Chest Imaging

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Imaging Methods

Cheap
Fast
Easy

- **CXR** * Low Dose Of Radiation

Computed Tomography

- MRI
- Ultrasound
- Nuclear Medicine

3D (more details), longer tima than XR, high radiation dose

How to read CXR?

Always take a good history
(acute vs chronic , fever …)

Optimize room lights

Patient data

Marker

Image view (PA, AP, lateral….)

Technique; rotation, penetration, inspiration

After that describe and put a differential diagnosis

Finally reach the final diagnosis (some time you need further imaging)

Chest x-ray, contents

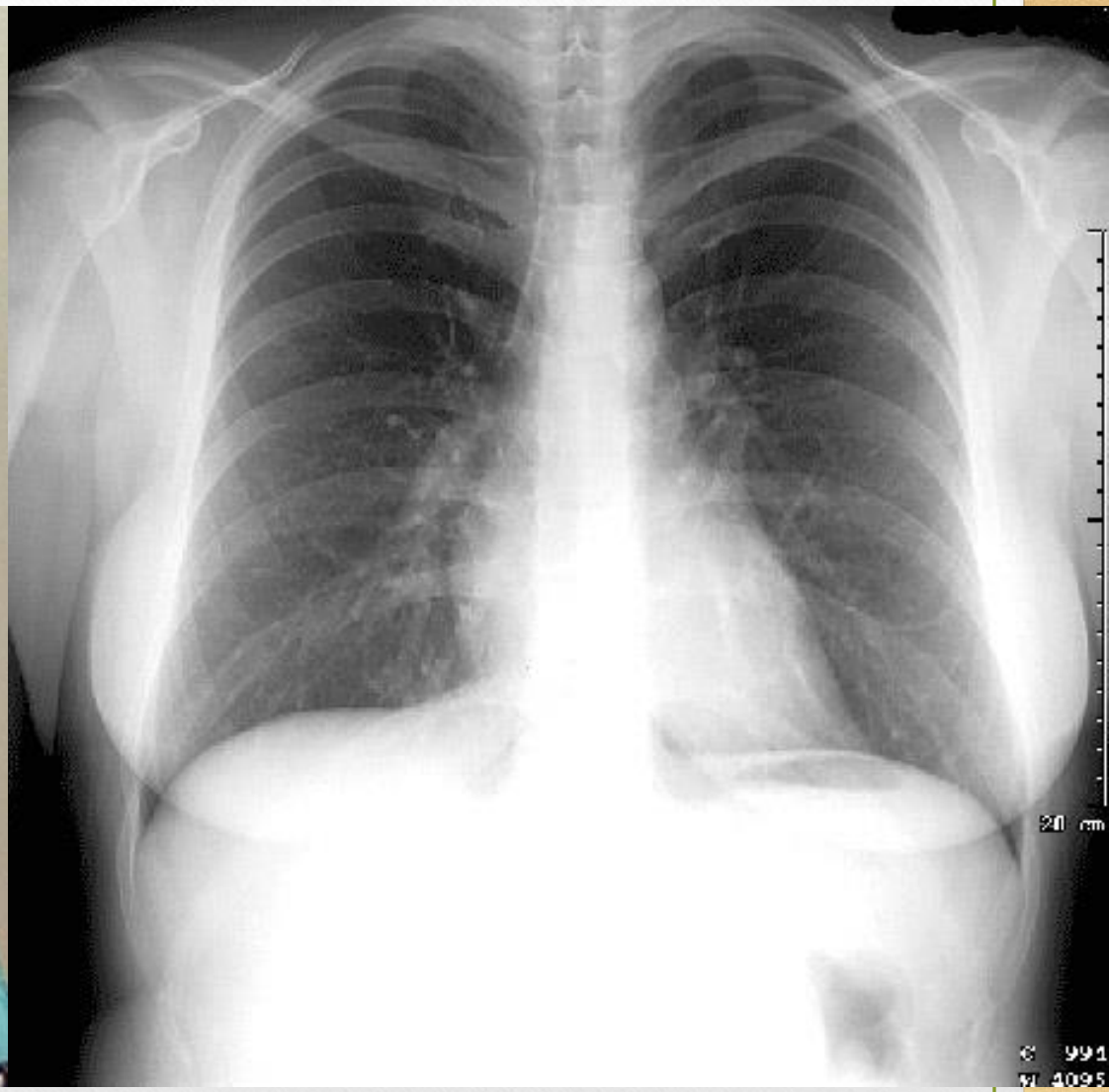
- Technique
- Routine:
  - PA vs. AP, AP is used in pediatric age group and unstable patients.
  - lateral CXR

  The combination of these two views allows us to determine the site of pathology
- Lateral decubitus film;

When we say right lateral decubitus film, the right side is the dependant side of the patient.

