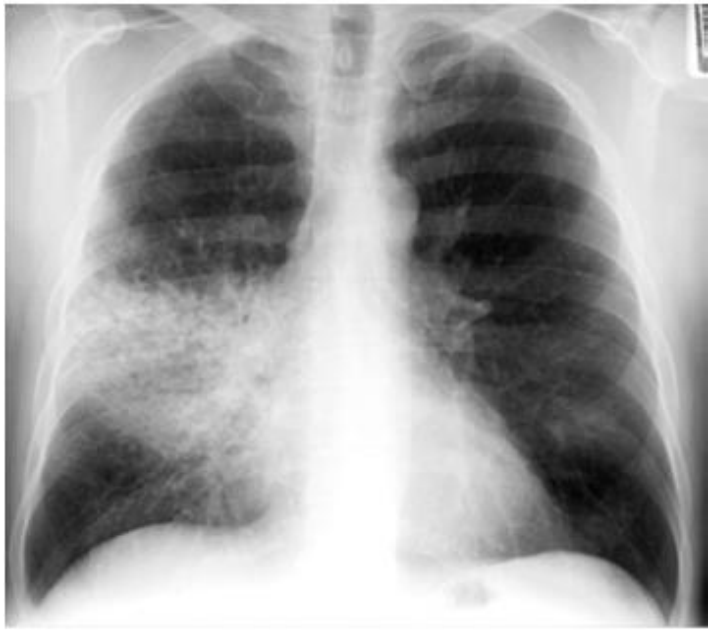
Silhouttes sign

The loss of clarity of a structure, such as the hemidiaphragm or heart border.

It suggests that there is adjacent soft tissue shadowing, such as consolidated lung.

The reason is, that borders, outlines and edges seen on plain radiographs depend on the presence of two adjacent areas of different density.

If two soft tissue densities lie adjacent, then they will not be visible separately.



Collapse (Atelectasis)

A collapse usually occurs due to proximal occlusion of a bronchus, causing subsequently a loss of aeration.

The remaining air is gradually absorbed, and the lung loses volume.

Proximal stenosing bronchogenic carcinoma, mucous plugging, fluid retention in major airways, inhaled foreign body or malposition of an endotracheal tube are the most common reasons for a lung collapse.

Tracheal displacement or mediastinal shift towards the side of the collapse is often seen.

Further findings are elevation of the hemidiaphragm, reduced vessel count on the side of the collapse or herniation of the opposite lung across the midline.

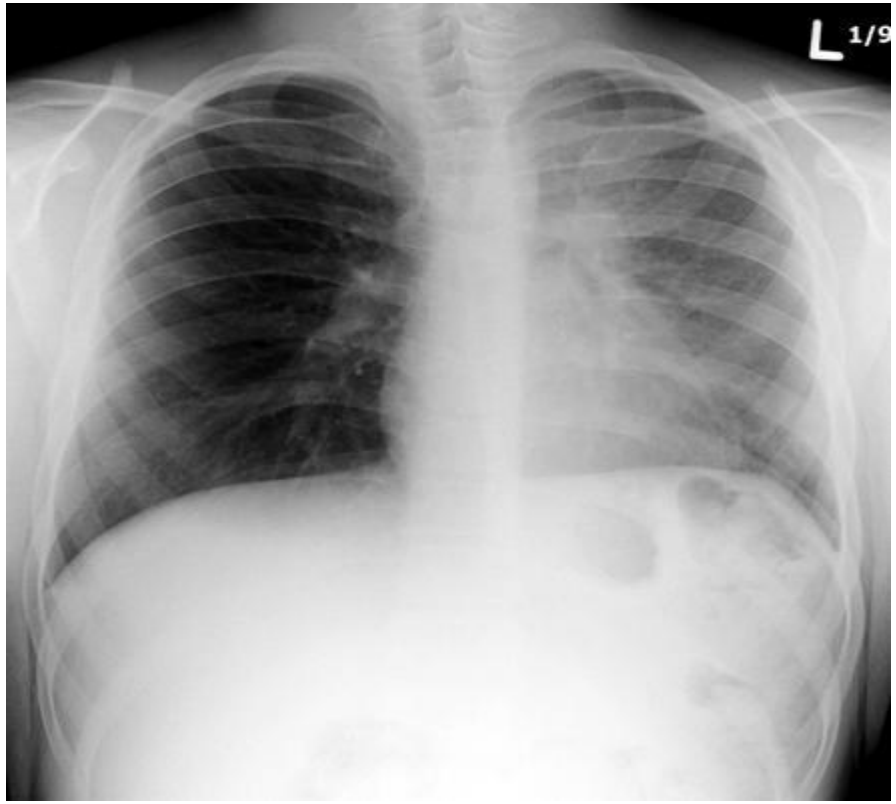
Collapse (Atelectasis)

Lobar signs

- Shift of fissures
- Crowding of vessels and airways
- Increased opacity -Silhouette sign

Extra lobar signs

- Elevation of hemidiaphragm
- Mediastinal shift
- Hilar shift and distortion
- Compensatory hyperinflation
- Ribs are close together
- Tracheal shift



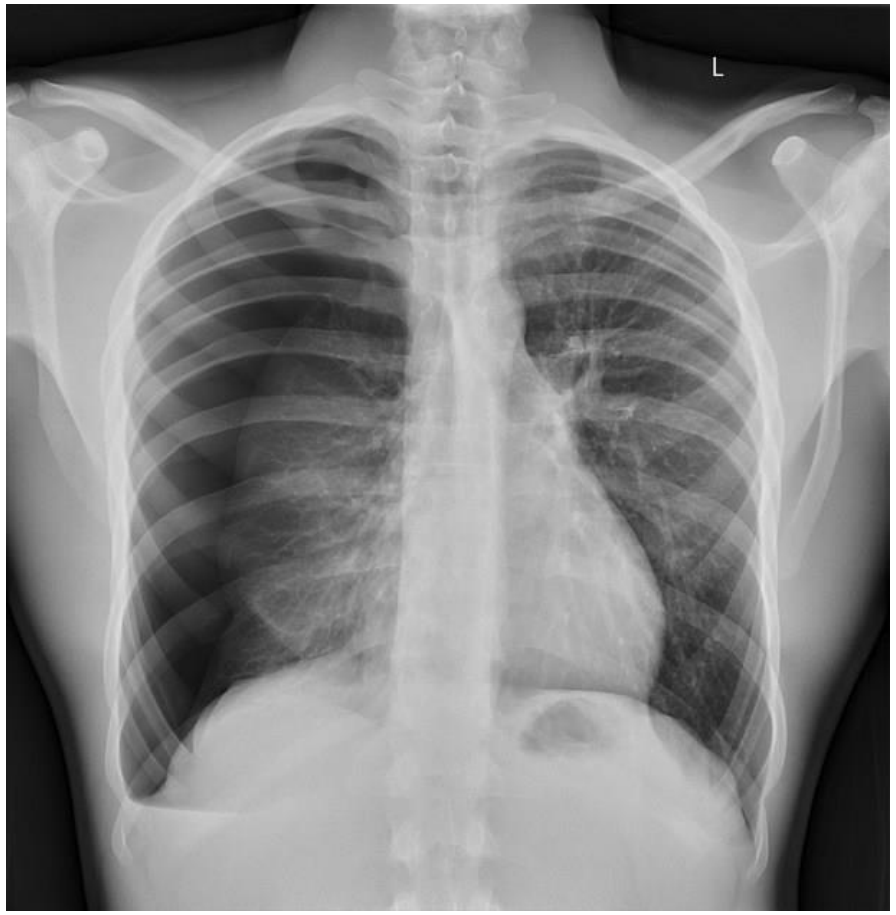
PNEUMOTHORAX

Accumulation of air in the pleural space.

