

CHEST IMAGING

DR. Jehad Fataftah •
Consultant Interventional
Radiologist
PRINCE HAMZAH HOSPITAL •

CHEST IMAGING

- Chest imaging remains major component of diagnostic radiology.
- The chest x-ray is the most commonly performed **diagnostic x-ray examination.**
- A chest x-ray makes images of the heart, lungs, airways, blood vessels and the bones of the spine and chest.

Anatomy of the lungs

The Right lung is larger than the left, because most of the heart encroaches on the left lung.

❑ The right lung has three lobes:

- upper lobe
- Middle lobe
- Lower lobe

❑ The left lung has two lobes:

- upper lobe
- lower lobe

Anatomy of the lungs / 2

Adjacent lobes are separated by an interlobar fissure.

In the right lung:

- ❑ The minor (**transverse**) fissure separates the upper lobe from the middle lobe.
- ❑ The major (**oblique**) fissure separates the upper and middle lobes from the lower lobe.

In the left lung:

- ❖ The **major or oblique fissure** separates the upper lobe from the lower lobe.

In the Right Lung, there are:

- 1- Minor (Transverse) Fissure
- 2- Major (Oblique) Fissure
- 3- Azygus Fissure: around the Azygus vein at the Apex of the right Lung
- 4- Superior Accessory Fissure: in the right lower lobe, separating the Superior (Apical) segment from the four basal Segments

All Fissures consist of two layers (parietal & Visceral) Except the Azygus Fissure which consists of four layers (2 parietal & 2 visceral)

Segmental anatomy

Segments of the right lung

Upper lobe segments:

- Apical segment
- Anterior segment
- Posterior segment

Middle lobe segments

- Lateral segment
- Medial segment

Segmental anatomy / 2

Right lower lobe segments:

- Superior segment
- Medial basal
- Anterior basal
- Lateral basal
- Posterior basal

Segmental anatomy / 3

Left lung segments:

Upper lobe

- Apical posterior segment
- Anterior segment
- Superior lingular segment
- Inferior lingular segment

The lingular segment in the left lung is similar in position to the right middle lobe.

Segmental anatomy / 4

Left lower lobe segments:

- Superior segment
- Medial basal
- Anterior basal
- Lateral basal
- Posterior basal

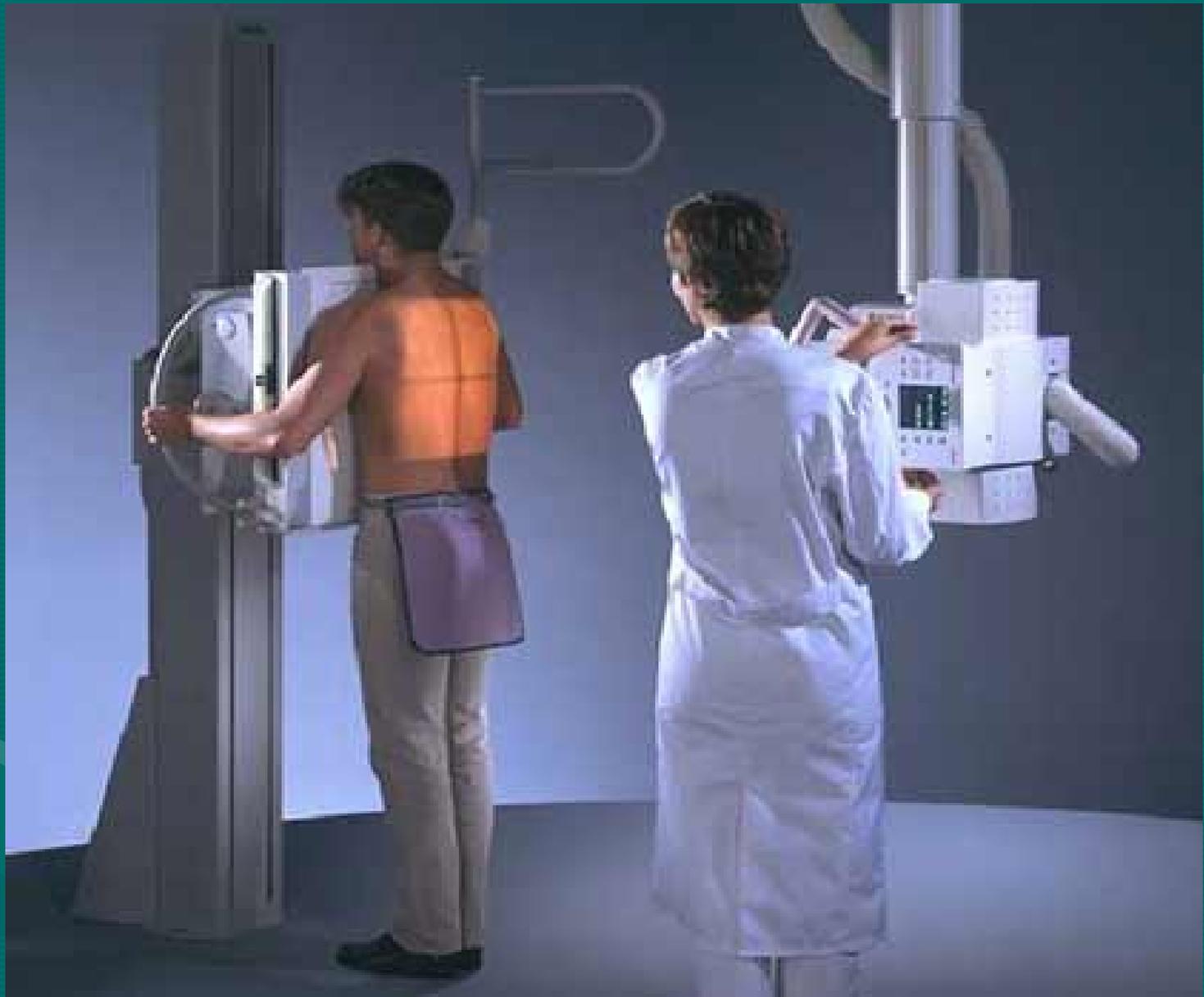
Routine plain chest radiography:

❖ Postero-anterior view (PA)

❖ Lateral view.

Sometimes Lateral view is required and it can be:
1- Left Lateral: the left side of the Pt close to the cassette
2- Right Lateral the right side of the Pt close to the cassette

□ The term PA refers to the direction of the x-ray beam which traverses the patient from posterior to anterior.



PA chest radiography is preferred to AP, why ?

Most of the time, CXR is taken PA in which the Pt is standing with the Xray cassette (film) in front of him, and the Pt is holding the cassette so that :

- 1- the heart is close to the cassette >>>The heart is normal in size
- 2- Clavicles go down below Apex
- 3- Scapulae pushed away from the lung fields

- ⊙ Less magnification of the heart.
- ⊙ More lung fields are visualized.
- ⊙ The PA projects the scapula away from the lung fields.
- ⊙ The apices of the lungs are closer to the film in the PA and appear more clear.

Other plain chest radiography:

➤ Antero–posterior view (AP)

- ★ very ill patients who are unable to stand.
- ★ infants and small children.

➤ Inspiration–expiration films

- ★ suspected bronchial foreign body aspiration.
- ★ suspected small pneumothorax.

Routinely, CXR should be done while the Pt is in deep inspiration. But sometimes expiratory films are required as in cases of suspected bronchial foreign body aspiration and suspected small pneumothorax.

Before reading the x-ray film, the following should be checked:

1. Request form

- name, age, sex and date
- clinical information.

Any CXR image without name, date, or markers should not be reported

In any CXR, you should check centering, degree of inspiration and exposure. If one of them is disrupted for example if the Pt is rotated (not centralized properly) you may ask to repeat the image with the Pt centralized, however you can interpret and report the image without repeating it to avoid exposing the Pt to radiation.

2. Technical factors:

- markers. `right/left`
- centering (patient position).
- degree of inspiration.
- exposure (penetration). `bones need lower exposure`

1- Centering: to ensure that the Pt is centralized, look at the spinous processes & trachea, they should be central in the midline and equidistant to both medial ends of clavicles

3- Exposure:

look at the retrocardiac disc spaces, they should be JUST VISIBLE

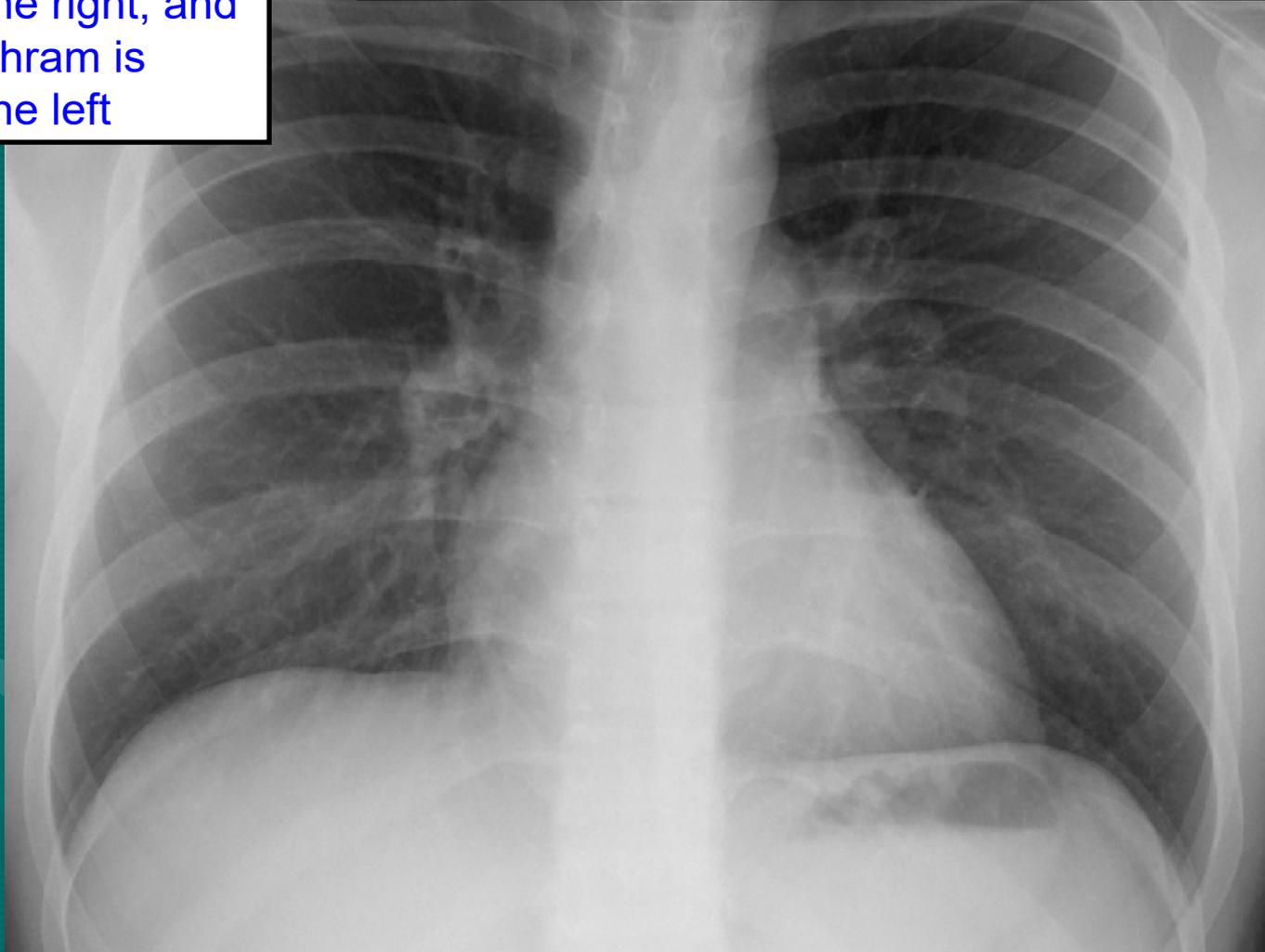
* if the retrocardiac disc spaces are very clear + Lungs are dark black = Overexposure

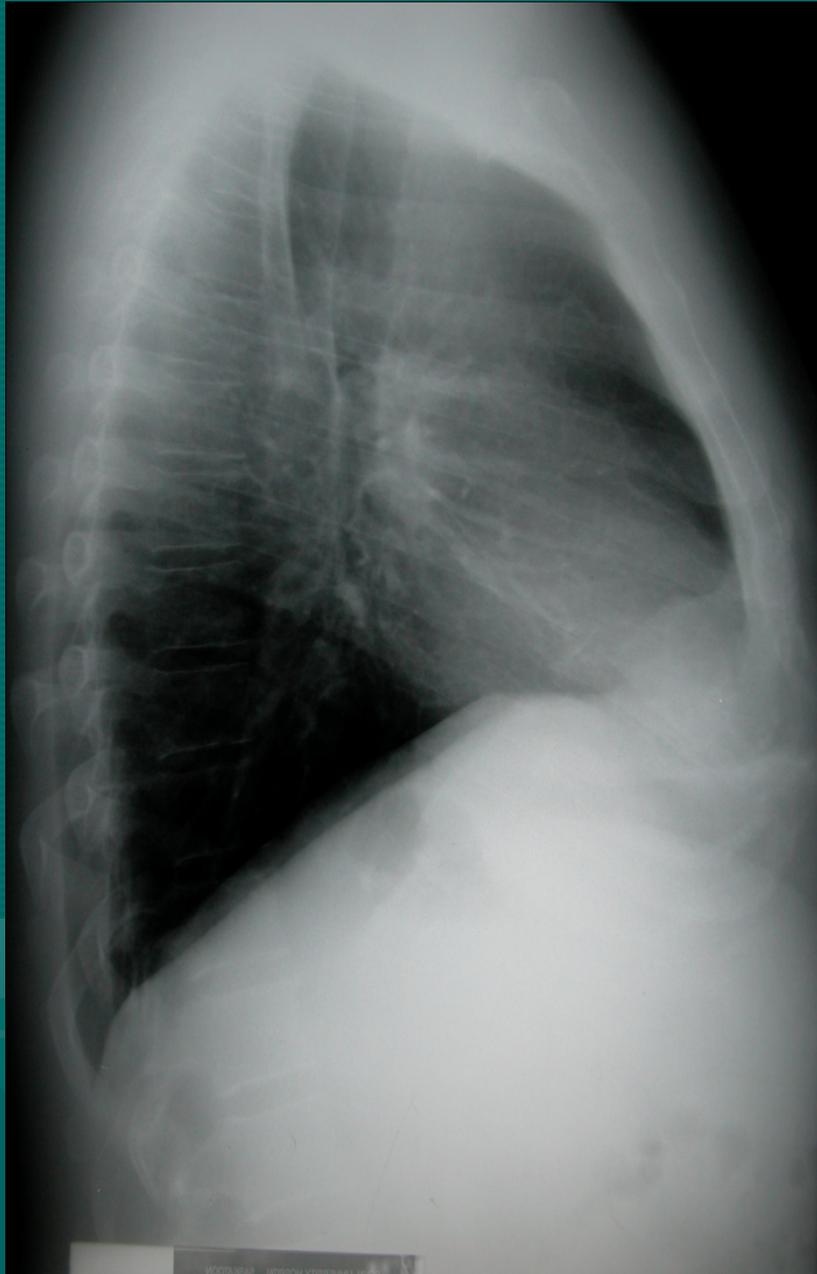
* if the retrocardiac disc spaces are not visible + Lungs are bright white = Underexposure

at any X-RAY, we look for
heart size
costophrenic angle
bones (fracture..)
normally: the left hemidiaphragm is
higher than the right, and
the right diaphragm is
higher than the left

2- Degree of Inspiration:

- * There should be 6 ribs anteriorly with the 6th one crossing the Diaphragm
 - * the heart is normal in size in inspiratory films & enlarged in expiratory films
- How can we judge whether the heart is normal in size or enlarged?
By calculating the Cardiothoracic Ratio; Normally, the widest diameter of the heart should be 50% or less the widest diameter of the chest in adults and 60% or less the widest diameter of the chest in children





PNEUMONIA

- Is an inflammation of the lung, which can be caused by a variety of micro-organisms, including bacterias, viruses, and fungi.
- **Lobar pneumonia:** inflammation confined to a lobe of the lung.
- **Bronchopneumonia:** refers to bilateral multifocal areas of consolidation.