  - Used to assess pleural effusion. If you suspect pleural effusion on the right side, then you have to take right lateral decubitus film.
  - Used to assess pneumothorax. If you suspect pneumothorax on the right side, then you have to take left lateral decubitus film.
- lordotic view, used to assess pancoast tumors and right middle lung lobe collapse.
- Determine technically adequate film (inspiration, penetration and rotation)
- Anatomy
- Interpretation

Chest x-ray positioning - PA -



This position of the arm in order to displace the scapulae away from the lung field.
The image is taken on full inspiration

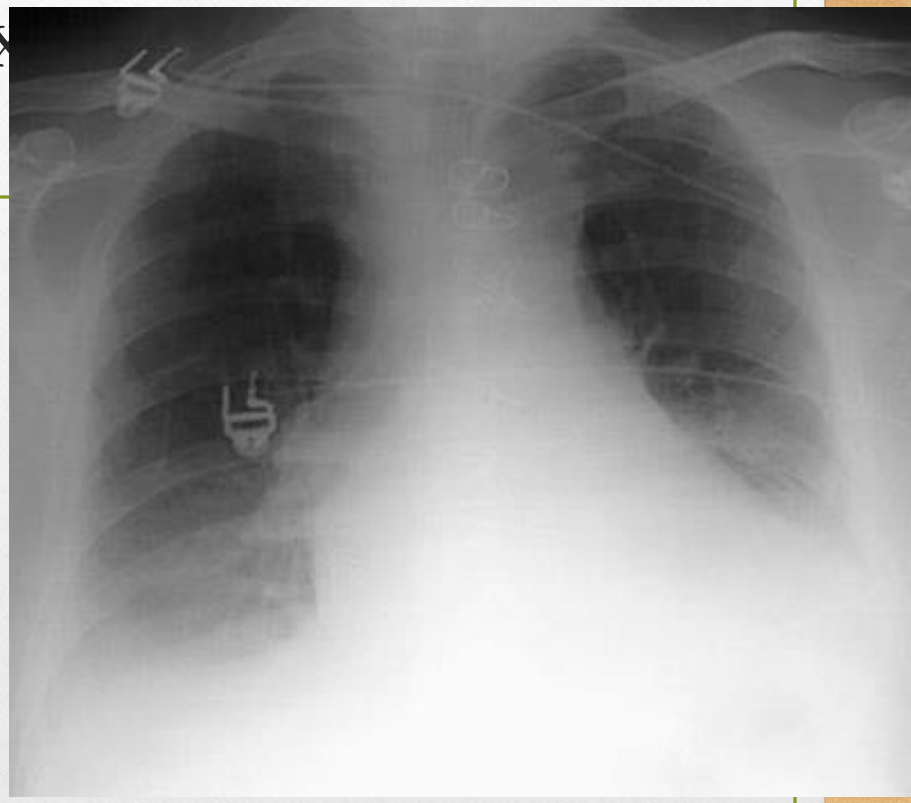
Chest x-ray positioning -lateral-

In lateral X-ray, the left side of the patient is the one that faces the film

Chest x-ray - AP -

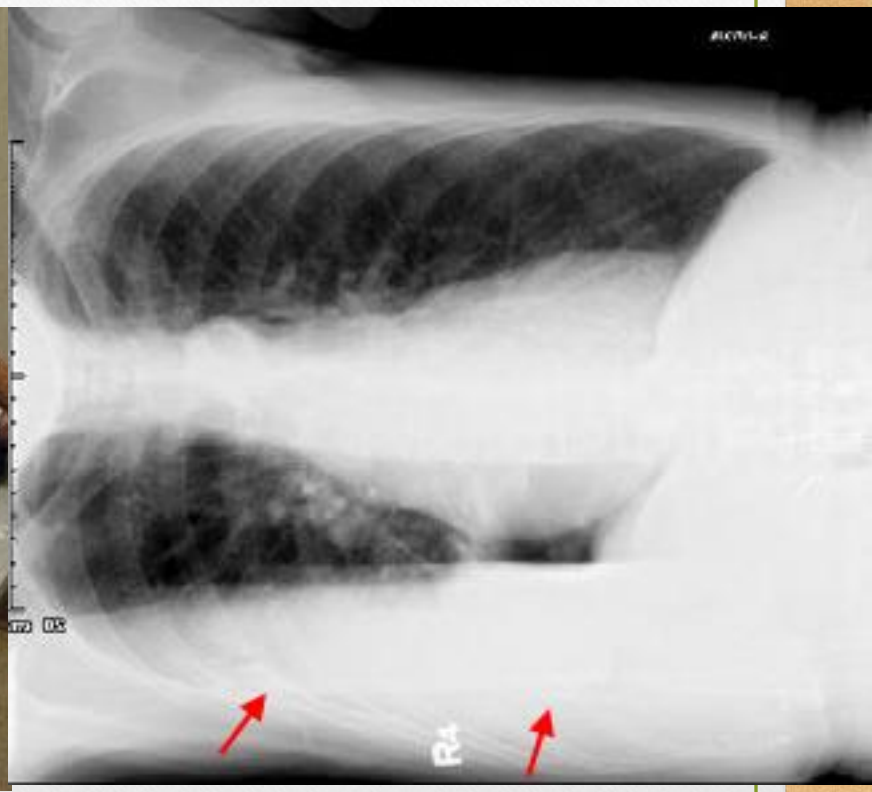
Chest x

PA



AP

CXR –lateral decubitus



This is a right lateral decubitus X-ray, as the right side of the patient is the dependent side when taking the image