Characterized by:

Jet Black lung field (loss of lung markings)
collapsed lung (deflated)

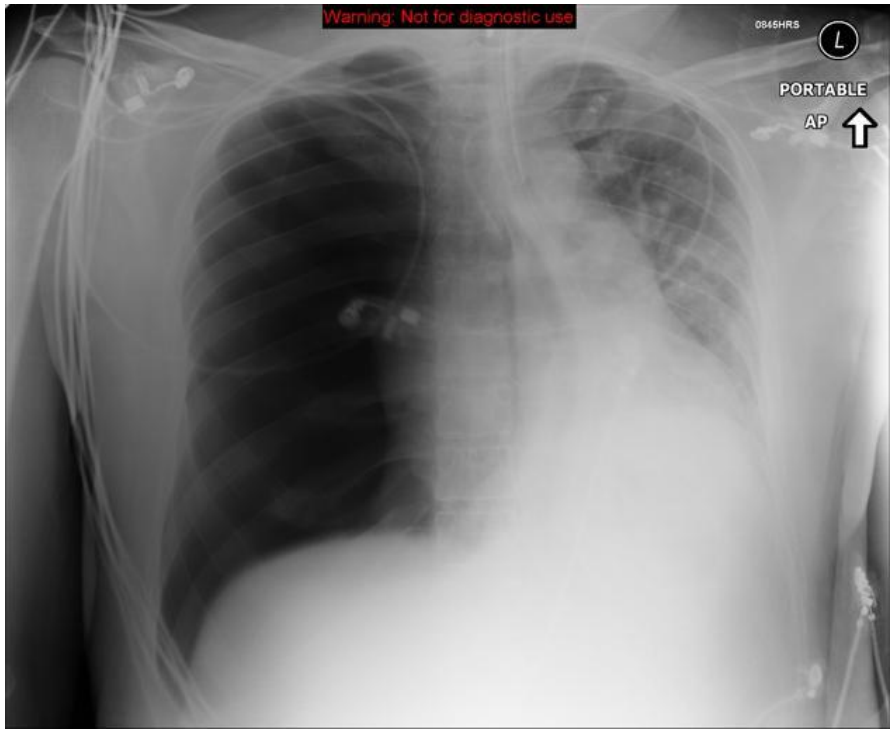
PNEUMOTHORAX



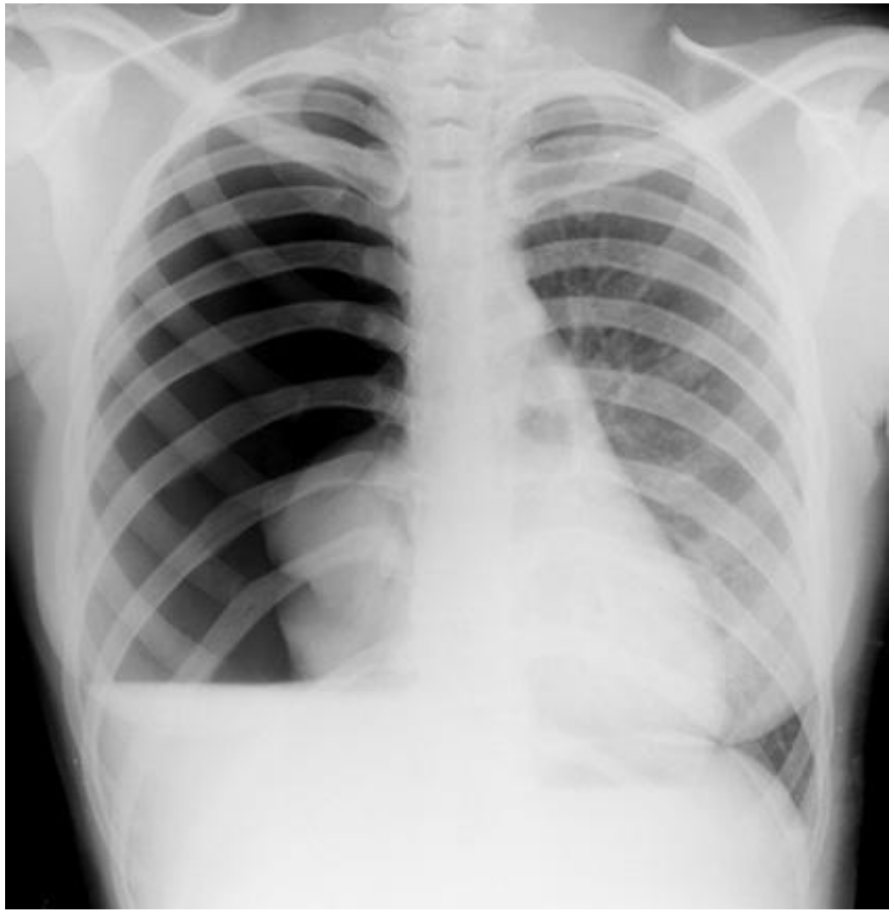
TENSION PNEUMOTHORAX

Tension pneumothorax : Develops air accumulates and compresses the lung, eventually shifting the mediastinum, compressing the contralateral lung, and increasing intrathoracic pressure enough to decrease venous return to the heart, causing shock.

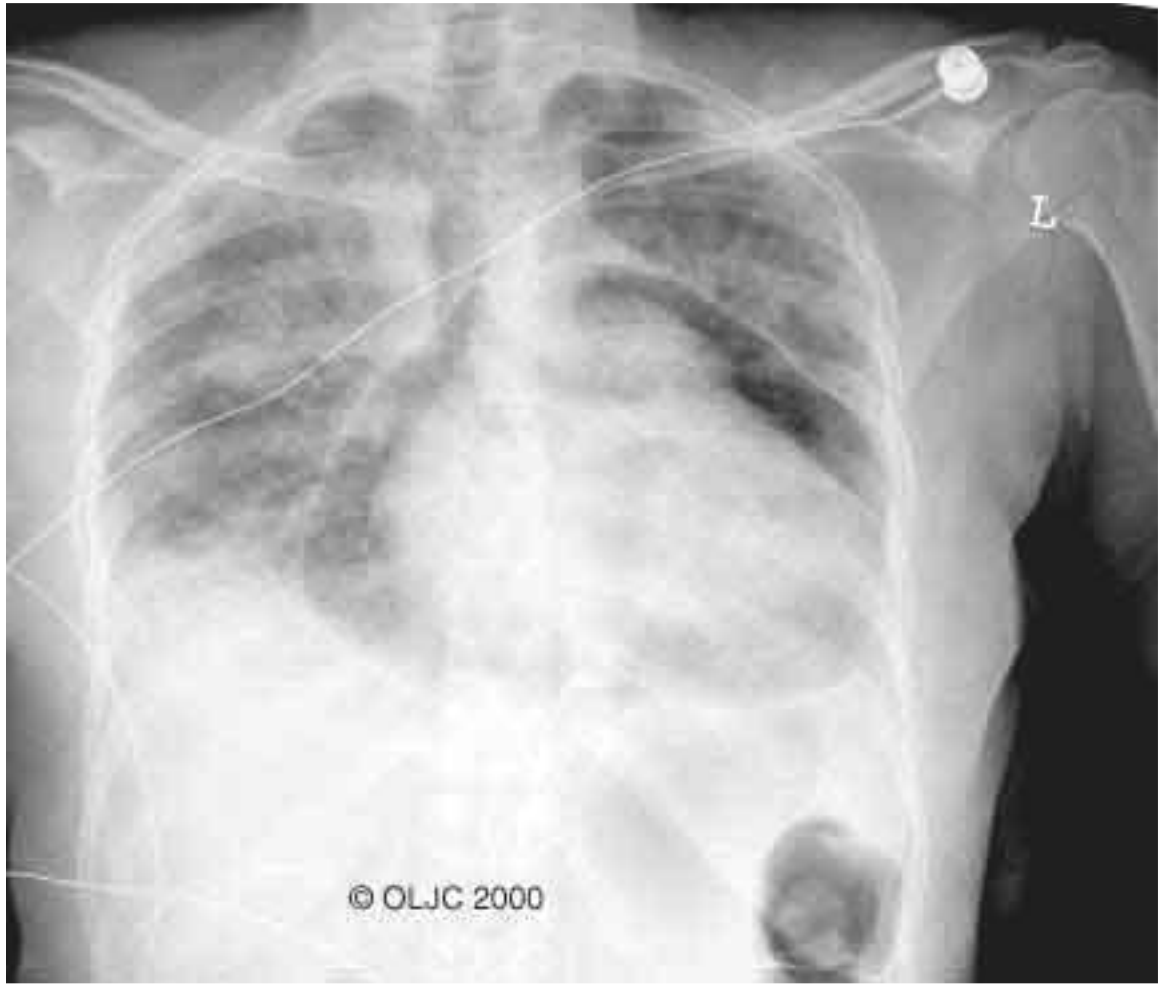
Symptoms and signs :Initially are those of simple pneumothorax.
As intrathoracic pressure increases, patients develop hypotension, tracheal deviation, and neck vein distention.