1- Lobar Pneumonia: may affect one or more segment , one or more lobe or the entire lung
2- Bronchopneumonia: usually in the hilar region, unilateral or bilateral

Pneumonia can be classified into:

- ❖ **Primary pneumonia** : arising in a normal lung.
- ❖ **Secondary pneumonia**
result of a disease or abnormality already present in the lung.

Pneumonia can be primary or secondary,
example: Lymphoma >>> LN enlargement >>> compression >>> secondary pneumonia

Pneumonia / 2

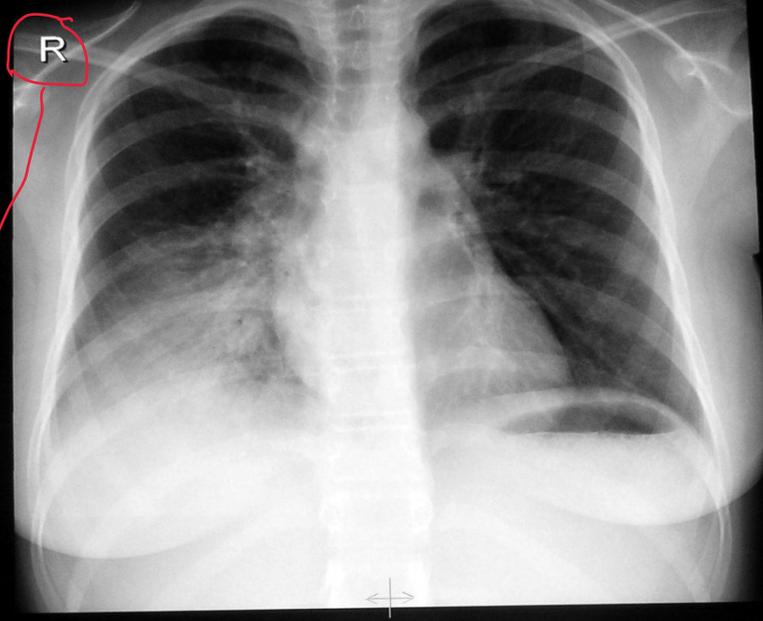
- ❖ With treatment most types of bacterial pneumonia can be resolved within 2 weeks.
- ❖ Viral pneumonia may last longer.
- ❖ Mycoplasmal pneumonia may take 4 weeks to resolve completely.

❑ What examinations should be considered in patients with pneumonia that does not resolve as promptly as it should ?

- ✓ **CT scan**
- ✓ **Bronchoscopy**

On writing CXR report for a Pt with pneumonia, request a follow up CXR two weeks after starting treatment, mostly but not always, bacterial pneumonia resolves within 2 weeks, Viral pneumonia takes up to month, Atypical pneumonia (example Mycoplasmal pneumonia) takes 4-6 weeks
if your pt doesn't improve with the follow up then you should consider CT to avoid other pathologies

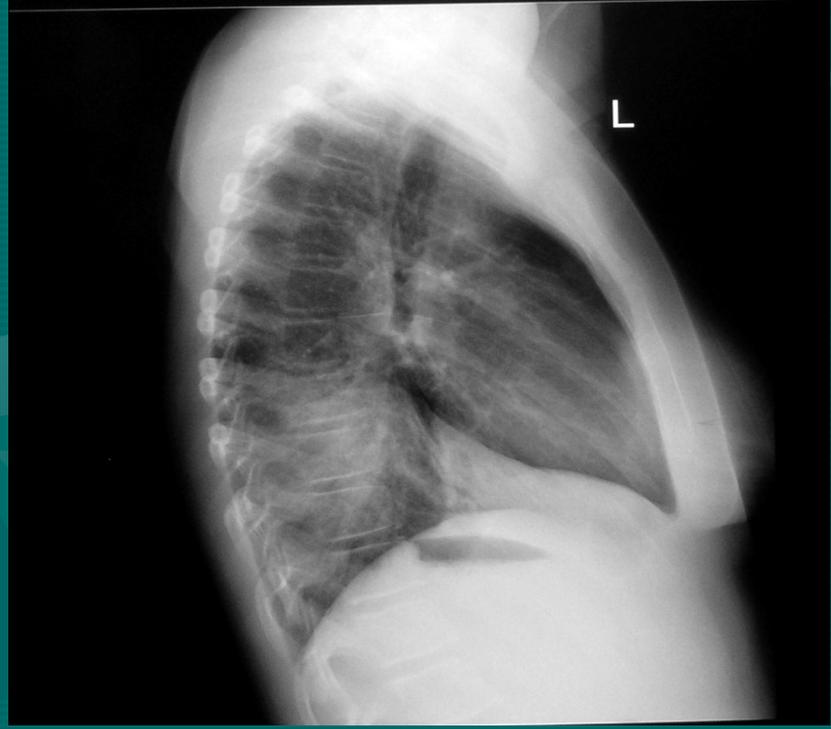
CXR PA and Lateral view showing infiltration (consolidation) of the right lower lobe typical for lobar pneumonia

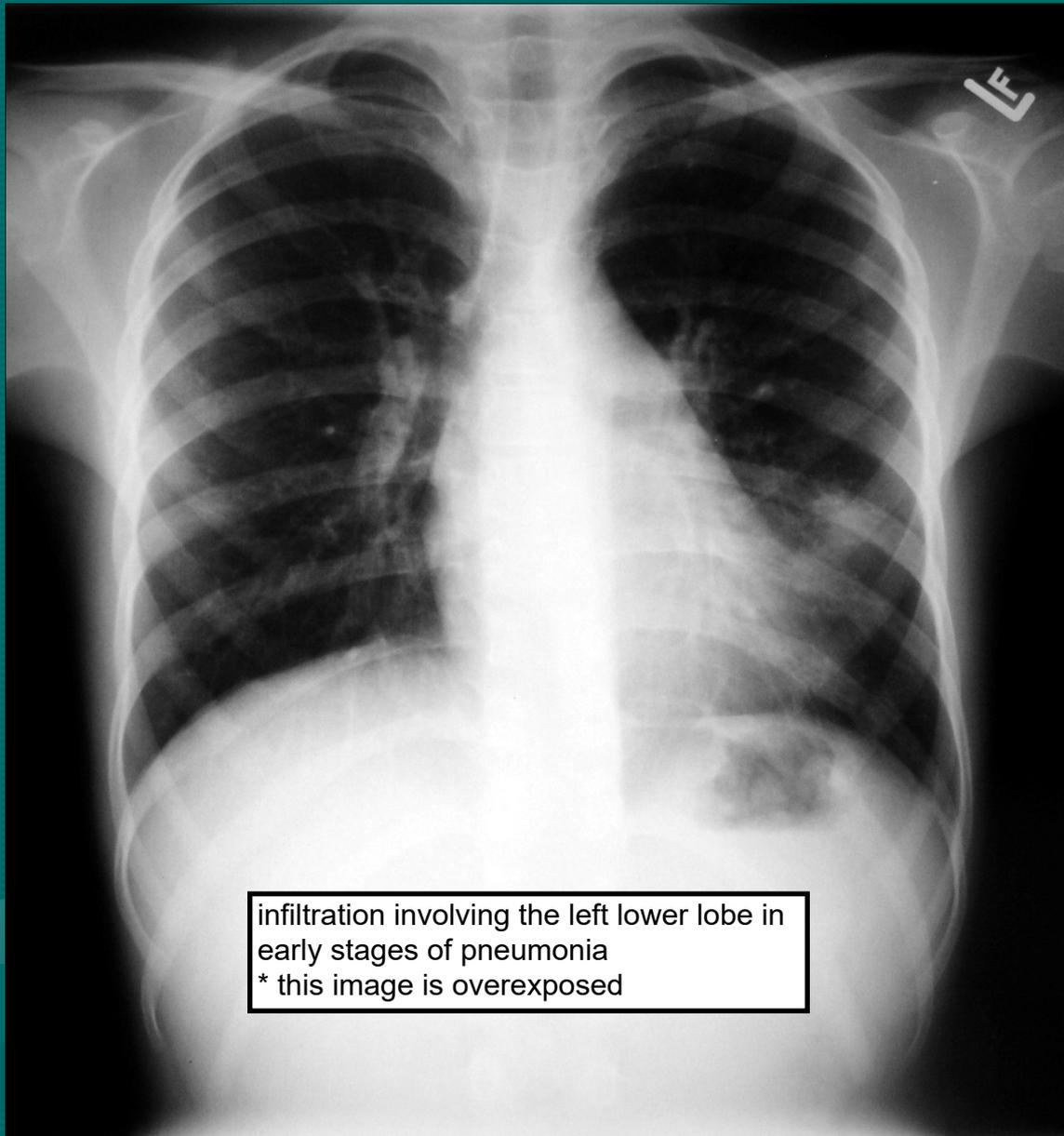


if you saw this R on the other side, this might indicate that the heart is on the other side - dextrocardia

Situs inversus - when all organs are opposite

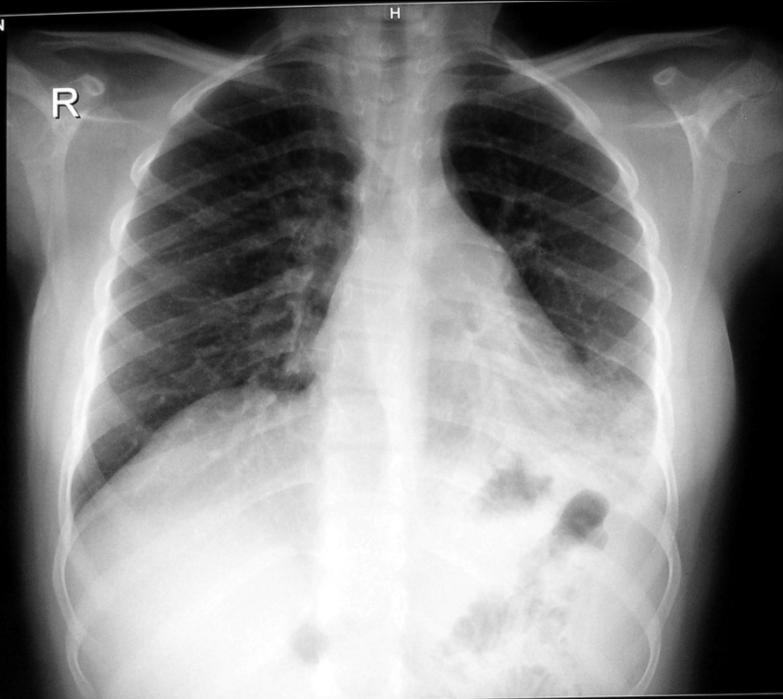
this take a risk for volvulus





infiltration involving the left lower lobe in
early stages of pneumonia
* this image is overexposed

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01:48:30



infiltration involving the left lower lobe plus obliteration of the costophrenic angle = pneumonia & effusion

V033 Thorax pa
V 125.0
mAs 1.16

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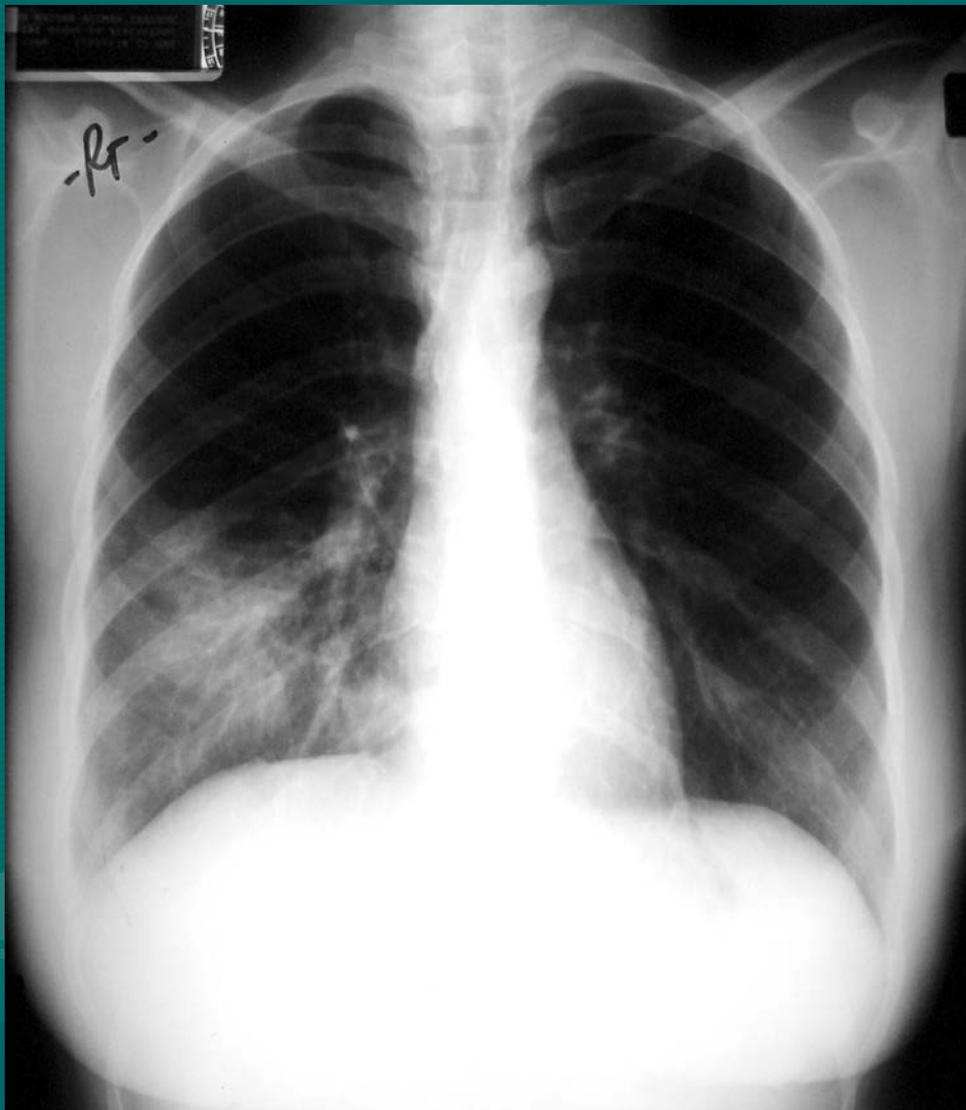
V034L Thorax lat
V 125.0
mAs 3.89