HYDROPNEUMOTHORAX



PNEUMOPERICARDIUM



Hyperinflated lungs

Commonly presented with COPD patients

Characterized by:

- more darkness of lung
- anterior ribs more than 6
- horizontal anterior ribs
- wide intercostal space
- tubular shape heart
- flat diaphragm

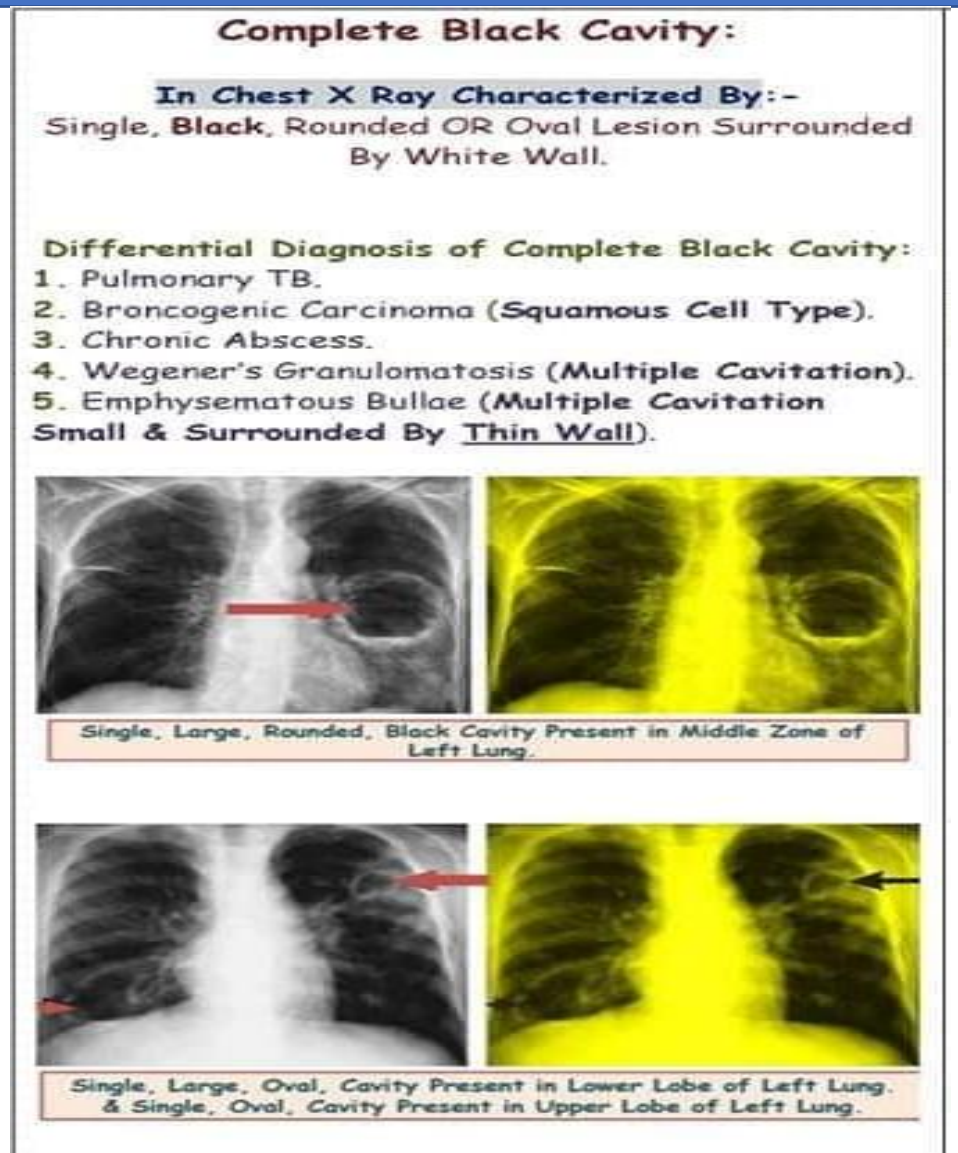
Lung cavity

Complete black cavity:

Single, black, round or oval, surrounded by whit wall

DDx:

1. Pulmonary TB
2. Bronchogenic carcinoma
3. Chronic abscess
4. Wegeners Granulomatosis (multiple)
5. Emphysematous bullae (small and multiple)



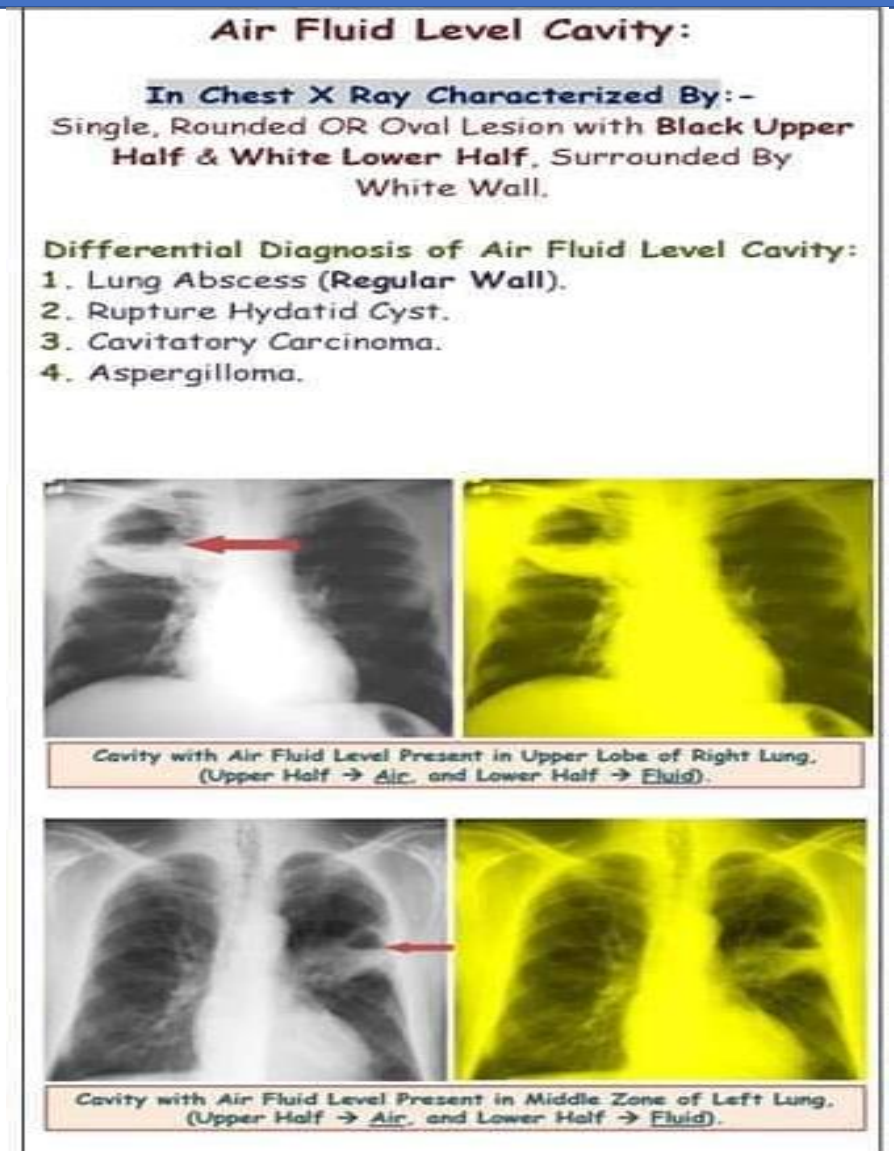
Lung cavity

Air fluid level cavity:

Single, round or oval, black upper half and white lower half, surrounded by white wall

DDx:

1. Abscess
2. ruptured hydatid cyst
3. Cavitatory carcinoma
4. aspergilloma



Air Fluid Level Cavity:

In Chest X Ray Characterized By:-
Single, Rounded OR Oval Lesion with **Black Upper Half & White Lower Half**, Surrounded By White Wall.

Differential Diagnosis of Air Fluid Level Cavity:
1. Lung Abscess (**Regular Wall**).
2. Rupture Hydatid Cyst.
3. Cavitatory Carcinoma.
4. Aspergilloma.

Cavity with Air Fluid Level Present in Upper Lobe of Right Lung. (Upper Half → Air, and Lower Half → Fluid).

Cavity with Air Fluid Level Present in Middle Zone of Left Lung. (Upper Half → Air, and Lower Half → Fluid).

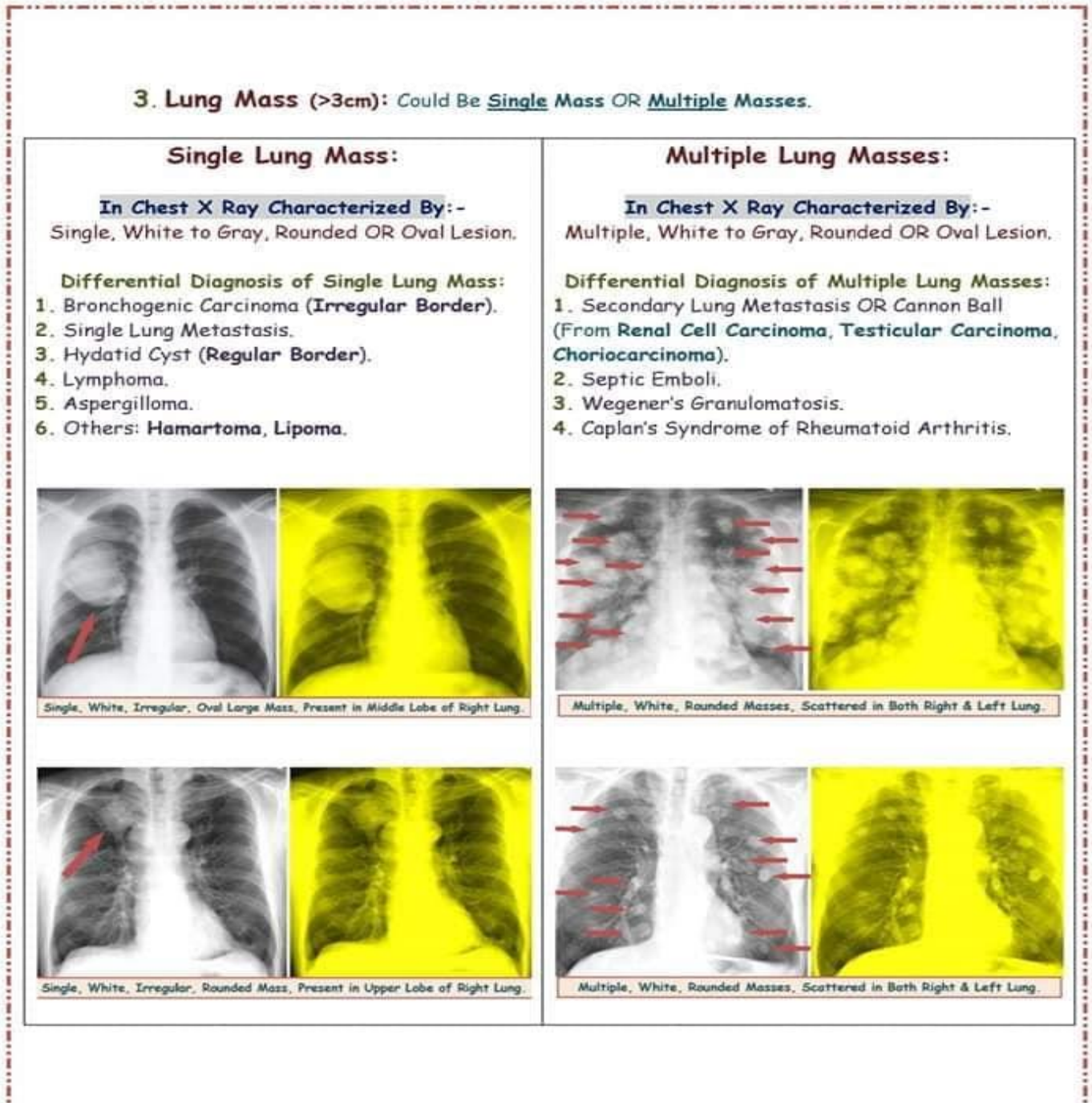
Lung mass

Single lung mass

White to gray, rounded or oval

DDx:

1. Bronchogenic carcinoma (irregular border)
2. Lung metastasis
3. Hydatid cyst
4. Lymphoma
5. Aspergilloma
6. Others: Hamartoma, Lipoma



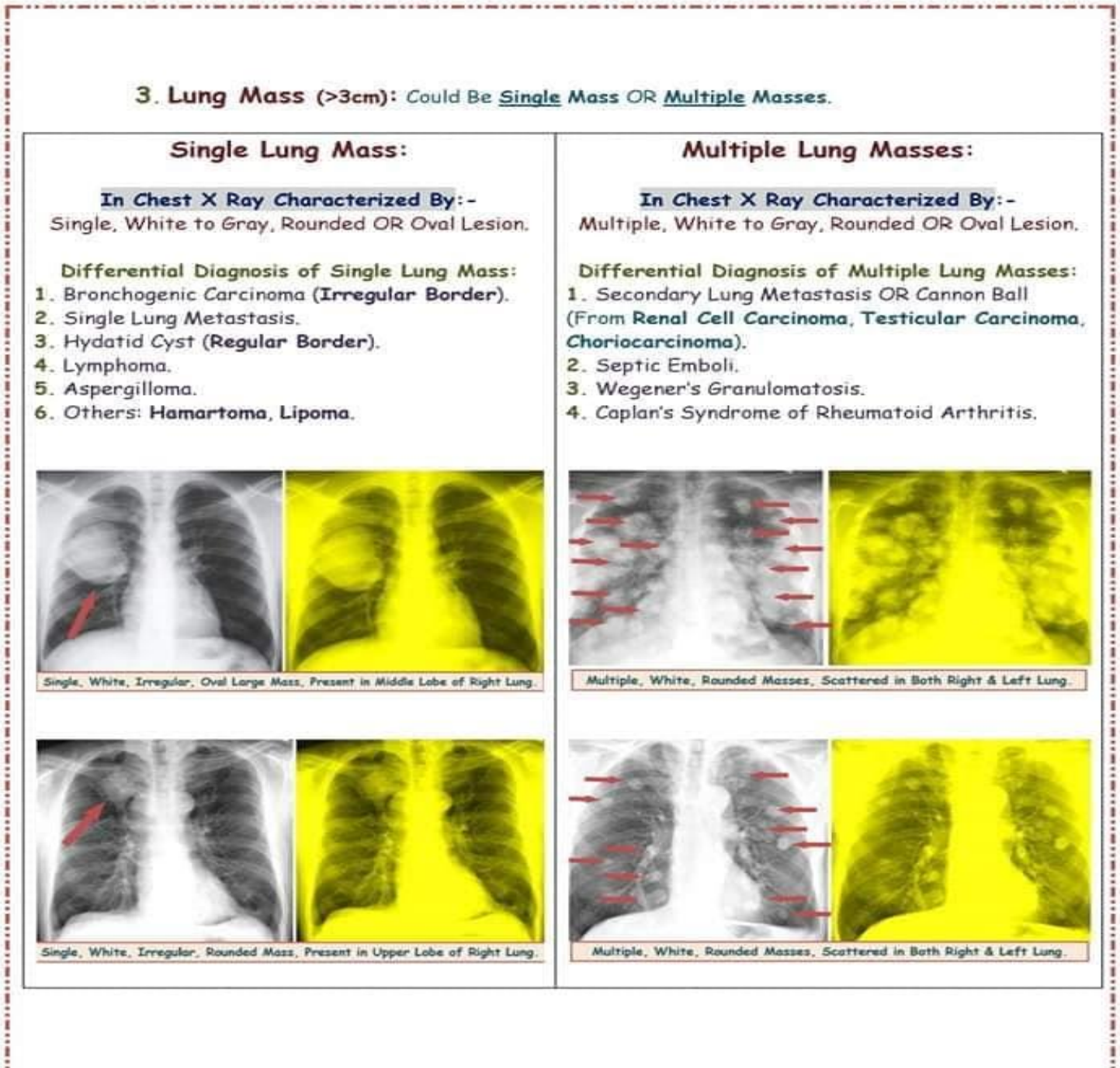
Lung mass

Multiple lung masses

White to gray, round or oval

DDx:

1. Lung metastasis (cannon ball)
2. Septic emboli
3. Wegener's Granulomatosis
4. Rheumatoid nodules



3. Lung Mass (>3cm): Could Be Single Mass OR Multiple Masses.

Single Lung Mass:

In Chest X Ray Characterized By:-
Single, White to Gray, Rounded OR Oval Lesion.

Differential Diagnosis of Single Lung Mass:
1. Bronchogenic Carcinoma (**Irregular Border**).
2. Single Lung Metastasis.
3. Hydatid Cyst (**Regular Border**).
4. Lymphoma.
5. Aspergilloma.
6. Others: **Hamartoma**, **Lipoma**.

Single, White, Irregular, Oval Large Mass, Present in Middle Lobe of Right Lung.

Single, White, Irregular, Rounded Mass, Present in Upper Lobe of Right Lung.

Multiple Lung Masses:

In Chest X Ray Characterized By:-
Multiple, White to Gray, Rounded OR Oval Lesion.

Differential Diagnosis of Multiple Lung Masses:
1. Secondary Lung Metastasis OR Cannon Ball (From **Renal Cell Carcinoma**, **Testicular Carcinoma**, **Choriocarcinoma**).
2. Septic Emboli.
3. Wegener's Granulomatosis.
4. Caplan's Syndrome of Rheumatoid Arthritis.

Multiple, White, Rounded Masses, Scattered in Both Right & Left Lung.

Multiple, White, Rounded Masses, Scattered in Both Right & Left Lung.