Scale

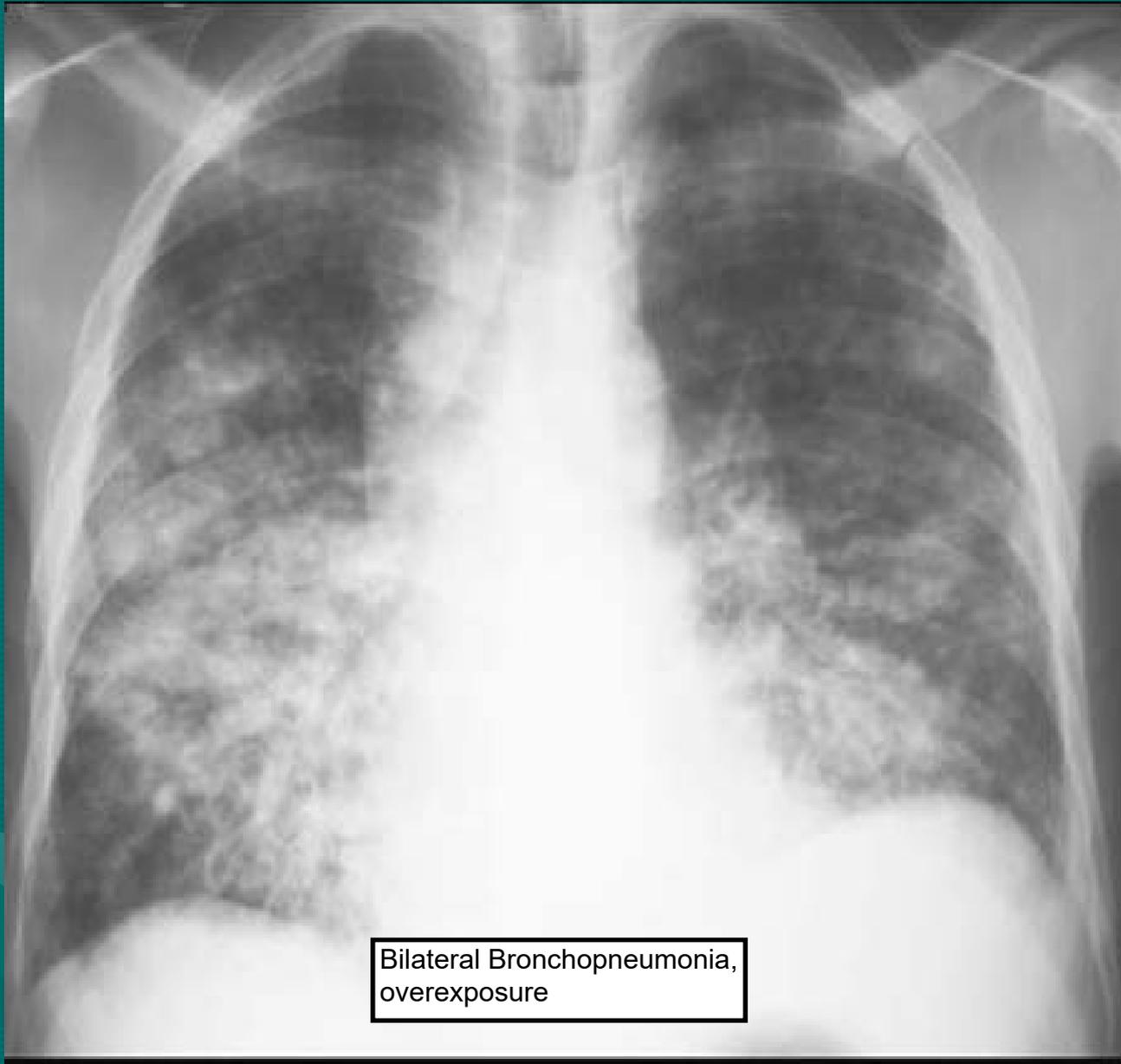
SECURITY FORCE

Scale

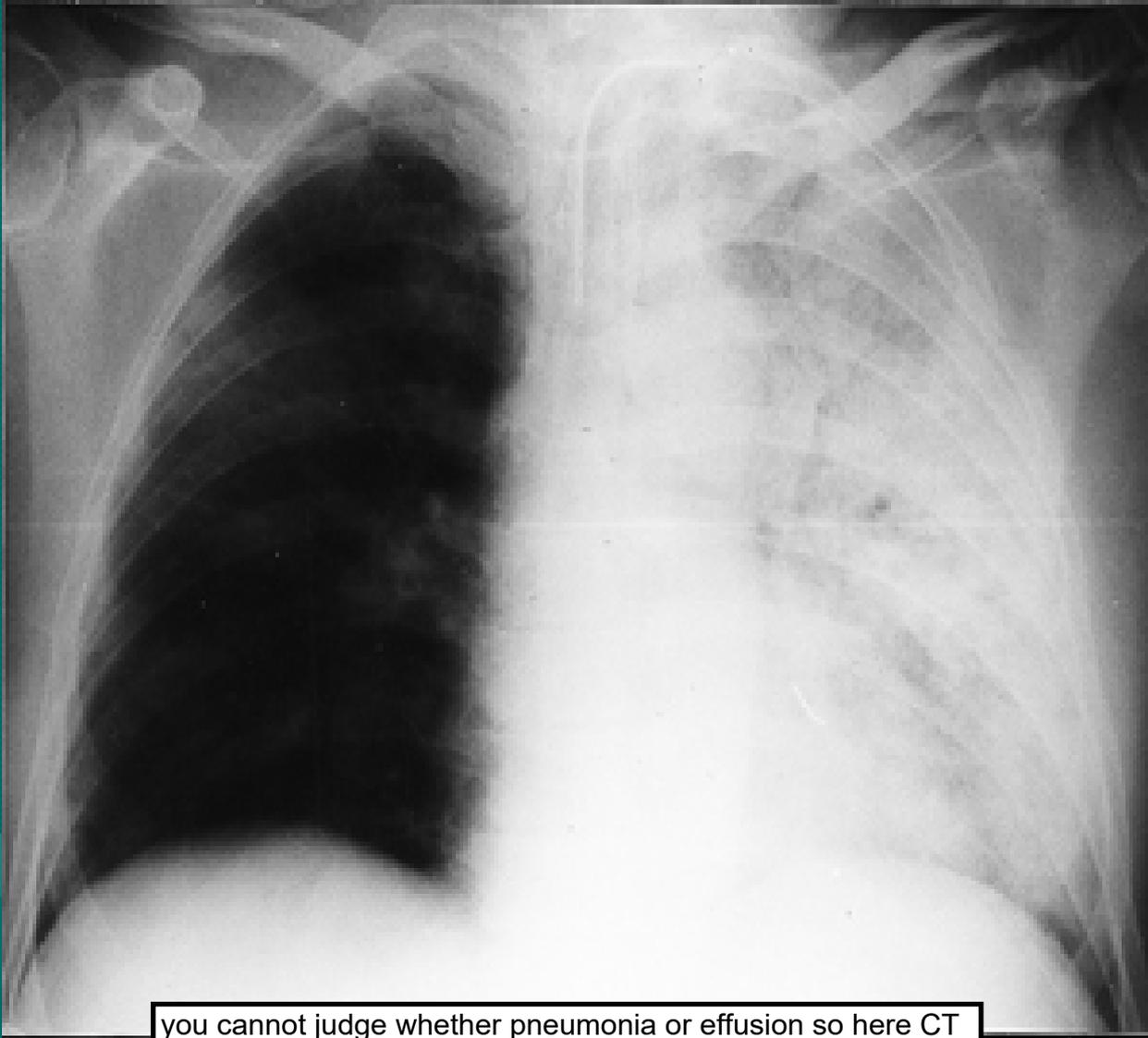
Whenever there is an abnormal area of shadowing (increased density/whiteness) in the lungs, the diagnosis of infection or cancer should be considered likely causes



CXR alone is not sufficient for definitive Dx for example this image can be cancer so you should correlate your initial Dx with the Pt clinical data and CXR. and follow up the Pt if no improvement you do CT looking for cancer



Bilateral Bronchopneumonia,
overexposure



you cannot judge whether pneumonia or effusion so here CT scan is a must since the management of Pleural effusion (Chest Tube) is totally different from the management of pneumonia
P.S: the Pt has tube



require CT scan

Pulmonary Collapse:

collapsed lung appears more opaque = White

Emphysema:

the opposite of collapse; the lung is more

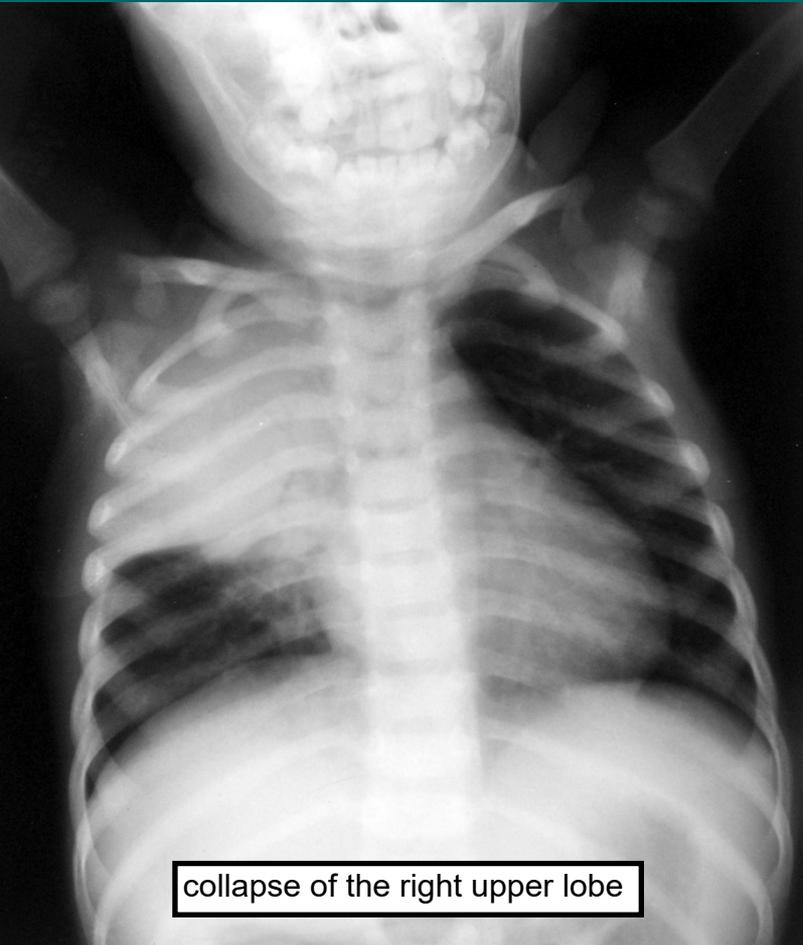
translucent = Black

Pulmonary collapse

- ❖ Pulmonary collapse or atelectasis refers to a decrease in volume of a lung, lobe or segment.
- ❖ Obstruction to flow of air is the most common cause of collapse.
- ❖ Air in the alveoli is absorbed and because no further air enters the alveoli distal to the obstruction, the lung tissue collapses and becomes more opaque

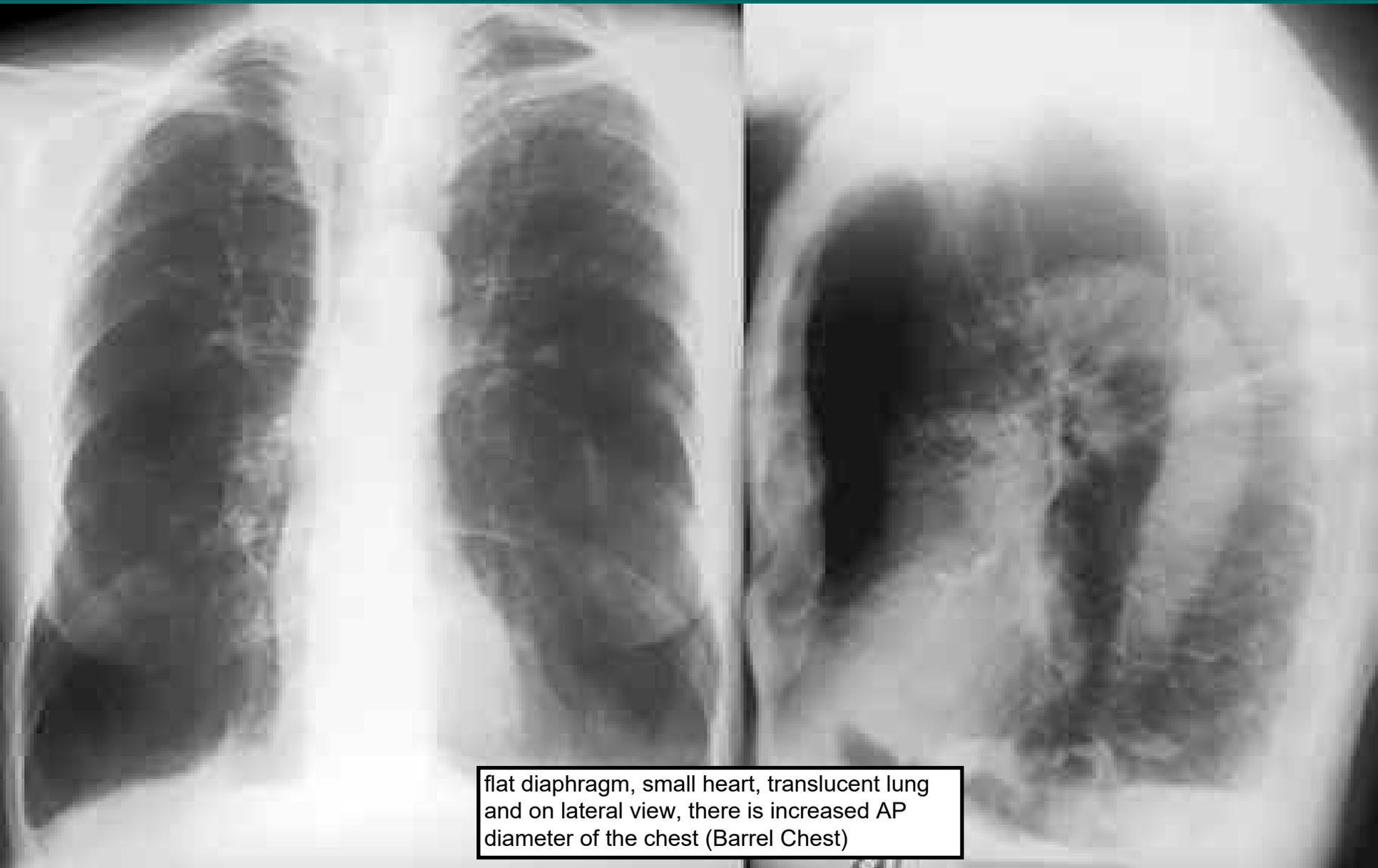
Pulmonary collapse / 2

- ❑ Common causes of bronchial obstruction causing collapse:
 - Bronchial carcinoma
 - Mucus plug (pneumonia, postoperative).
 - Foreign body.
 - Inflammatory bronchial disease (bronchial tuberculosis).
 - Extrinsic compression of airway by tumor or enlarged lymph nodes.



Emphysema

- Is an increase in the size of the air spaces distal to the terminal bronchioles, with dilatation or destruction of their walls.
- The lung appear more translucent with reduction in size and number of the small vascular markings.
- The diaphragms are low and flat.
- The heart shadow is long and narrow.
- The postero-anterior diameter of the chest is increased in the lateral view resulting in barrel chest.



flat diaphragm, small heart, translucent lung
and on lateral view, there is increased AP
diameter of the chest (Barrel Chest)

Pleural effusion

Is fluid collection in the space between the parietal and visceral layers of the pleura, usually contains serous fluid, but may have differing contents.

- Haemothorax: blood, usually following trauma. -
- Empyema: purulent fluid (pus). -
- Hydropneumothorax: fluid and air. -

Pleural Effusion

is most common in the lower lobes but it can be:

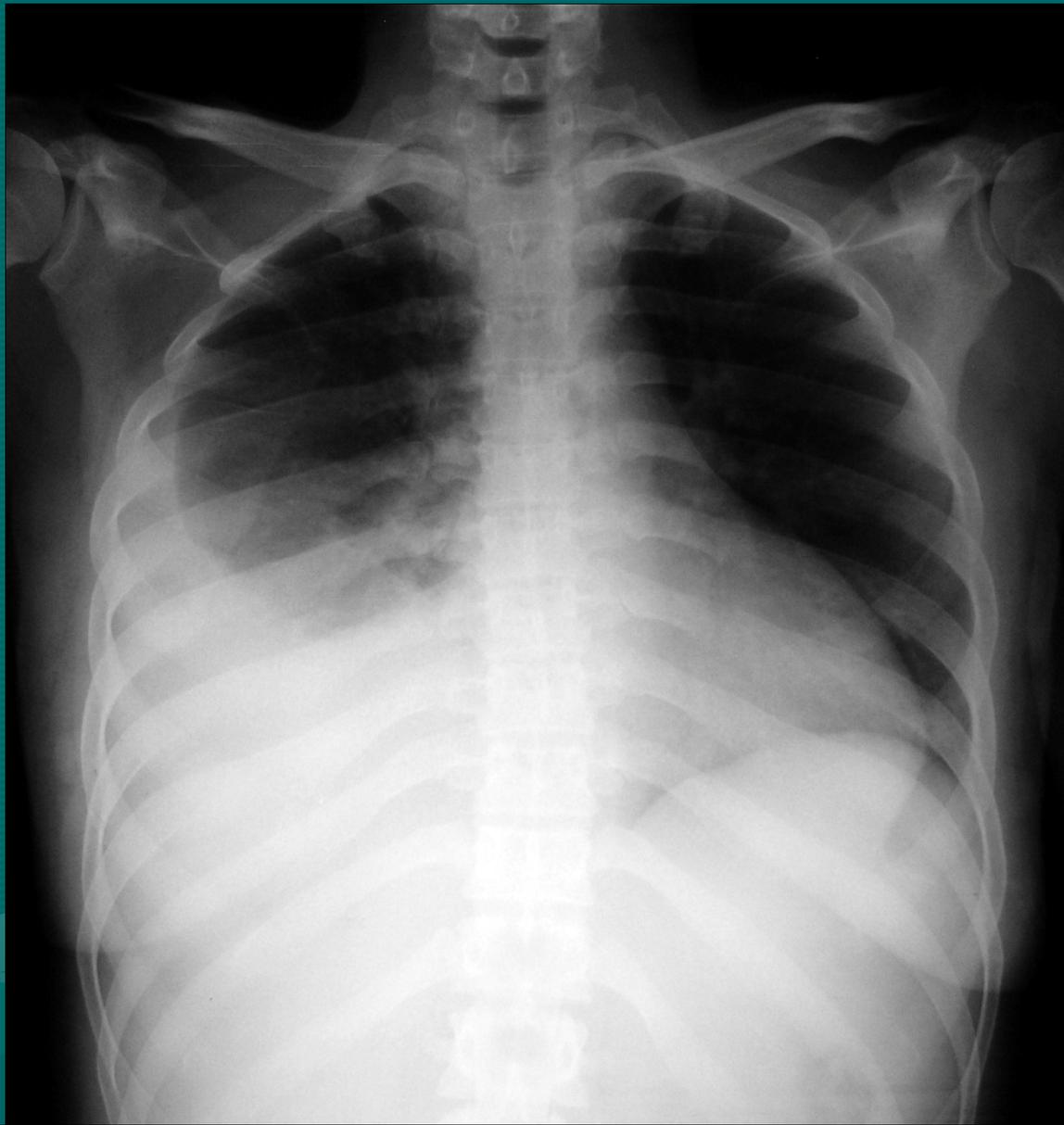
- 1- Localized: between interlobar fissures
- 2- Localized Lateral: in the upper lobes