Lung nodule

Reticulonodular shadow

Multiple, white to gray, small nodules, infiltration starts from periphery to center of the lung

DDx:

1. IPF (most common >50%)
2. Silicosis (mostly apical)
3. Aspestosis (mostly basal)
4. Sarcoidosis
5. Connective tissue disease (RA or SLE)

4. Reticulo-Nodular Shadow (Lung Nodules <3cm):

Indicate **Pulmonary Fibrosis.**

In Chest X Ray Characterized By:-

Multiple, White to Gray, Small, Nodules with Reticular Infiltration Starting From **Periphery** Up to **Center** of the Lung.

Differential Diagnosis of Reticulo-Nodular Shadow:

1. Idiopathic Pulmonary Fibrosis (**IPF**) →Most Common **50%** (**Basal Lung Fibrosis**).
2. Silicosis (**Apical Lung Fibrosis**).
3. Asbestosis (**Basal Lung Fibrosis**).
4. Sarcoidosis.
5. Connective Tissue Diseases (**Rheumatoid Arthritis, SLE**).

Multiple, Bilateral, White, Small, Nodules with Reticular Infiltration of Both Lungs.

Multiple, Bilateral, White, Small, Nodules with Reticular Infiltration of Both Lungs.

Widening of mediastinum

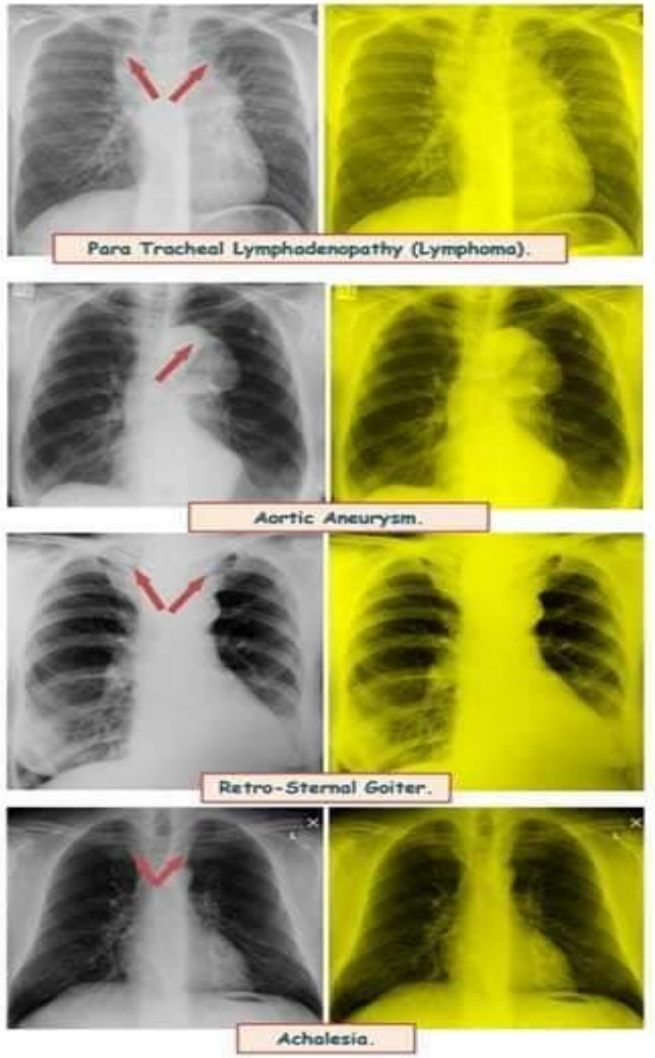
DDx:

1. Paratracheal lymphadenopathy (TB, Lymphoma or CA)
2. Aortic aneurysm
3. Achalasia
4. Retrosternal Goiter
5. thymoma

2. Widening of Mediastinum:

Differential Diagnosis of Wide Mediastinum:

1. Para Tracheal Lymphadenopathy (Due to: Pulmonary TB, Lymphoma, CA Lung).
2. Aortic Aneurysm.
3. Retro-Sternal Goiter.
4. Achalesia.
5. Thymoma.



Large Hilum

Normally lies between 2nd – 4th rib
Contains: LN, Bronchus and Blood Vessels

DDx:

1. Lymphoma
2. Sarcoidosis
3. Bronchogenic carcinoma
4. Pulmonary TB
5. Mycoplasma Pneumonia

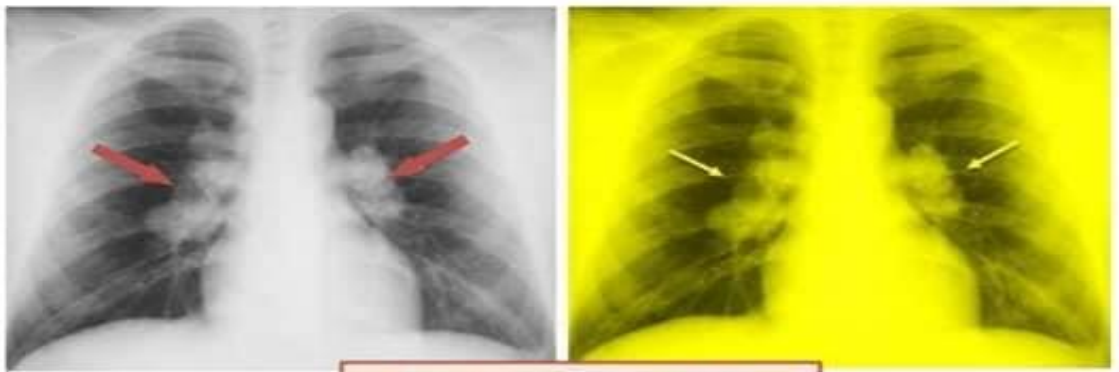
❖ Abnormalities of Hilum:

1. Enlargement of Hilar Shadow:

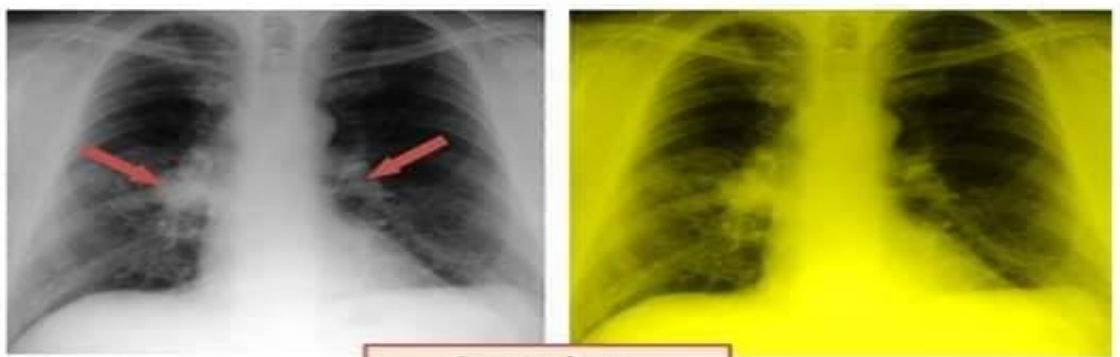
Normally the Hilum Lies Between 2nd & 4th Rib,
It Contains: Lymph Nodes, Bronchus, and Blood Vessels.

Differential Diagnosis of Enlarged Hilar Shadow:

1. Pulmonary Sarcoidosis.
2. Lymphoma.
3. Cancer Lung (Bronchogenic Carcinoma).
4. Pulmonary TB.
5. Mycoplasma Pneumonia.



Pulmonary Sarcoidosis.



Cancer Lung.

Cardiac Shadow

Flask shape heart

Indicate Pericardial Effusion

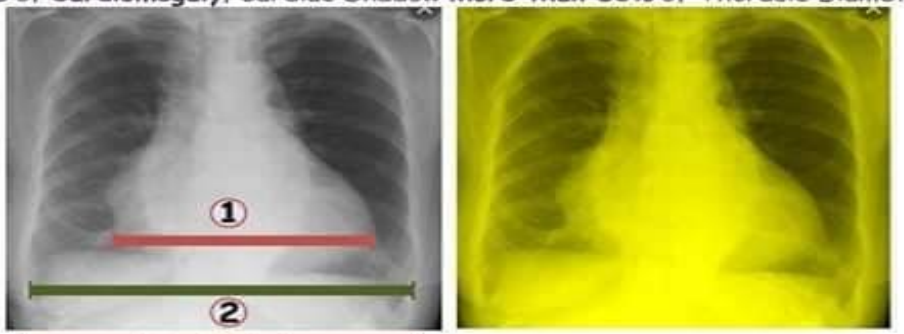
Tubular shape heart

Indicate COPD

❖ Abnormalities of Cardiac Shadow:

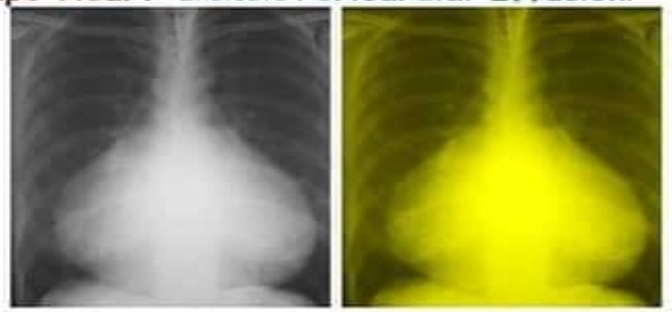
1. **Cardiomegaly:** Measured From **P-A View** Chest X Ray.
Cardiomegaly Detected in Chest X Ray By **Cardio-Thoracic Ratio**.

Cardio-Thoracic Ratio → Cardiac Shadow Less than 50% of Thoracic Diameter.
In Case of **Cardiomegaly**: Cardiac Shadow **More than 50%** of Thoracic Diameter.

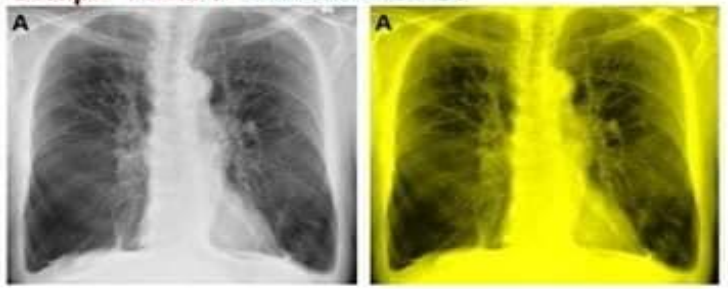


1. Cardiac Shadow.
2. Thoracic Diameter.

2. **Flask Shape Heart:** Indicate **Pericardial Effusion**.



3. **Tubular Shape Heart:** Indicate **COPD**.



Abnormalities in Diaphragm

Elevation of diaphragm dome

DDx:

1. Phrenic nerve palsy
2. Lung collapse
3. Pneumonectomy or lower lobectomy
4. Hepatomegally or Spleenomegally

Air under diaphragm

DDx:

1. Perforated viscus
2. Post operative

❖ Abnormalities of Diaphragm:

1. Elevation of Diaphragm Dome: Indicate → Phrenic Nerve Palsy, Lung Collapse, Pneumonectomy OR Lower Lobectomy, Hepatomegaly, Splenomegaly.

Elevated Right Dome of Diaphragm.

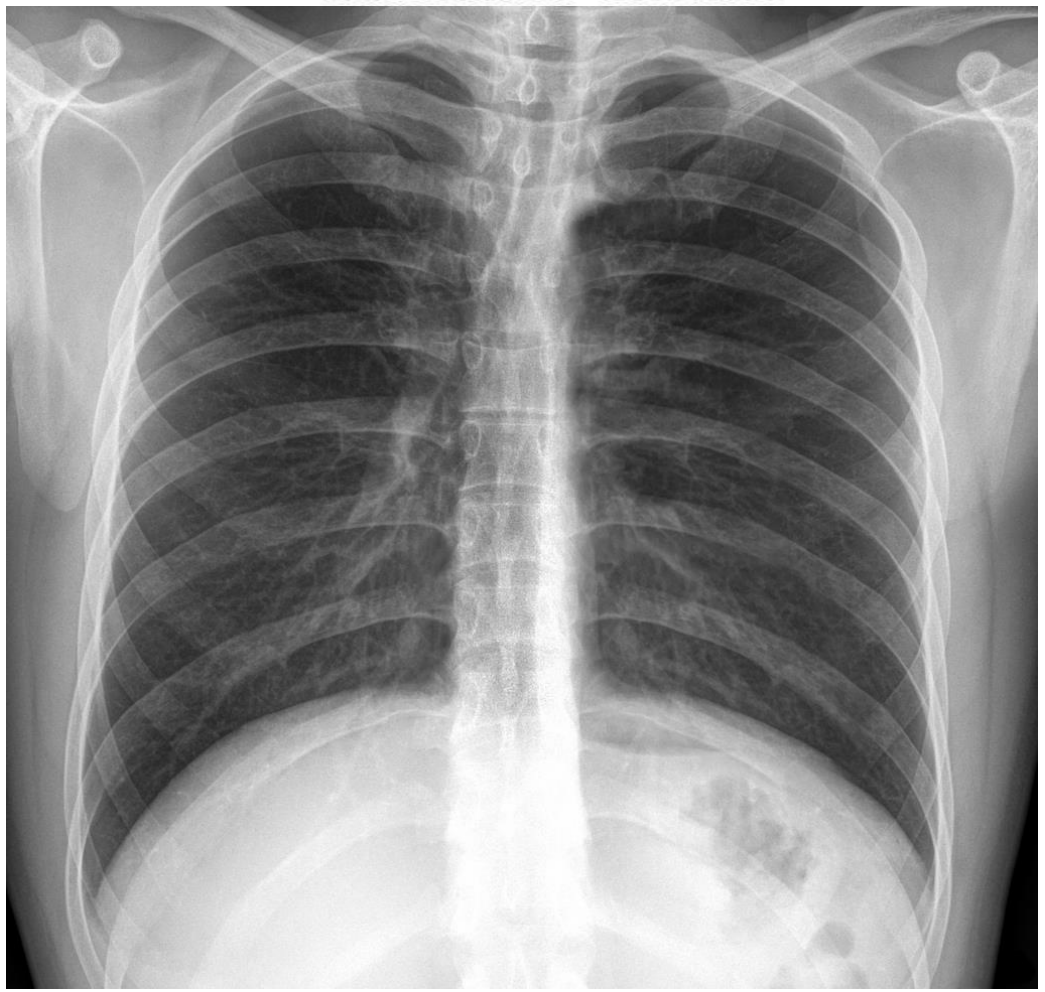
2. Air Under Diaphragm: Indicate → Perforated Viscous (Ex → Perforated Peptic Ulcer).

Air Under Diaphragm.

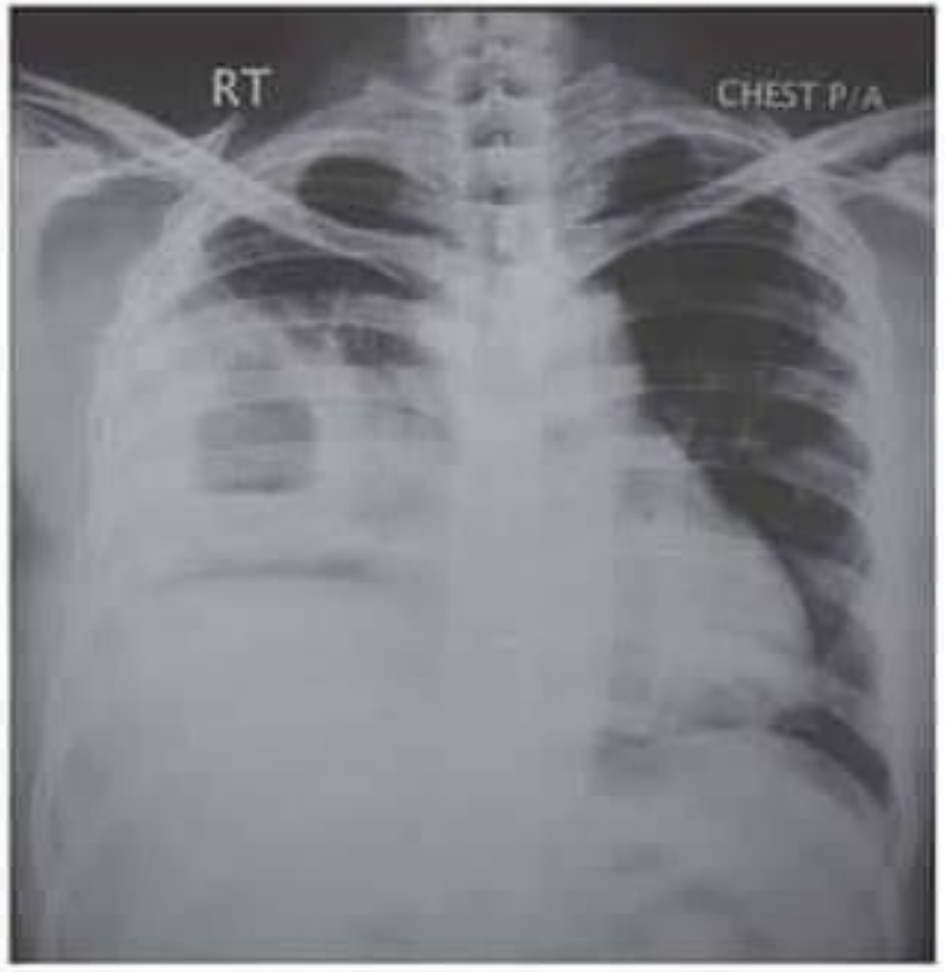
❖❖❖❖❖❖❖❖❖❖❖

Differential Diagnosis of Homogenous Opacity of the Lung:	Differential Diagnosis of Hometrogenous Opacity of the Lung:
1. Pleural Effusion. 2. Lung Collpase. 3. Lobar Pneumonia.	1. Interstitial Lung Disease. 2. Pulmonary Edema. 3. Broncho Pneumonia

Quizz!