* According to the amount of fluid, effusion may involve the whole lung or - if < 200 cc – not detected

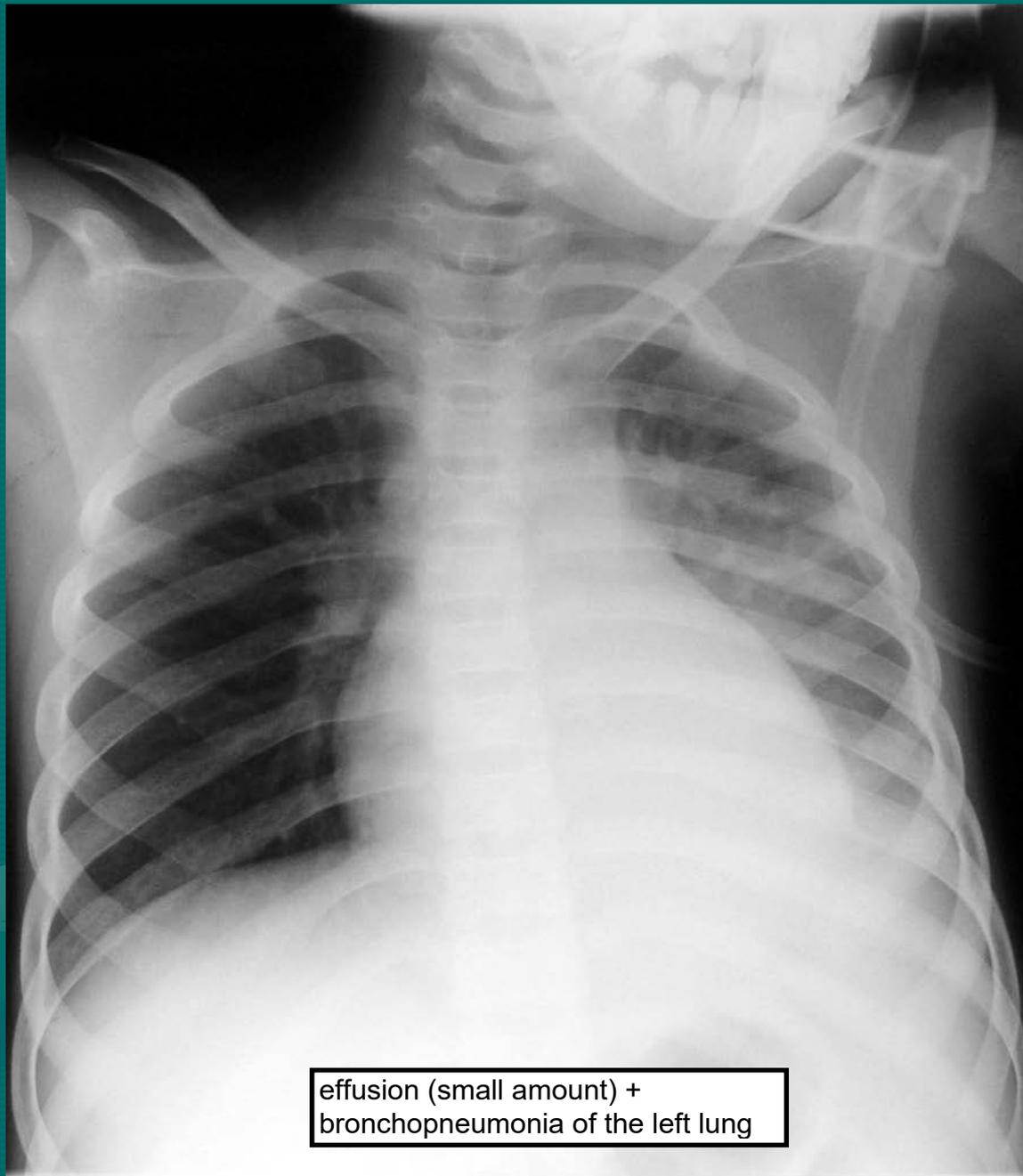
Pleural effusion / 2

Radiological features of pleural effusion on a chest x- ray:

- Homogeneous opacification.
- Loss of the diaphragm outline.
- No visible pulmonary or bronchial markings.
- Concave upper border which appear higher laterally.
- blunting or obliteration of the costophrenic angle.



Loss of the diaphragm outline, loss of vascular markings, Homogeneous opacification, obliteration of the costophrenic angle
How to differentiate between effusion and collapse?
Put the Pt in Lateral decubitus position so if effusion, fluid will go up and if collapse it wont change



effusion (small amount) +
bronchopneumonia of the left lung

Pneumothorax

- Is the presence of free air in the pleural space, by a tear in either the parietal or visceral pleura.
- The most common cause of pneumothorax is chest injury, but the most common cause of spontaneous pneumothorax is rupture of sub-pleural emphysematous bullae (bleb).

Radiological features of pneumothorax

- Lung edge: a thin white line at the lung margin, represent the visceral pleura.
- Absent lung markings between the lung edge and chest wall.
- Mediastinal shift: occur when a tension pneumothorax develops.

Chilaiditi Syndrome

Displacement of large bowel in-between the liver and the diaphragm, gas in these bowel loops must be differentiated from air under diaphragm



thin white line at the lung margin, loss of vascular and bronchial markings, and shift to the left side typical for pneumothorax

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Solitary Pulmonary Nodule

< 3 cm = nodule

> 3 cm = mass

WHAT IS SOLITARY PULMONARY NODULE ?

- It must be nodular or roughly spherical.
- Not larger than 3cm in diameter.
- About 40% of solitary pulmonary nodules are malignant.
- A nodule is assessed for its:

- size

The larger the nodule, the greater the likelihood of malignancy.

- Margins

Irregular contour or spiculated margins increase the probability of malignancy

- Calcification

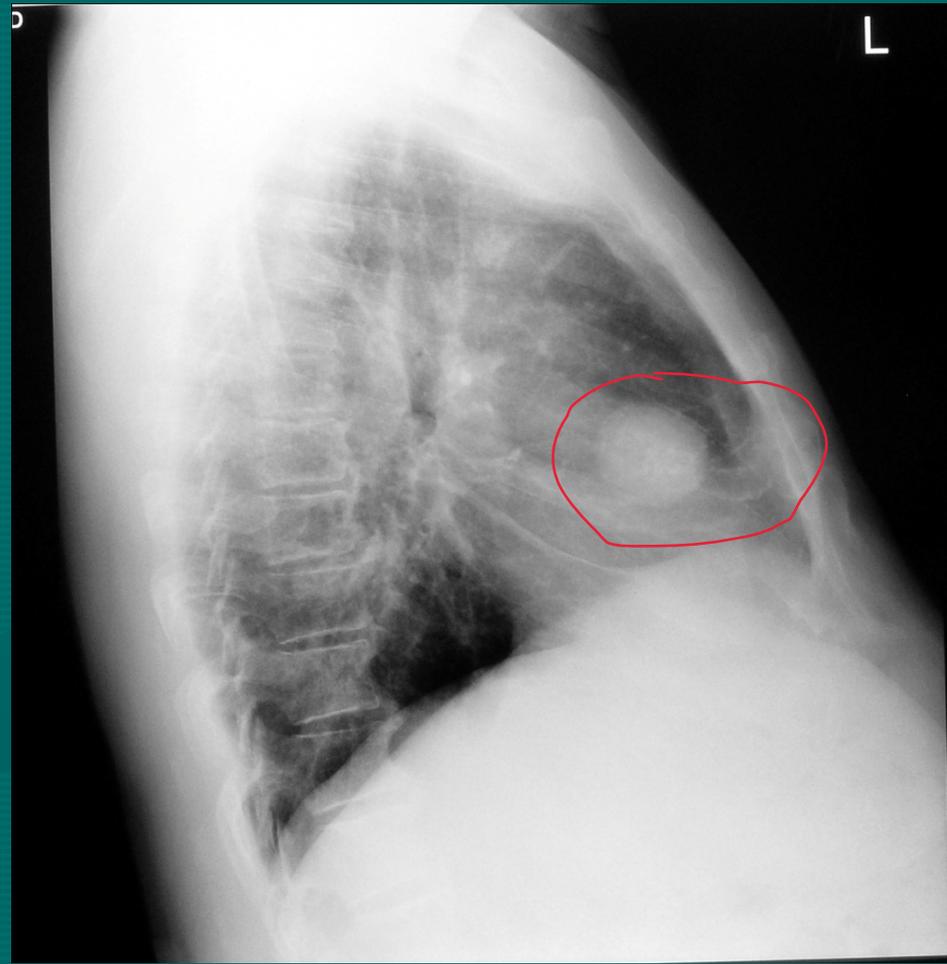
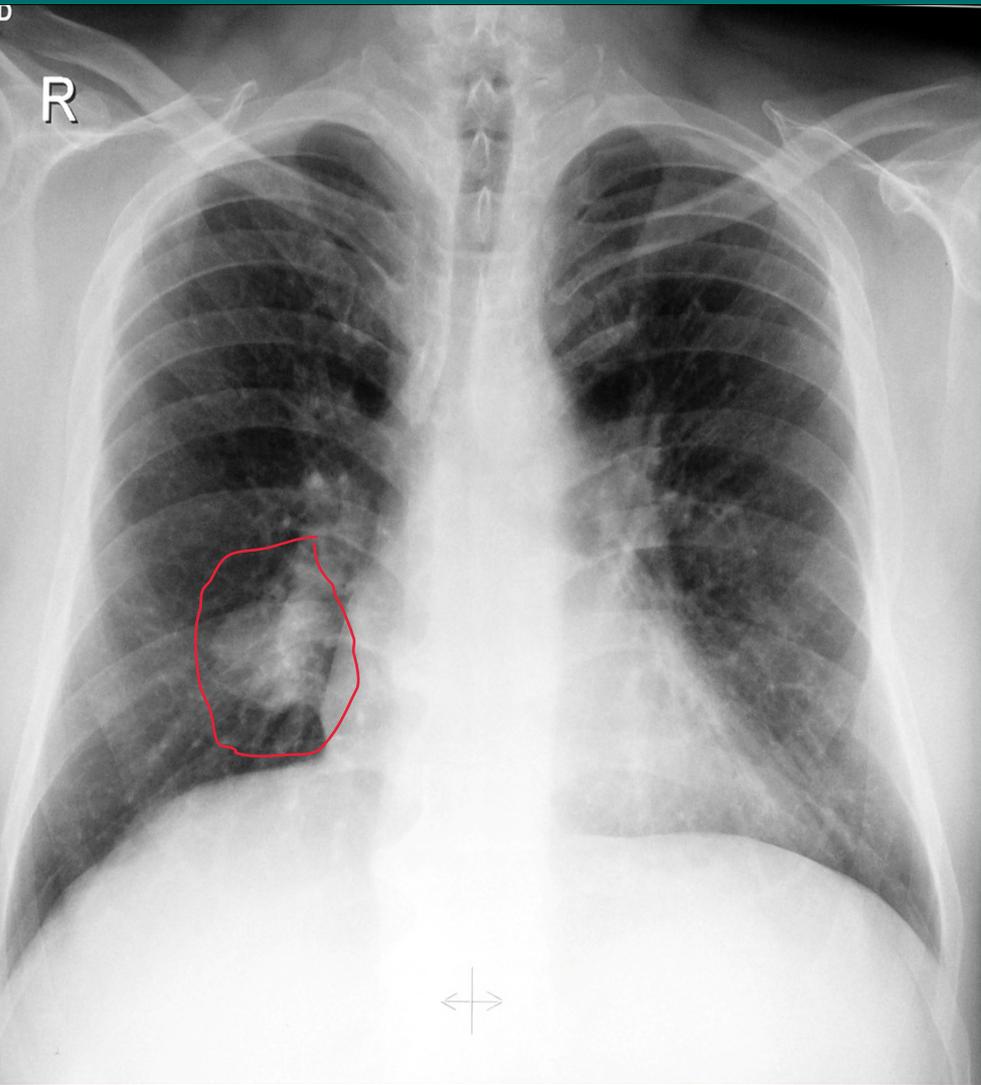
The presence of calcification within a nodule are in favor of benign lesion.

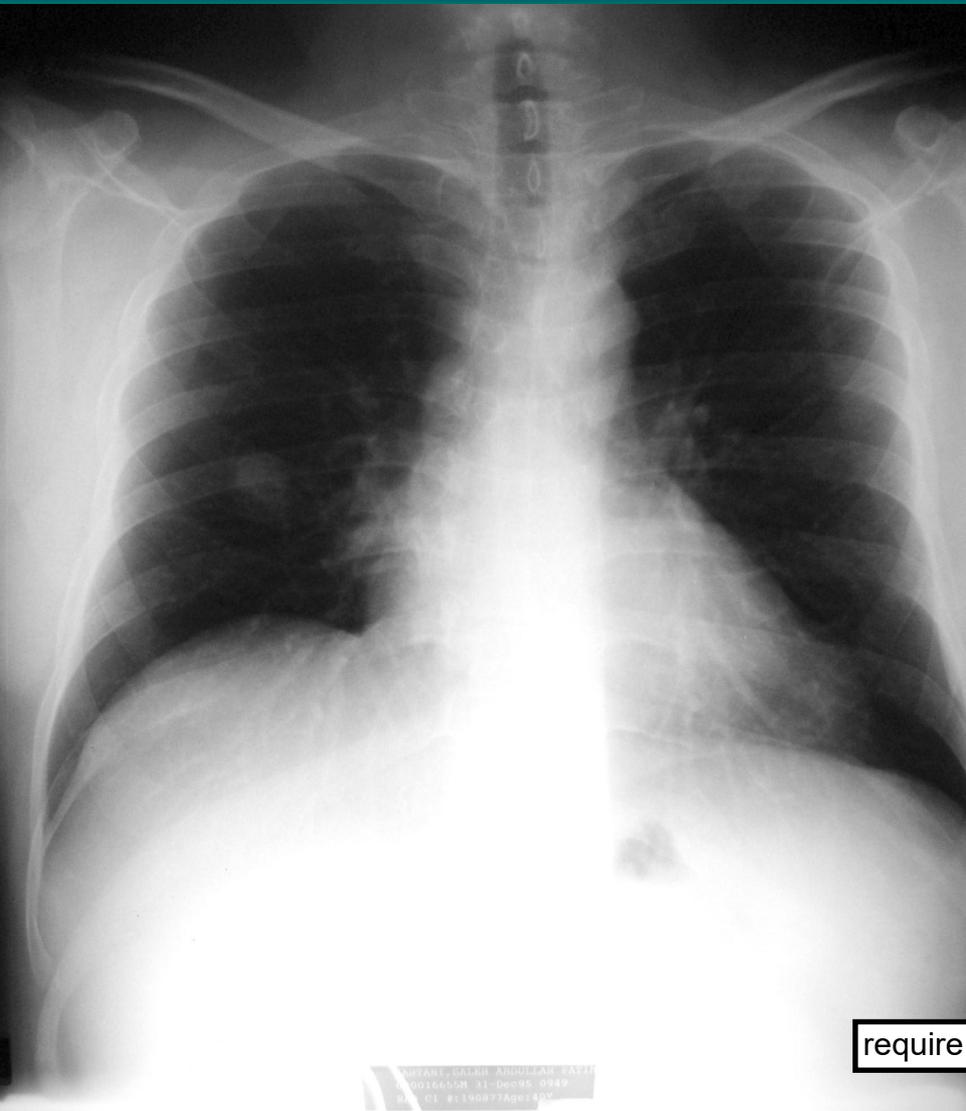
If the nodule has smooth well-defined outline, then it is more likely to be benign, so you should confirm your impression by CT , if on CT confirms, then send the Pt home and request follow up after 6 months