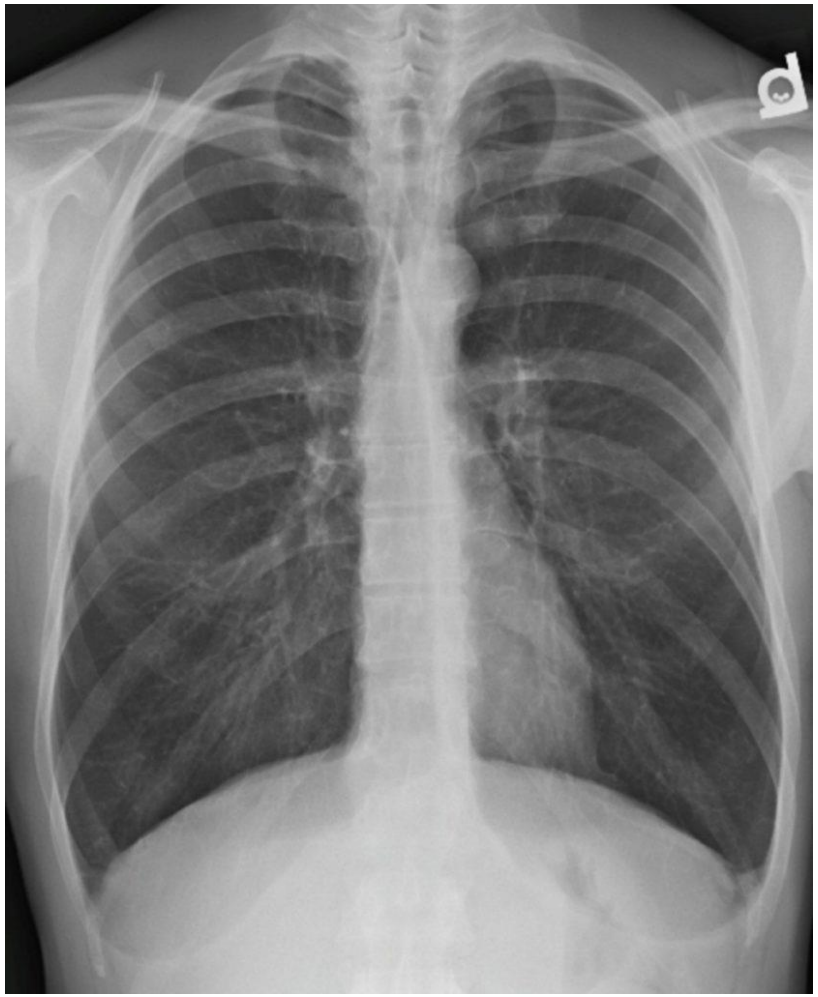


LUNG ABSCESS: ring shaped cavity with air-fluid level in the right middle zone.

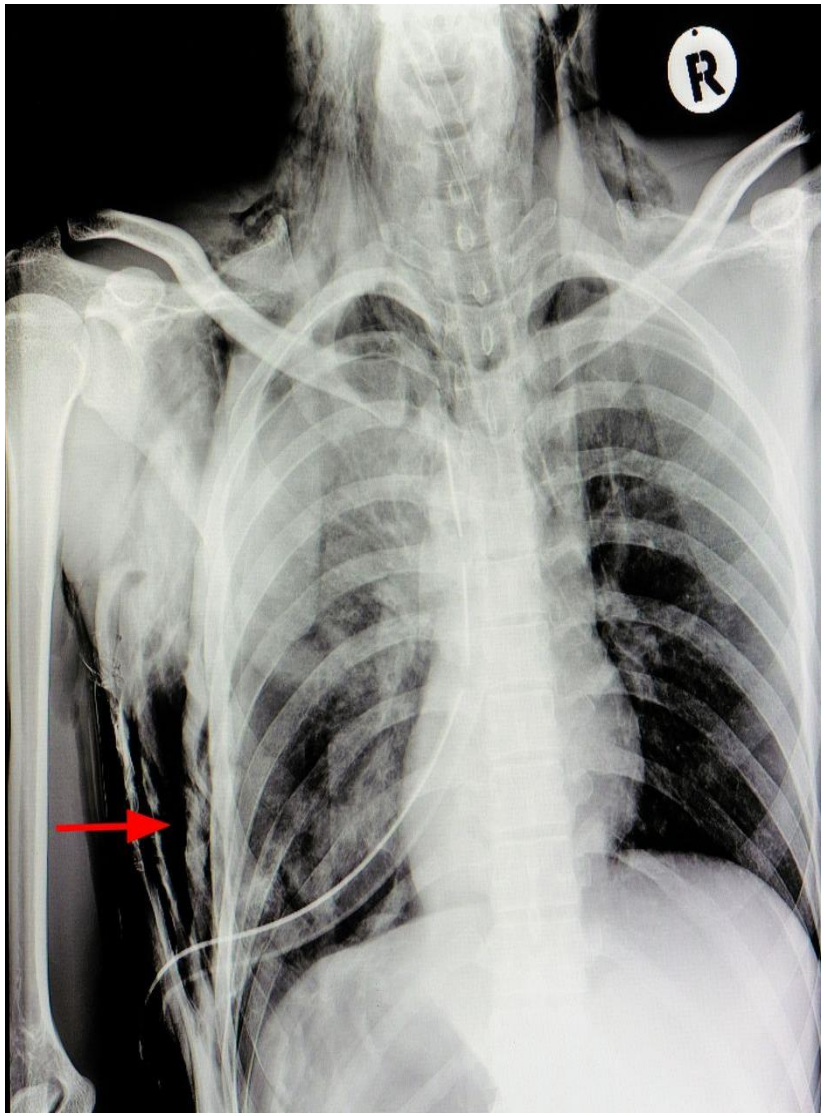


MILIARY TB: multiple military mottling involving all zones of both lung fields.

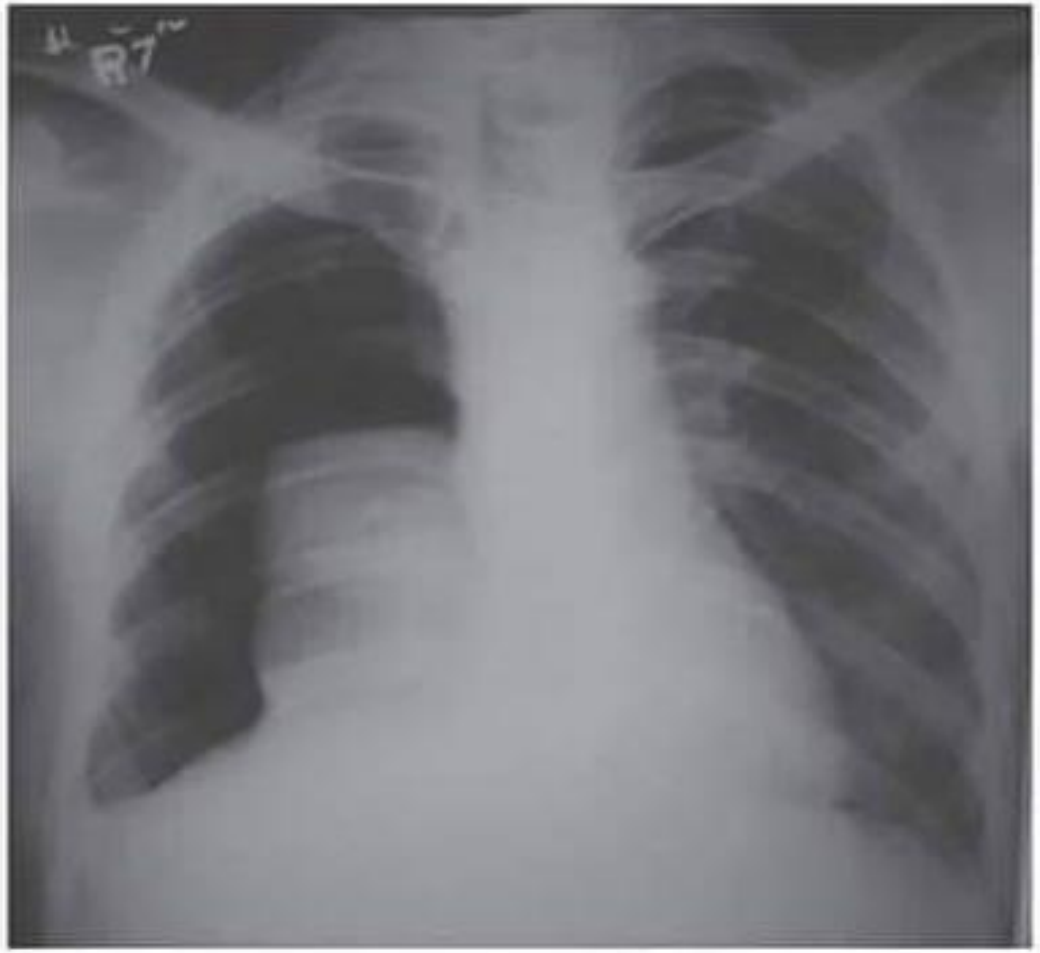
EMPHYSEMA: lung fields are hypertranslucent with flat diaphragm, the heart is elongated and ribs are widely separated.