CAUSES OF SOLITARY PULMONARY NODULE

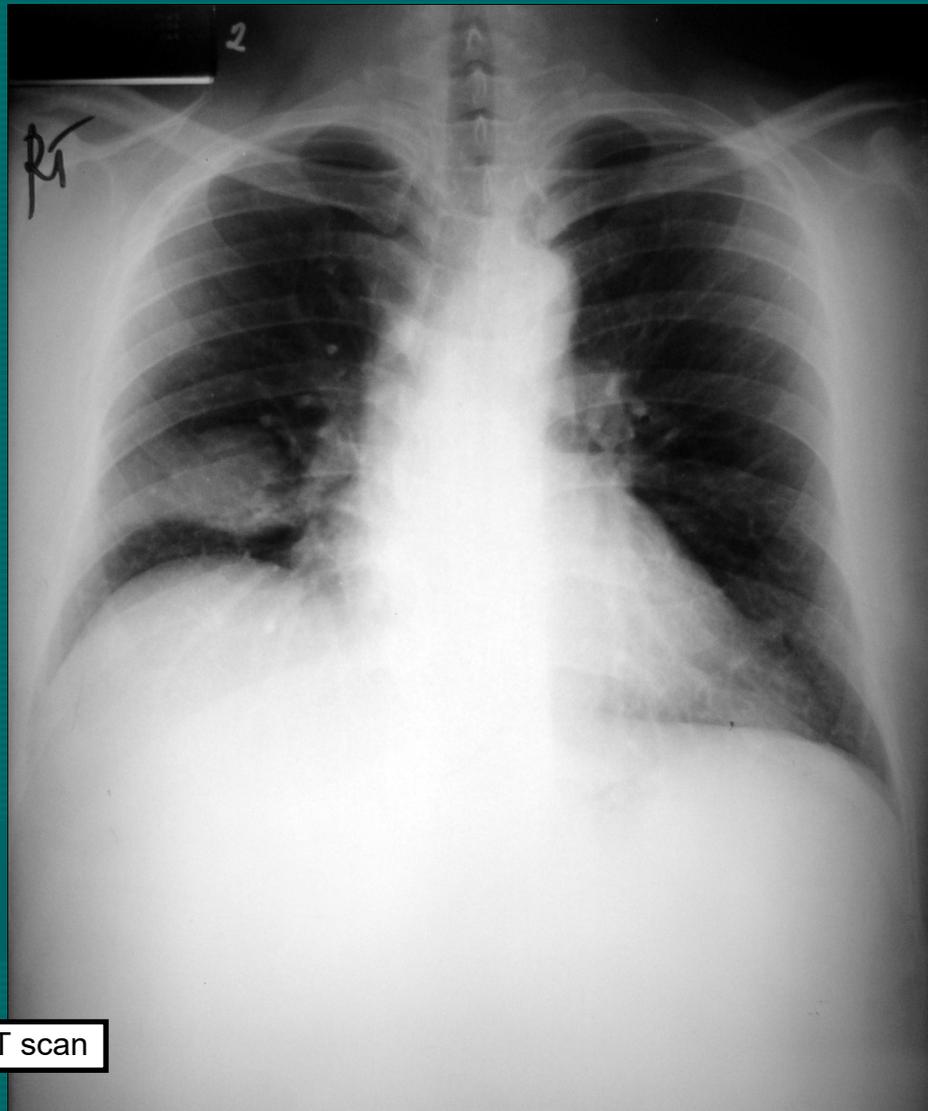
- Bronchial carcinoma.
- Metastasis.
- Hamartoma. mostly due to trauma
- Bronchial adenoma.
- Granuloma.
- Abscess.
- Hydatid cyst.
- Bronchogenic cyst
- Arterio-venous malformation.
- Rheumatoid nodule.

smooth well-defined pulmonary nodule = most likely benign >>> need CT





require CT scan



THE MEDIASTINUM

The mediastinum is situated between the lungs and extends from the thoracic inlet superiorly to the diaphragm inferiorly.

The mediastinum is divided into three parts:

1- Anterior mediastinum

Is the space in front of the anterior pericardium and trachea.

2- Middle mediastinum

Lies within the pericardial cavity.

3- Posterior mediastinum

Lies behind the posterior pericardium.

Mediastinum can be divided by two ways

1- Superior & Inferior Mediastinum the Inferior is divided into Anterior, middle, and posterior

2- The whole Mediastinum is divided into Anterior, middle, and posterior

ANTERIOR MEDIASTINAL MASSES

- Lymphoma.
- Thyroid (Retrosternal goiter).
- Teratoma.
- Thymic tumor.
- Pericardial cyst.
- Diaphragmatic hernia (morgagni hernia).

DDX for Anterior mediastinal mass

4 Ts 1- Thymus tumor

2- Thyroid

3- Terrible Lymphoma

4- Teratoma

Plus

Pericardial Cyst + Diaphragmatic hernia

Diaphragmatic Hernia

1- Morgagni hernia: congenital, present as an anterior mediastinal mass

2- Bochdalek hernia: congenital, present as an posterior mediastinal mass, discovered soon after birth because of the associated distress Syndrome

Rule

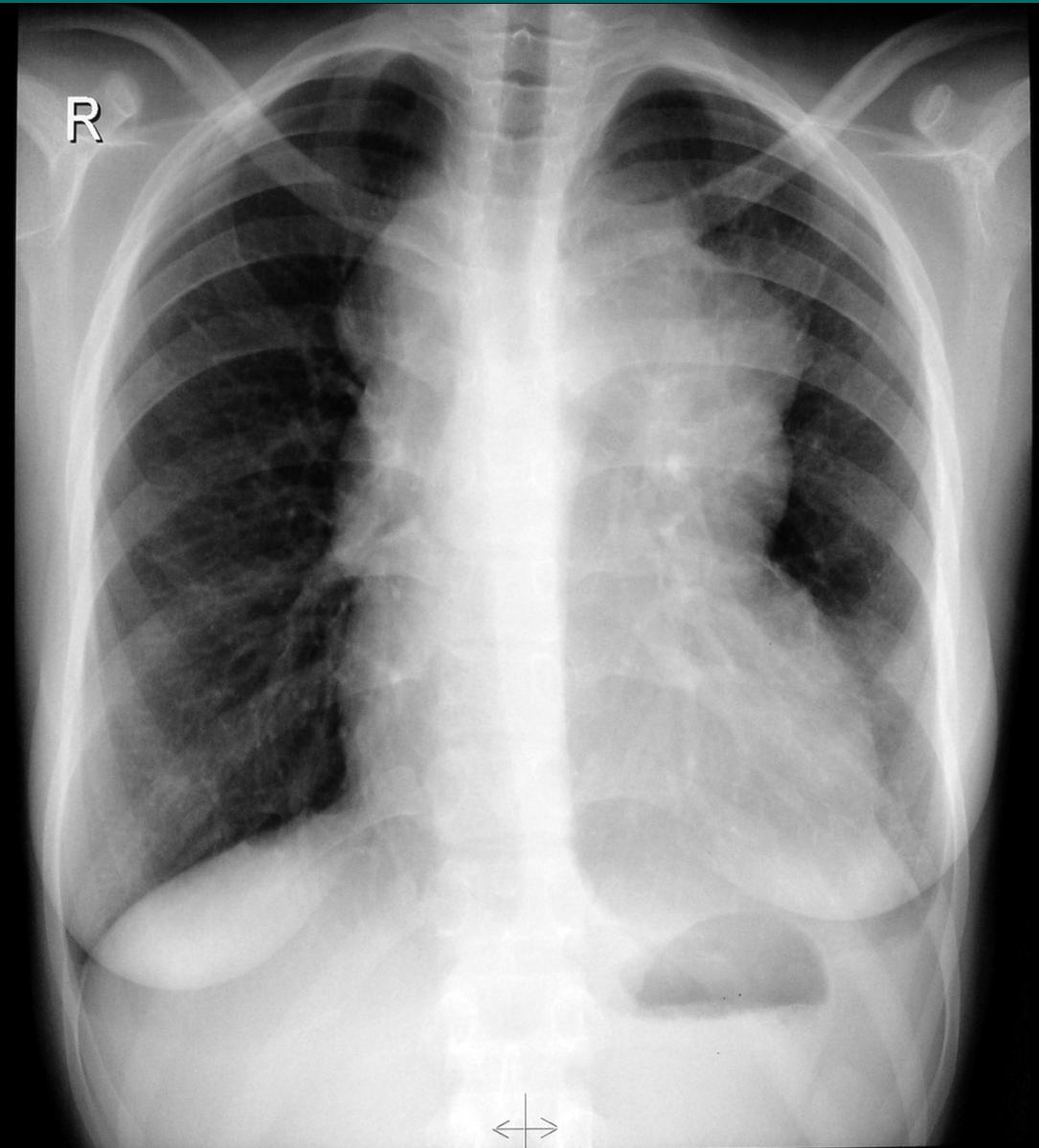
Anterior masses obscure the outline

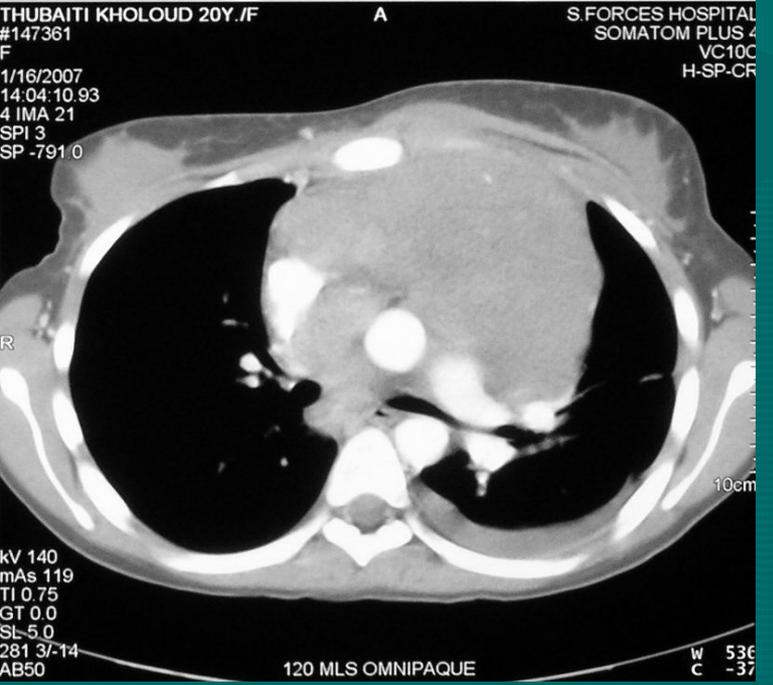
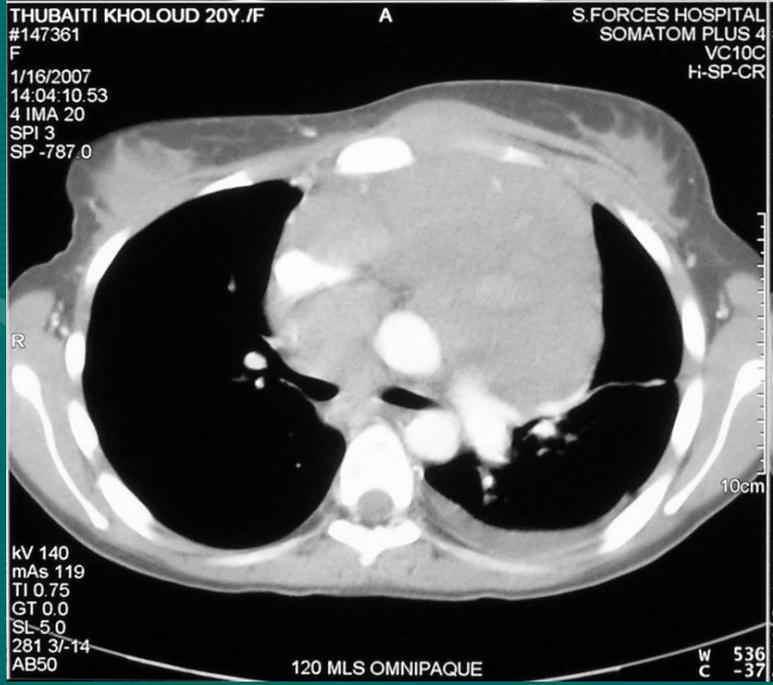
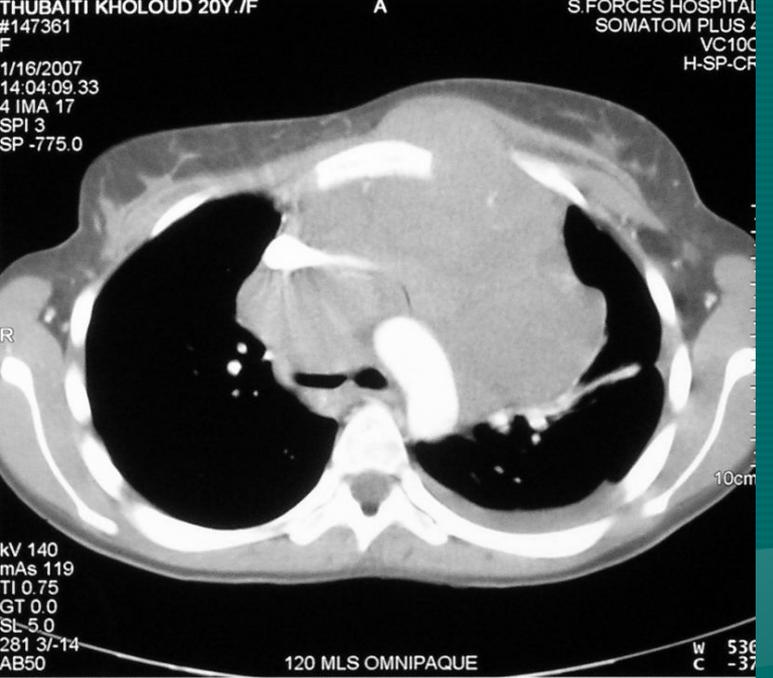
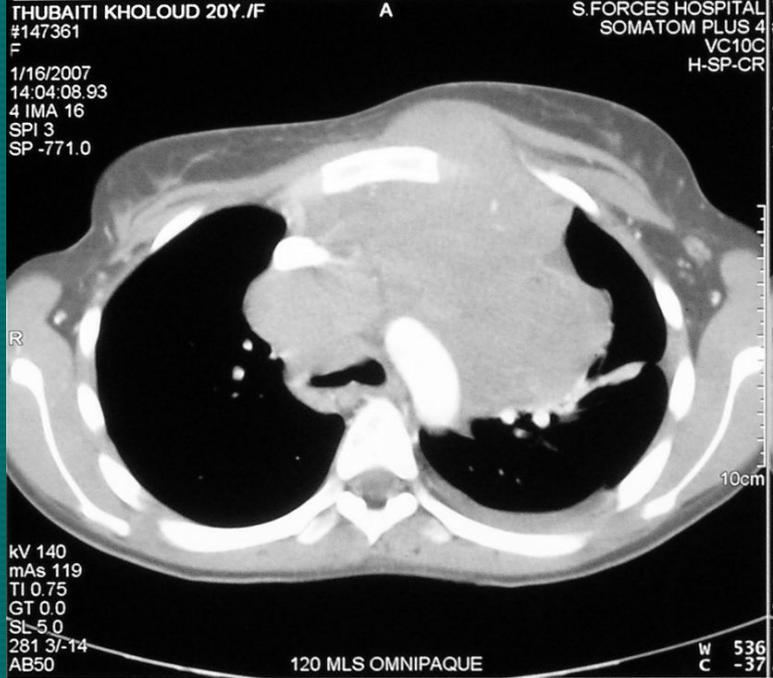
Posterior masses don't obscure the outline

MIDDLE MEDIASTINAL MASSES

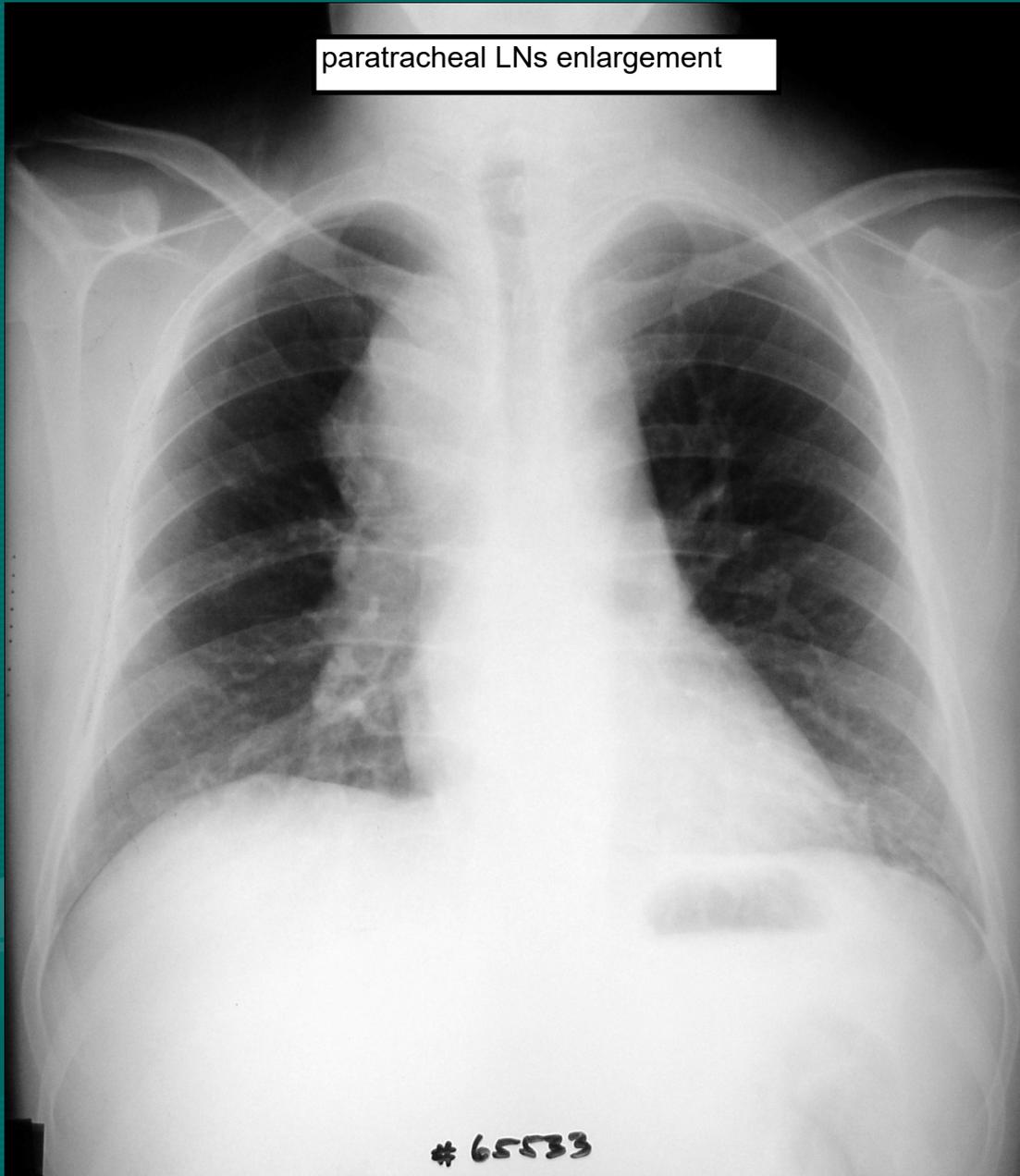
- Lymph node enlargement:
 - lymphoma
 - primary tuberculosis
 - sarcoidosis
- Bronchogenic cyst.
- Aneurysm of aortic arch.

outline is not clear = anterior mass
next step is CT: which shows soft tissue mass in
the anterior mediastinum



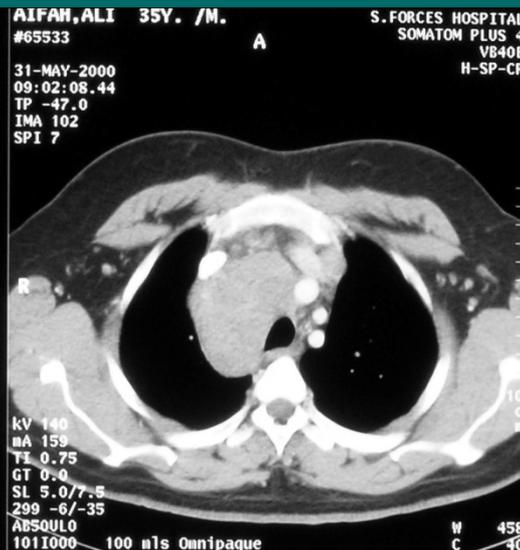
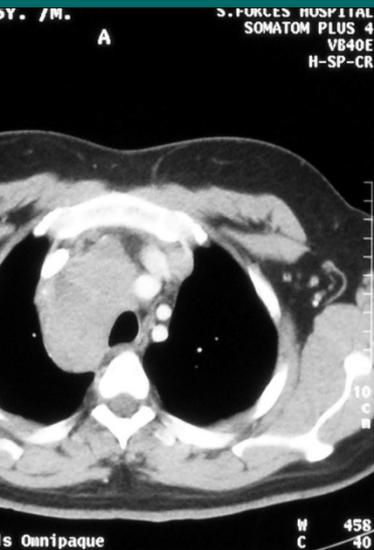


paratracheal LNs enlargement



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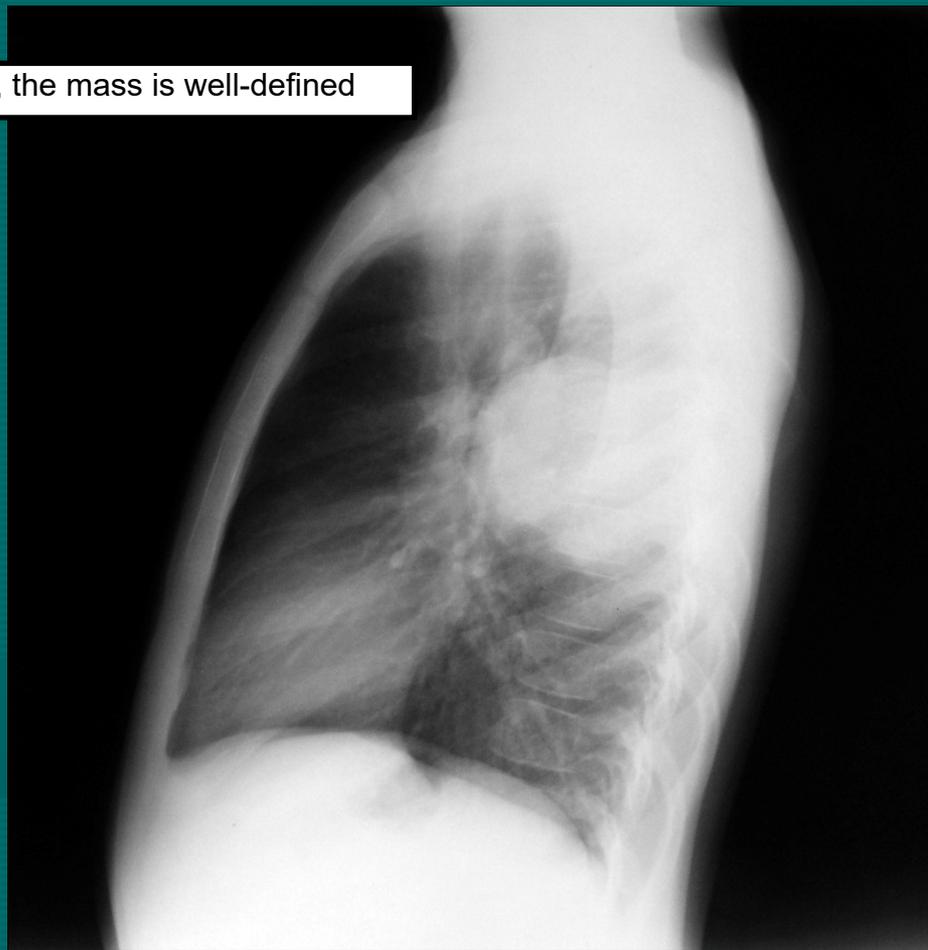
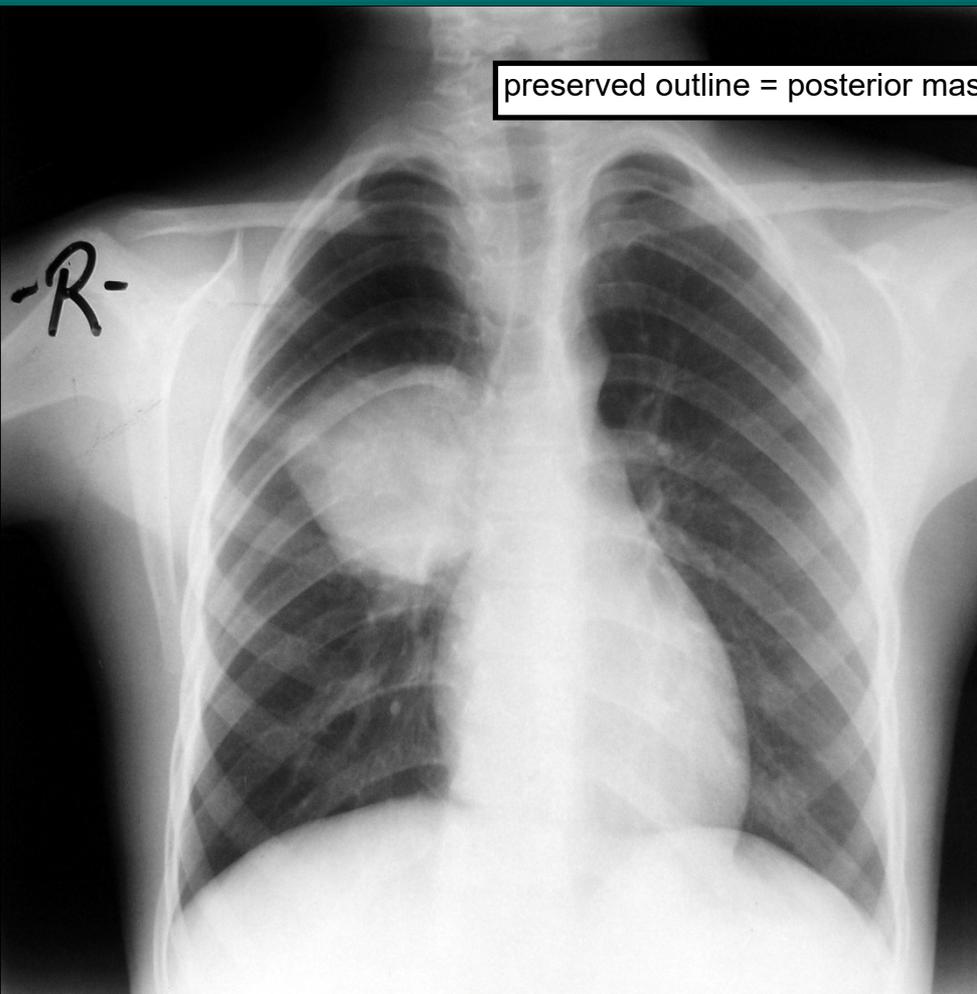
paratracheal LNs enlargement



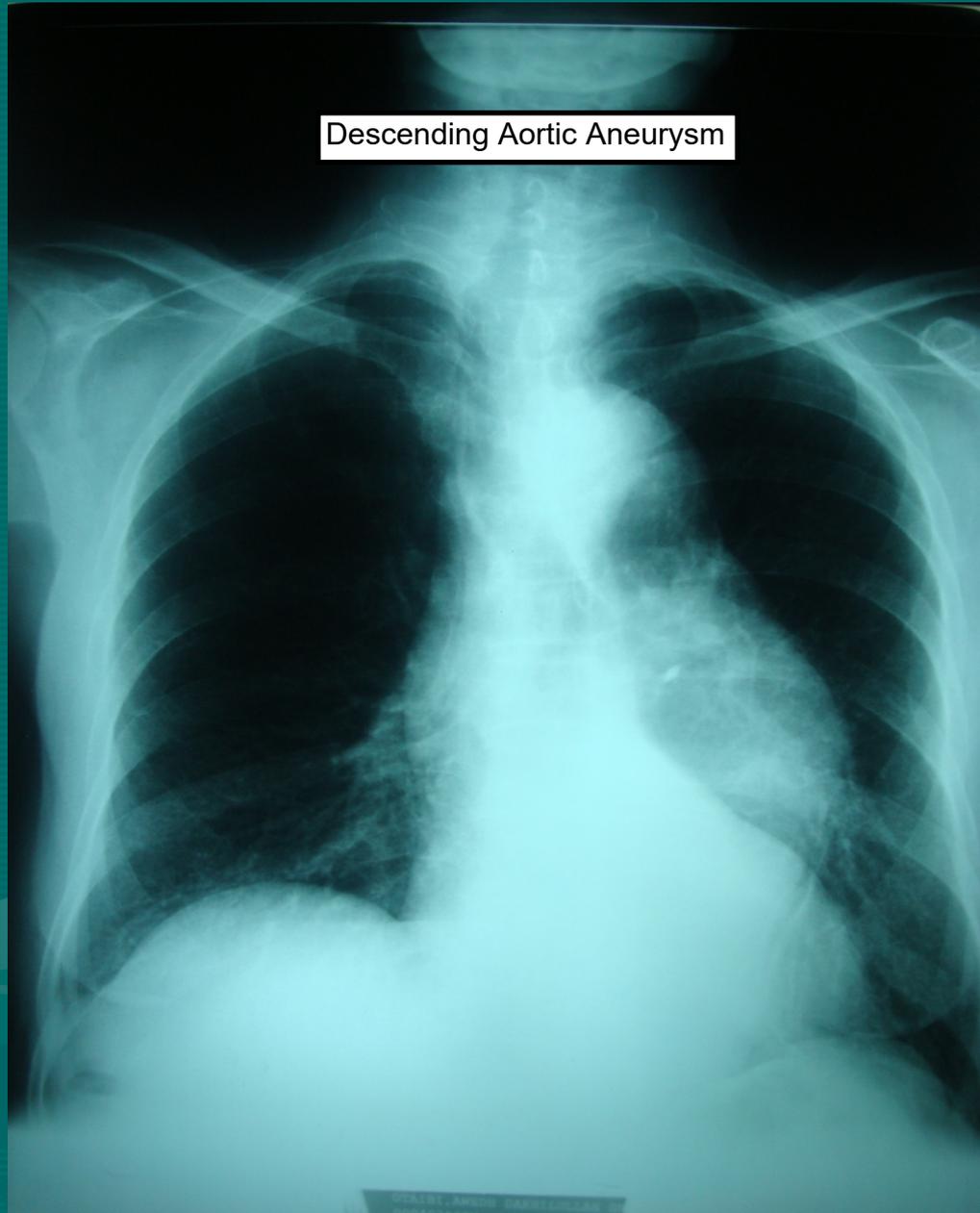
POSTERIOR MEDIASTINAL MASSES

- Neurogenic tumors
 - Neurofibroma
 - Ganglioneuroma
- Aneurysm of descending aorta.
- Hiatus hernia.
- Dilated esophagus (especially achalasia).
- Paravertebral mass or abscess.

preserved outline = posterior mass, the mass is well-defined



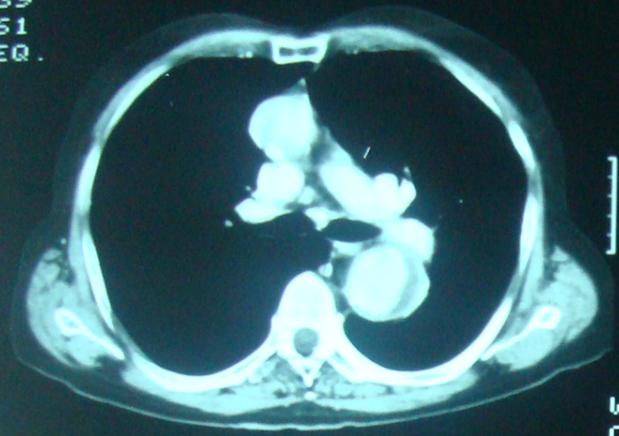
Descending Aortic Aneurysm



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Descending Aortic Aneurysm

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SCAN 62
CAL.REQ.