SURGICAL EMPHYSEMA: increased translucency with collapsed lung margins on rt. Side with multiple translucent shadows in the soft tissues on both sides. Intrathoracic tubes seen on both sides.



PNEUMOTHORAX: hypertranslucent area without bronchovascular markings with collapsed lung margins on right side.



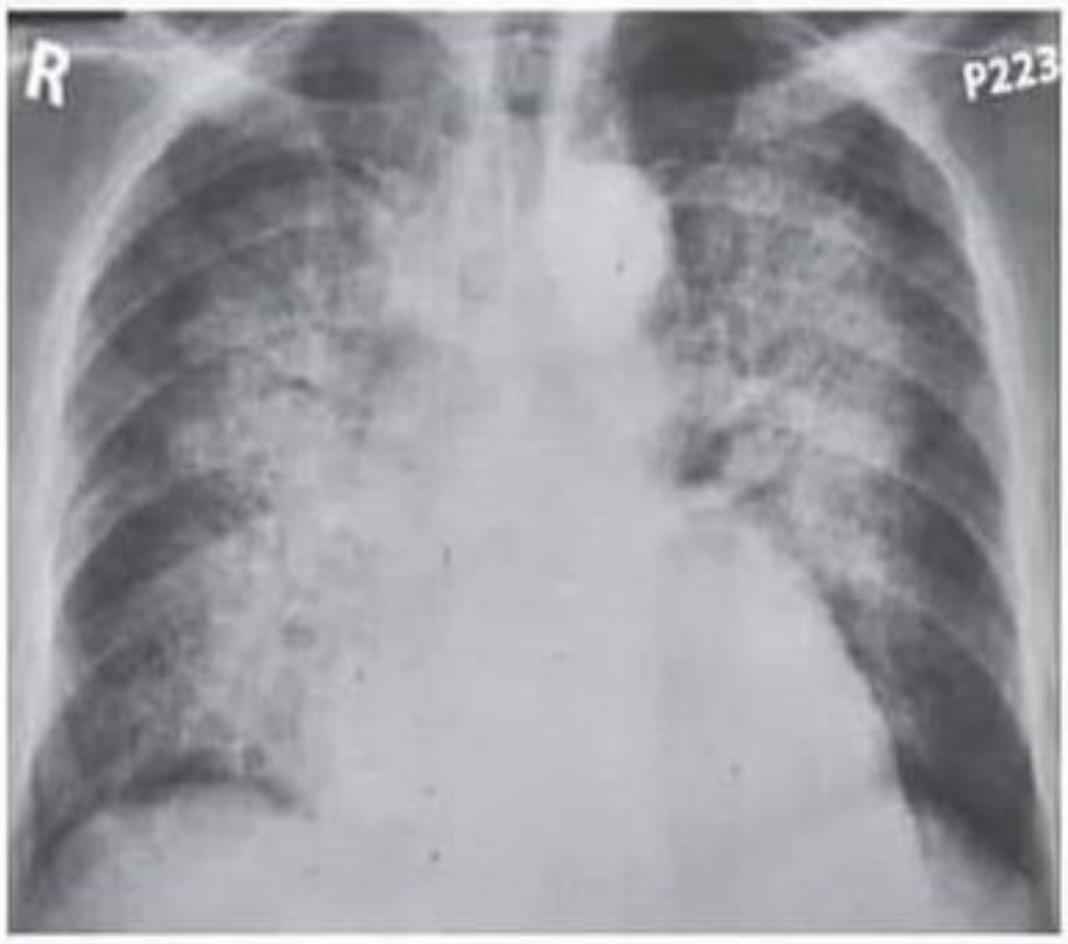
MITRAL STENOSIS: fullness of the pulmonary conus with flattening of the left border of the heart.

HYDROPNEUMOTHORAX: increased translucency with collapsed lung margins on the right side with a horizontal fluid level obliterating the right costophrenic and cardiophrenic angles.

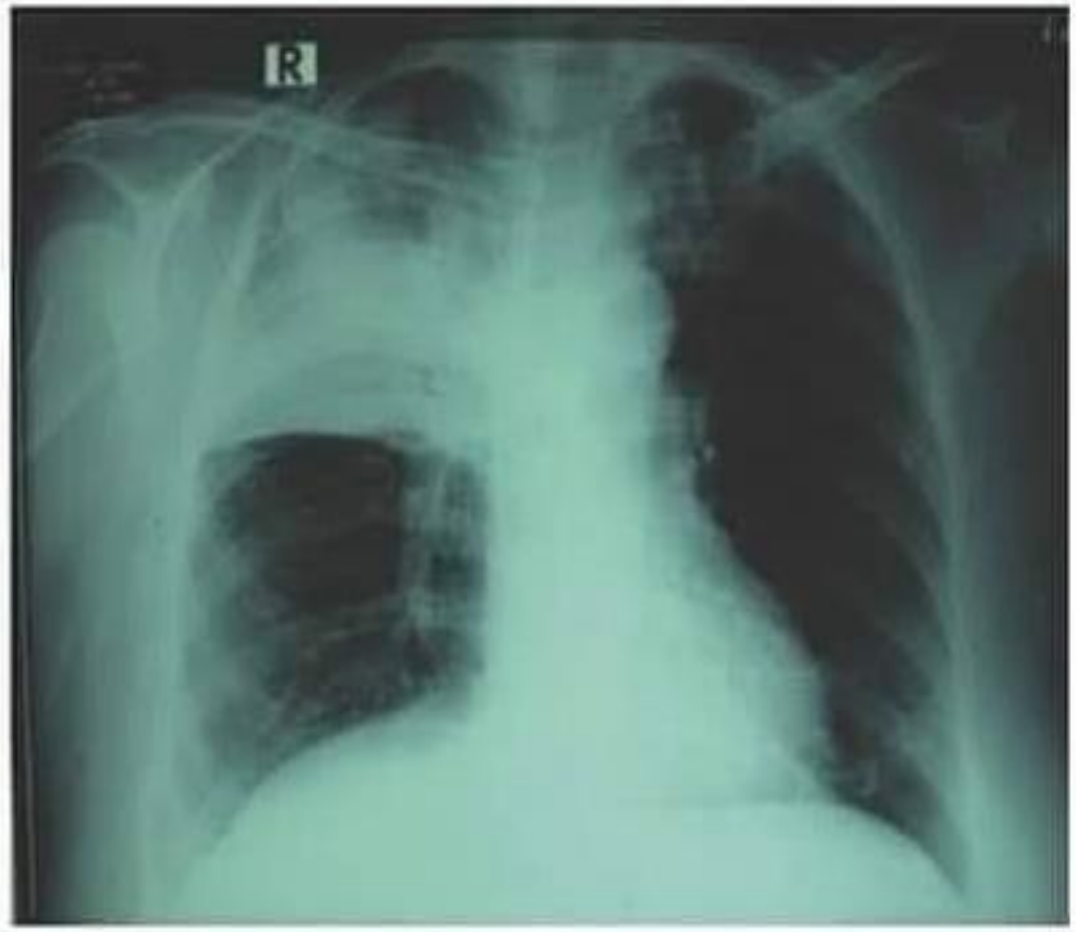
GAS UNDER DIAPHRAGM: gas under Rt. Dome of the diaphragm.

PERICARDIAL EFFUSION: hart enlarged in transverse diameter, globular shape with clear margins.

PULMONARY EDEMA: fluffy opacities spreading from both hilar regions showing a butterfly or bat's wing appearance with enlarged heart.



CONSOLIDATION: dence homogeneous opacity involving the Rt. Middle and upper zones with vesible airbronchogram.




Thank You!