TI 4
KV 125
AS .21
SL 8
GT 0
TP 105

100MLS/OMNIPAQUE/BOLUS
INFUSION GASTROGRAFIN

W 400
C 40

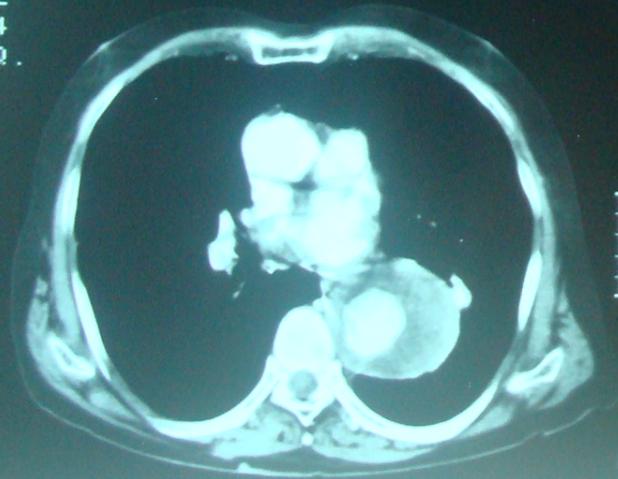
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SL 8
GT 0
TP 113

100MLS/OMNIPAQUE/BOLUS
INFUSION GASTROGRAFIN

W 400
C 40

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CAL.REQ.



TI 4
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AS .21
SL 8
GT 0
TP 129

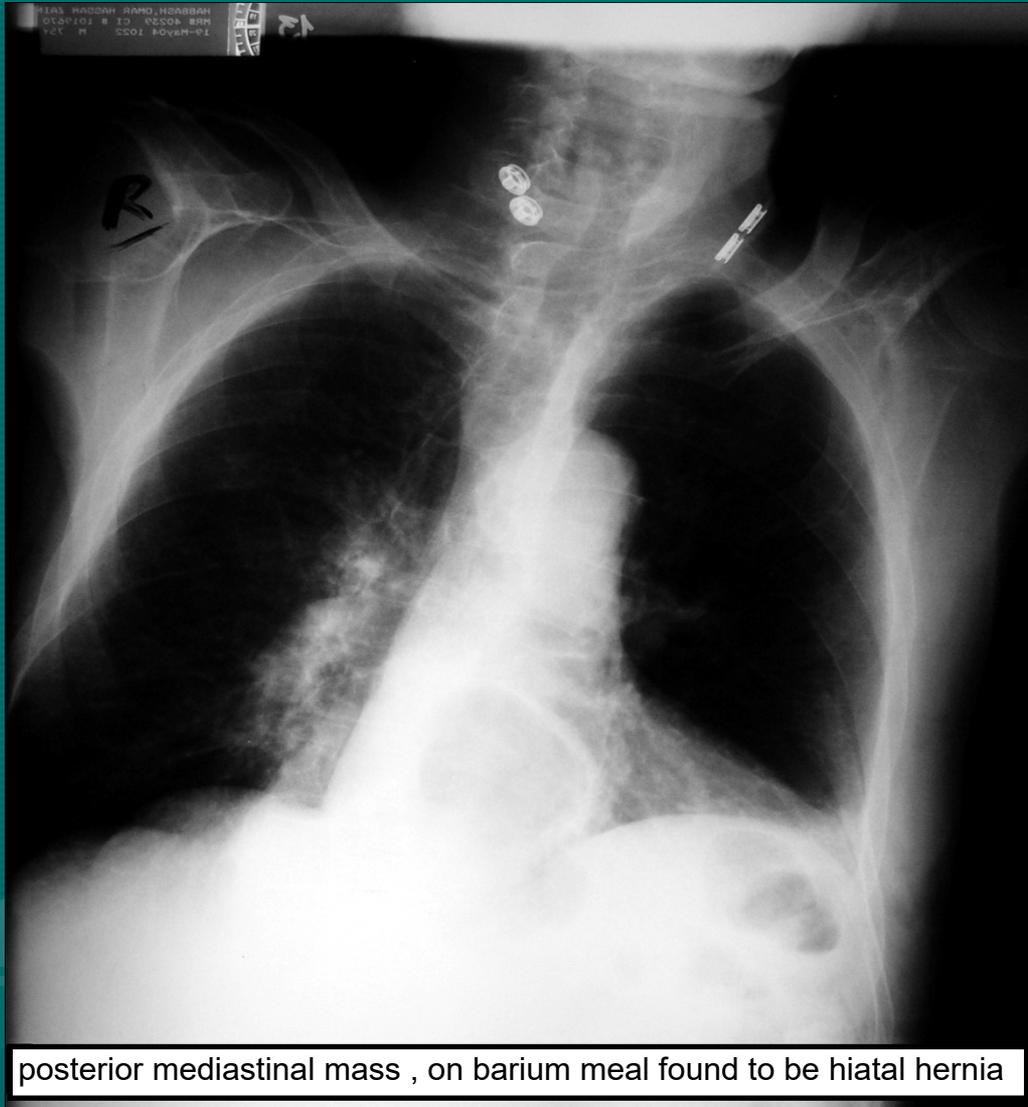
100MLS/OMNIPAQUE/BOLUS
INFUSION GASTROGRAFIN

W 400
C 40

TI 4
KV 125
AS .21
SL 8
GT 0

100MLS/OMNIPAQUE/BOLUS

W 400
C 40



posterior mediastinal mass , on barium meal found to be hiatal hernia

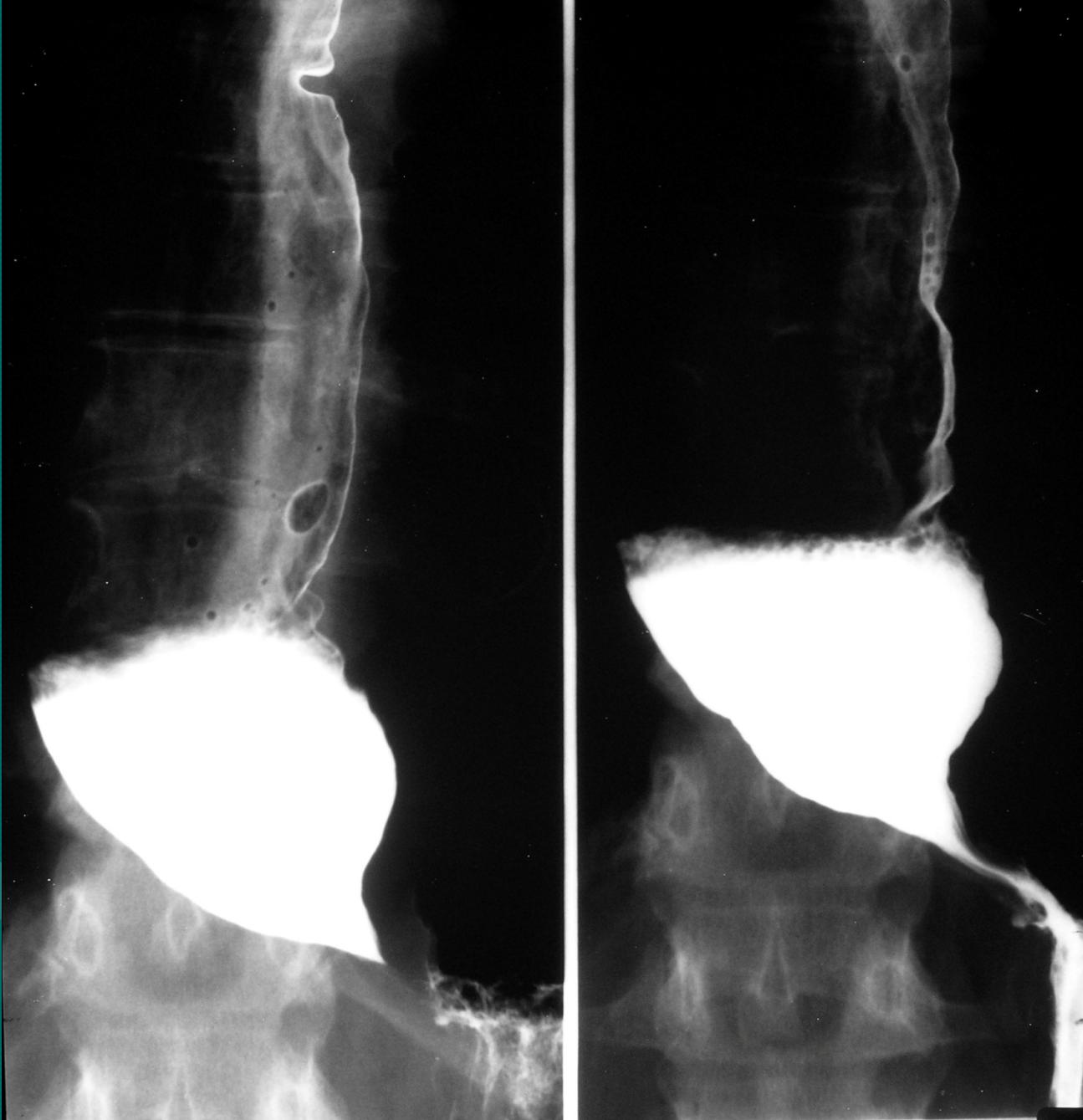


posterior mediastinal mass , on barium meal found to be hiatal hernia



posterior mediastinal mass , on barium swallow found to be Achalasia





posterior mediastinal mass , on barium swallow found to be Achalasia



Bilateral paratracheal (hilar) LNs enlargement = Sarcoidosis

TUMORS OF THE LUNG

- Lung cancer is the commonest fatal malignancy.
- The strongest risk factor is cigarette smoking.
- More than 95% of malignant tumors arise from the respiratory epithelium and are termed bronchogenic carcinoma.
- Less than 5% of lung cancers are of rare cell types, such as carcinoid tumors, lymphoma, or metastasis.

Types of lung cancers

1- Adenocarcinoma

- ❖ Is the most common type of lung cancer, making up 30-40% of all cases.
- ❖ Usually arise peripherally as solitary pulmonary nodule.

The alveolar cell carcinoma is a subtype of adenocarcinoma and arise within the alveoli producing areas of consolidation and the appearance resemble bronchopneumonia.

Types of lung cancers / 2

2- Squamous cell carcinoma

radioopaque mass with a central cavity (radiolucent)

- They typically occur in **central** bronchi.
- Grow slowly and cavitate more often than other cell types.

3- Small (oat) cell carcinoma.

- Are usually **central** in location.
- Have the fastest rate of growth.
- Typically associated with mediastinal adenopathy.

4- Large cell carcinoma.

- Usually arise at the **periphery** of the lung.
- The growth is relatively rapid.



ill-defined speculated hilar mass most likely to be malignant

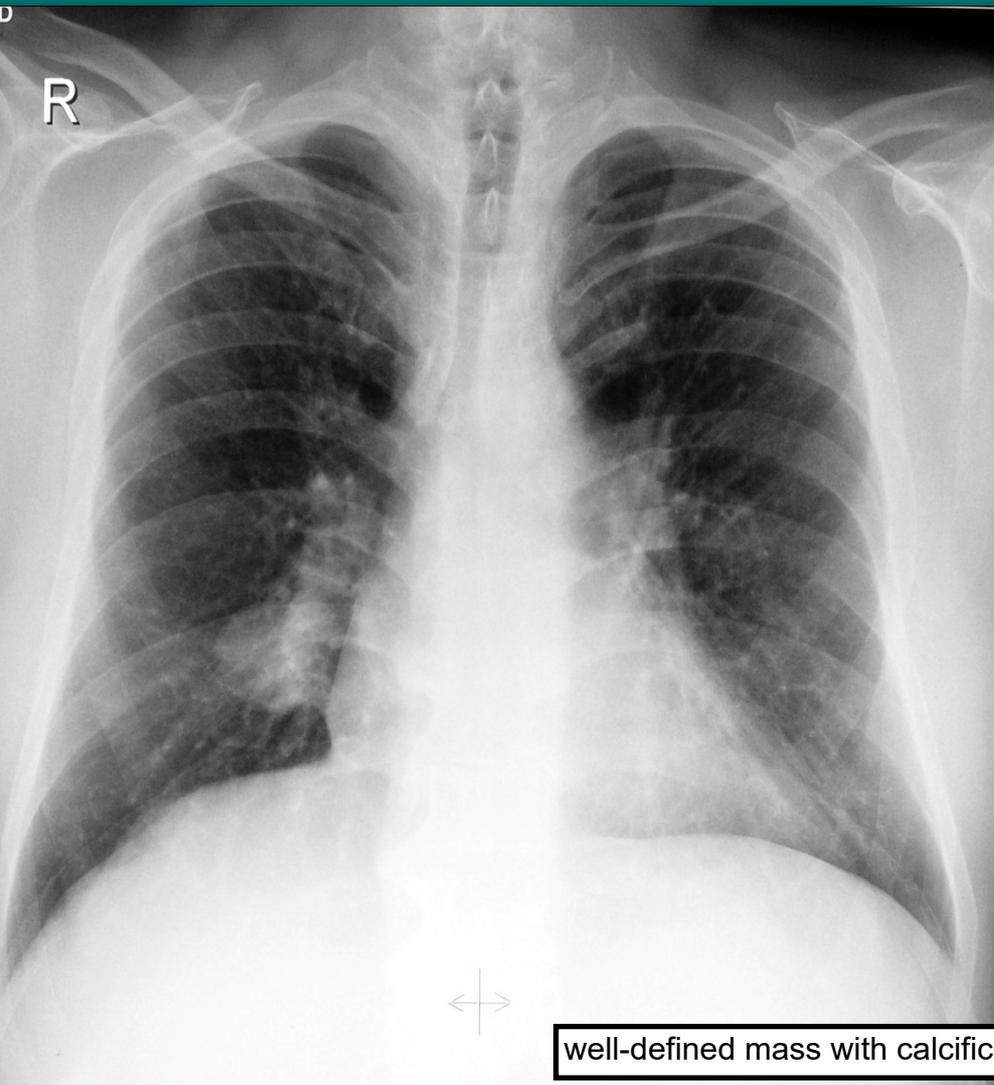
BENIGN TUMORS OF THE LUNG

- Hamartoma.

- Is the most common benign tumor of the lung.
- Appear as solitary, well marginated, rounded mass.
- Calcification (popcorn) is present in 40% of cases.
- Fat is seen in up to 50% of hamartomas.

- Adenoma.

- The vast majority of cases occur around the hilum and appear as round, well-defined nodule.

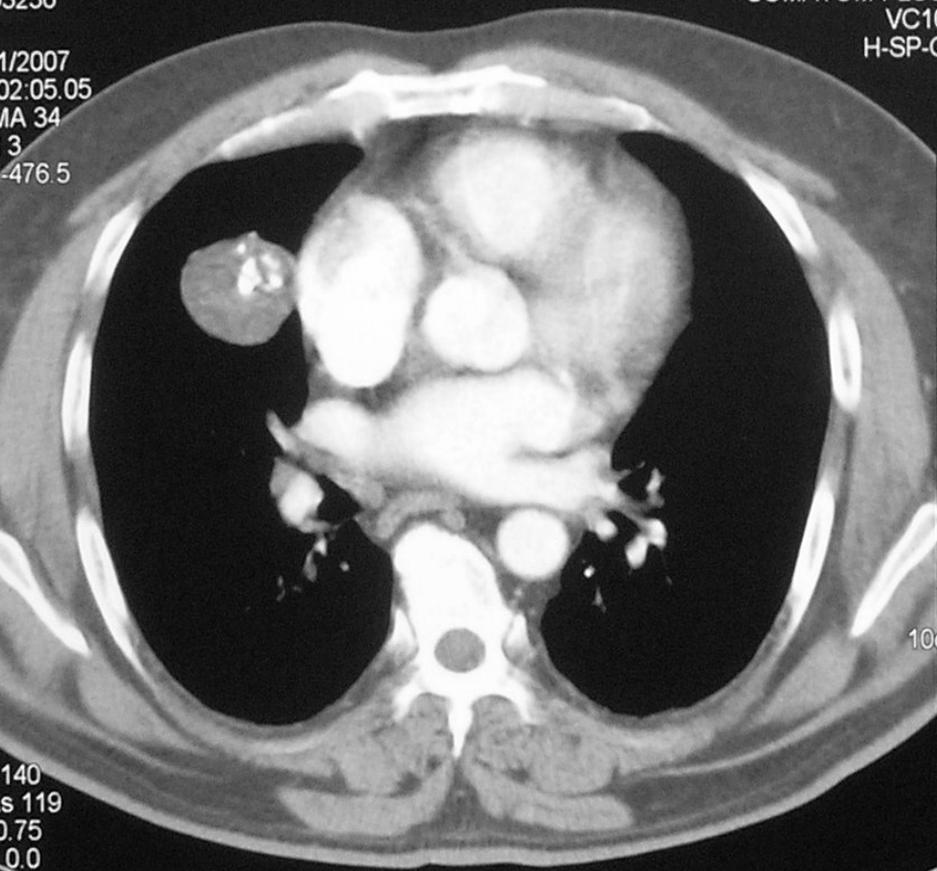


MARI, ABDULRAHMAN 67Y/M
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S. FORCES HOSPITAL
SOMATOM PLUS 4
VC10C
H-SP-CR

1/2007
10:02:05.05
MA 34
3
-476.5



10cm

140
s 119
0.75
0.0
5.0
-8/-35
50

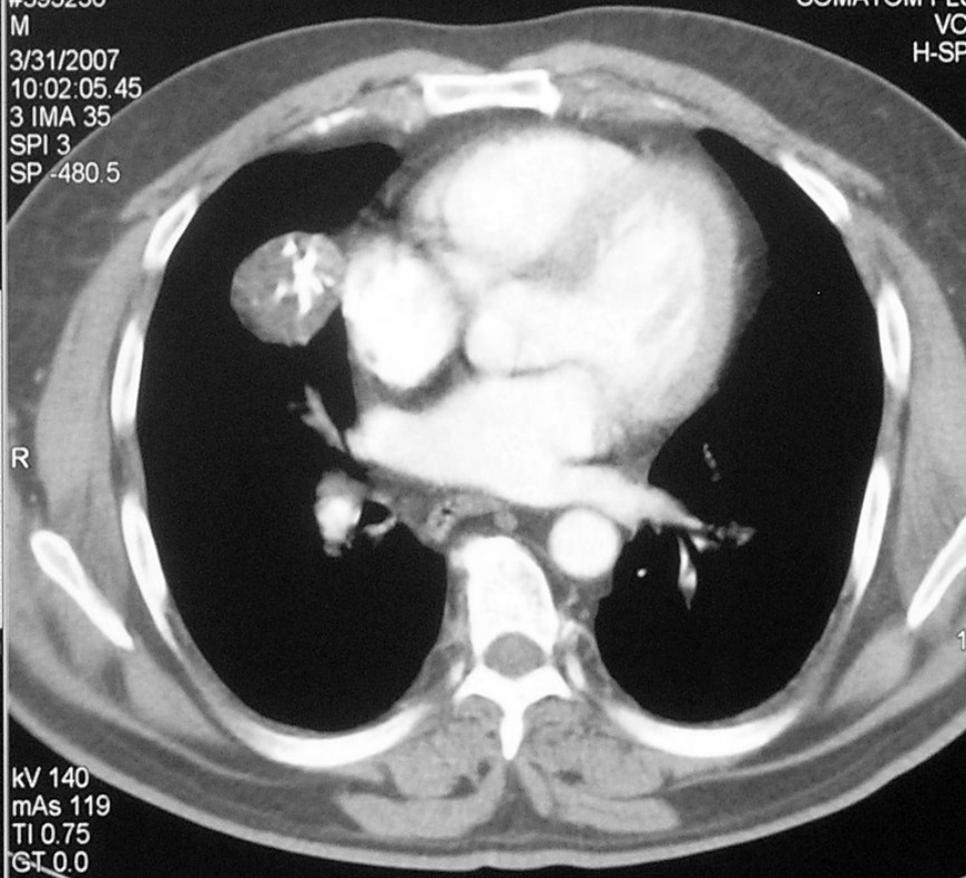
100 MLS OMNIP

ASMARI, ABDULRAHMAN 67Y/M

A

S. FORCES HOSPITAL
SOMATOM PLUS 4
VC10C
H-SP-CR

#593236
M
3/31/2007
10:02:05.45
3 IMA 35
SPI 3
SP -480.5



R

kV 140
mAs 119
TI 0.75
GT 0.0
SI 5.0

100 MLS OMNIP

well-defined mass with calcification most likely to be benign

W
C

Lung metastasis

Lung Metastasis

well defined
usually multiple
usually bilateral
variable in size and location

- The commonest primary tumors producing lung metastasis are breast, renal tract, thyroid, bone, and testicular tumors.
- Metastasis to the lung are usually bilateral and tend to be peripheral and more numerous at the lung bases.
- Lung metastasis are spherical in shape with a well-defined margin.



SAQER, ABDULLAH 40Y/M

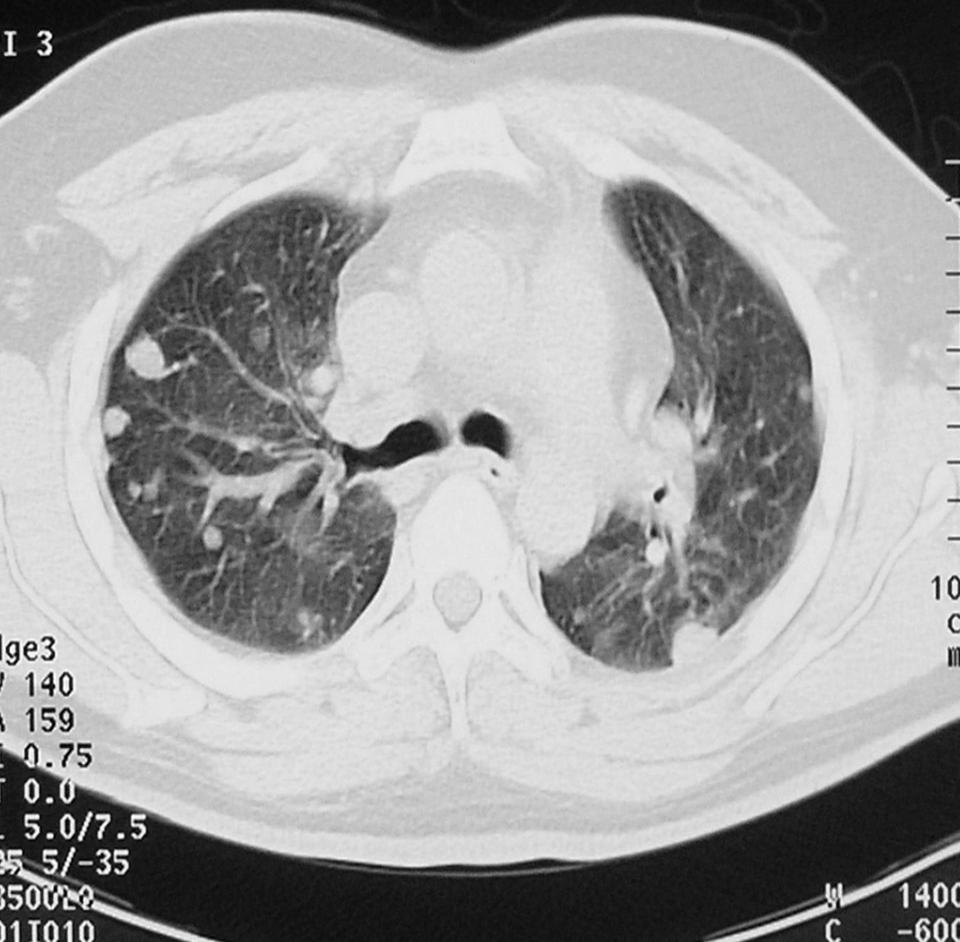
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A

S. FORCES HOSPITAL
SOMATOM PLUS 4
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H-SP-CR

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-268.5

I 3



SAQER, ABDULLAH 40Y/M

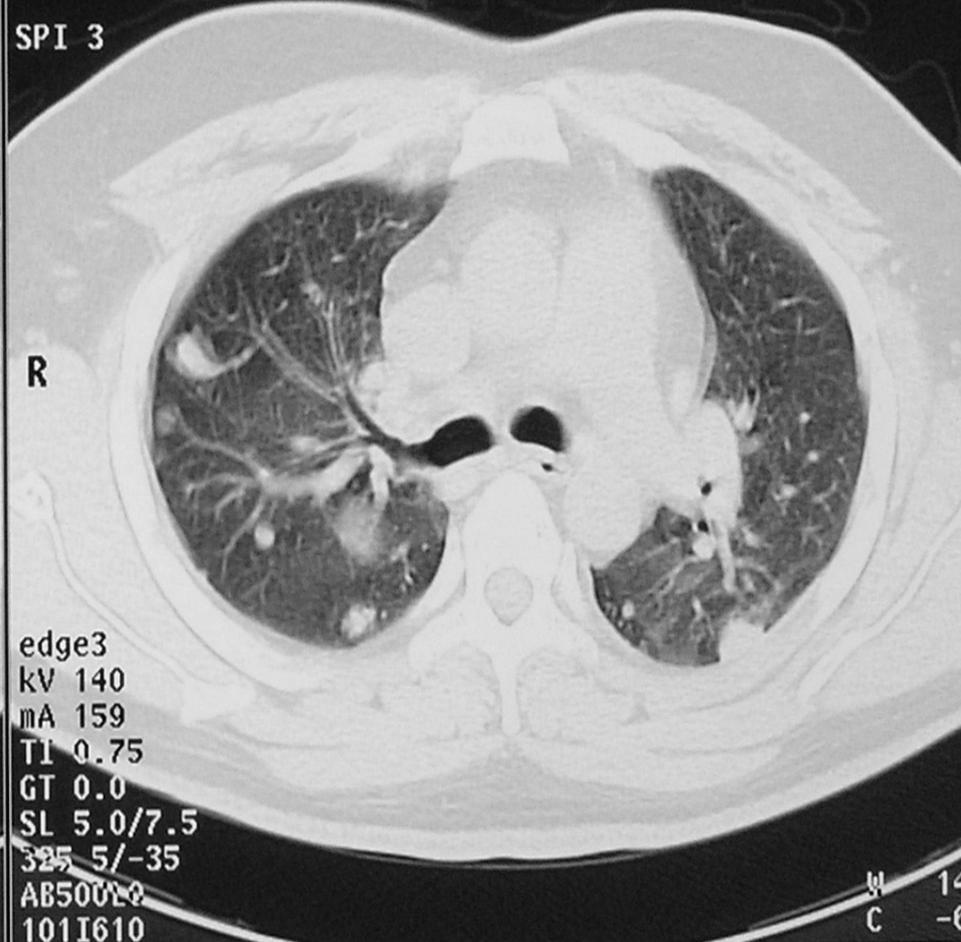
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A

S. FORCES HOSPITAL
SOMATOM PLUS
VC1
H-SP-CR

28-MAR-2006
11:40:52.59
TP -272.5

SPI 3



Chest Trauma

upper Chest Trauma carries risk of injury to vascular structures

Lower Chest Trauma carries risk of injury to liver, spleen & diaphragm

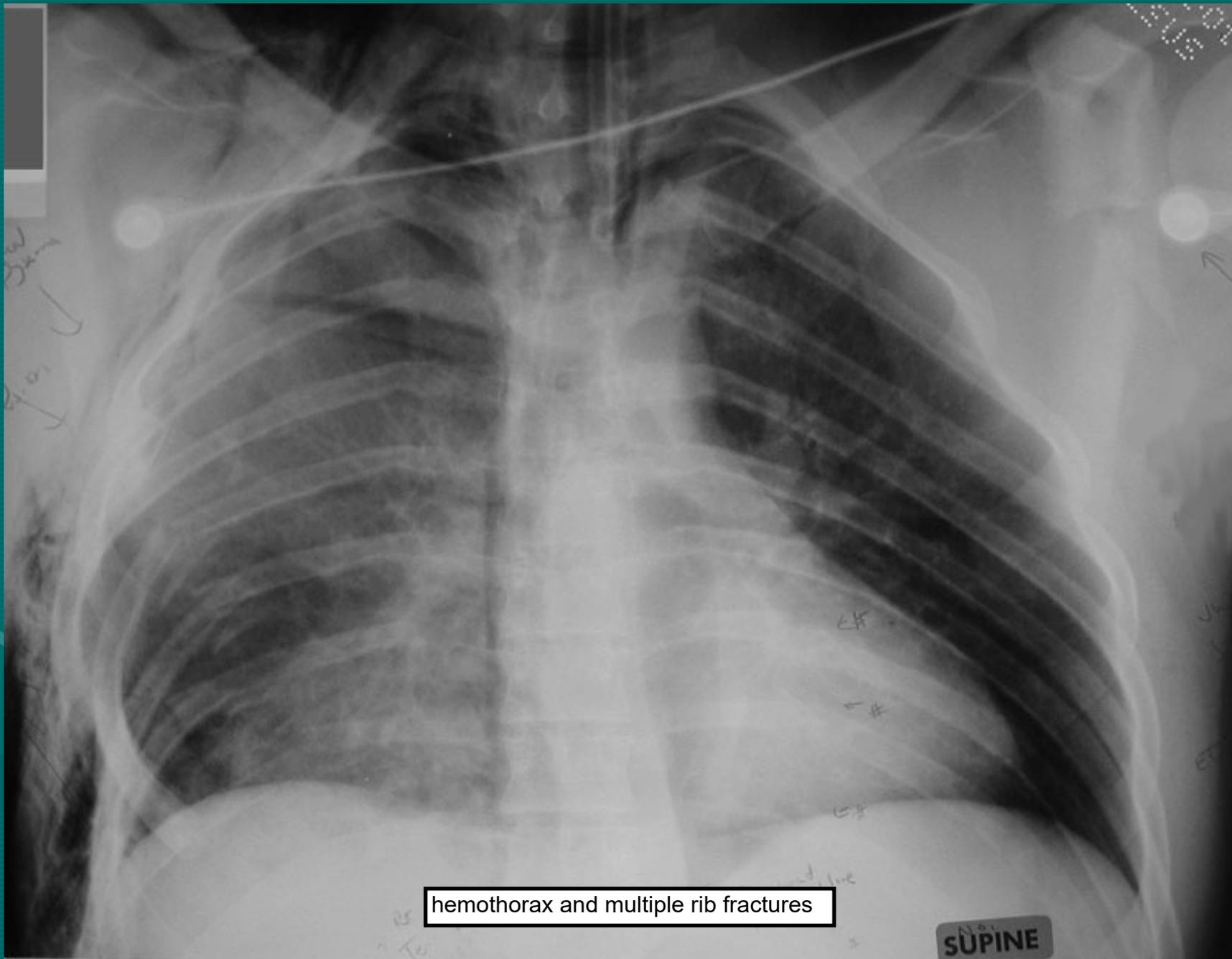
Chest trauma

- ❑ Chest trauma can be as blunt or penetrating.
- ❑ Penetrating chest trauma can injure vital organs such as the heart and lungs.
- ❑ The common clinical problems associated with chest injury include pulmonary contusion, pneumothorax and hemothorax.
- ❑ Fractures of the lower ribs may be associated with diaphragmatic tears and spleen or liver injuries
- ❑ Fractures of the upper ribs can be associated with injuries to adjacent great vessels.

Chest trauma / 2

What is the ABCDE approach to guide the radiographic search for thoracic injury ?

- Air : extra pulmonary (pneumothorax, subcutaneous emphysema, pneumomediastinum).
- Bones – rib fracture, thoracic spine, scapula and sternum fractures.
- Contusions and lacerations in the lung.
- Diaphragm - rupture.
- Effusions – hemothorax.



hemothorax and multiple rib fractures



Tension pneumothorax with mediastinal shift to the right, subcutaneous emphysema and rib fractures

A scenic landscape featuring a large body of water in the foreground, a dense forest of evergreen trees in the middle ground, and snow-capped mountains in the background. The scene is framed by dark evergreen branches on the right and left sides. The text "Thank You" is overlaid in the center in a red, rounded font with a white outline.

Thank You