Lordotic View

Better assess apices without bone overlap

This view is used to assess pancoast tumors and right middle lung lobe collapse

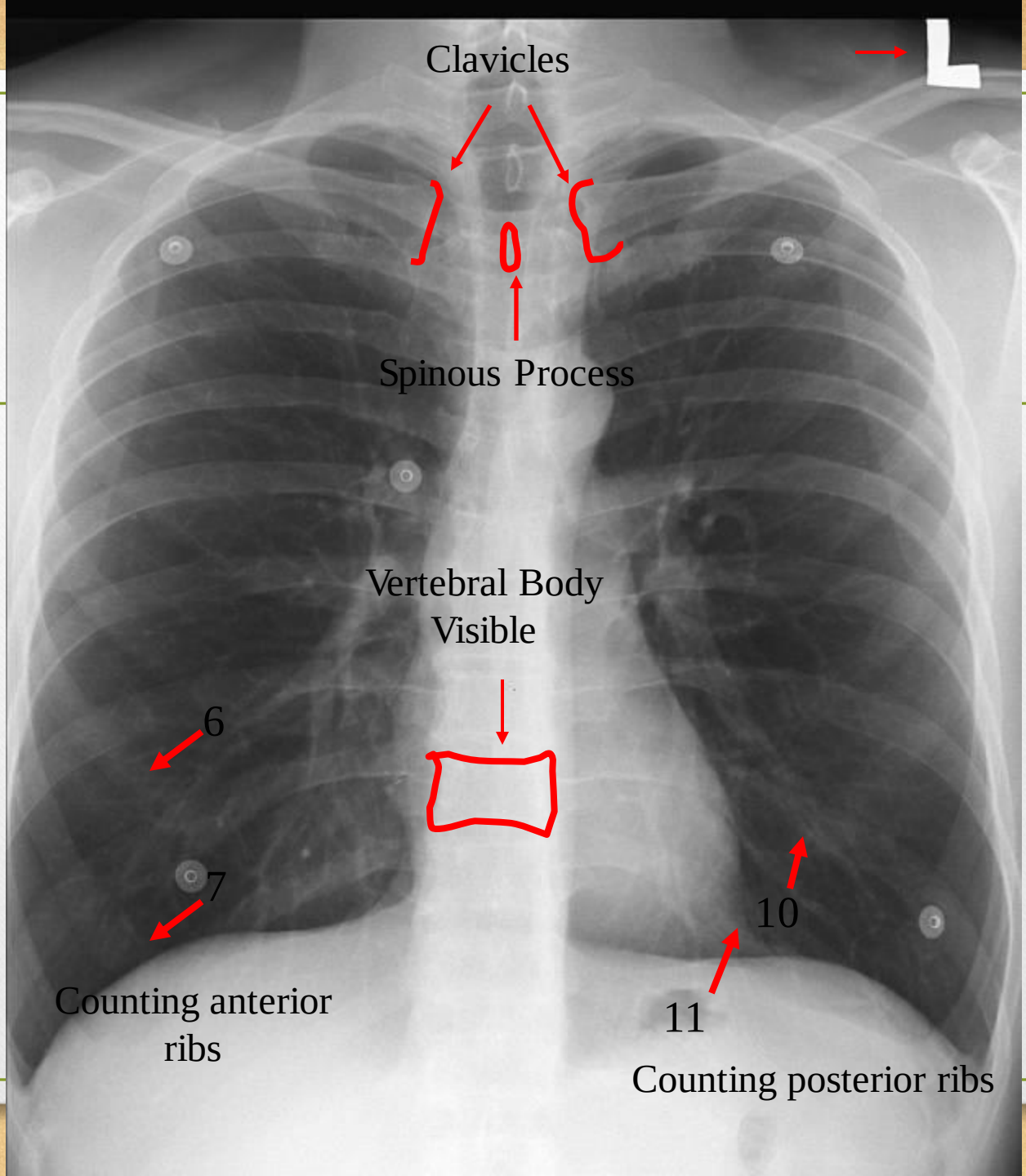
Approach to Chest Radiograph: Technical Factors

1. Patient identification (name and date)

2. Markers (left, right). The photographic plates should be labeled for right and left before taking the image. If the plate is labeled after taking the image depending on heart apex or something else, then cases as dextrocardia may be missed.

Approach to Chest Radiograph: Technical Factors

3. Rotation; Assessed by measuring the distance from the spinous processes to the clavicles on both sides, the distance should be equal.


Clavicles
Spinous Process
Vertebral Body Visible
6
7
Counting anterior ribs
10
11
Counting posterior ribs

Approach to Chest Radiograph: Technical Factors

4. Penetration

- In PA image, A good penetration means that you can count three visible thoracic vertebrae in the retrocardiac region. In both over and under penetrated CXR, it is difficult to count three vertebrae in retrocardiac region.

- In lateral x-ray.
  - The spine darkens (increased radioluscency) as we go caudally
  - sternum should be seen edge on
  - Two sets of ribs posteriorly (the wider and more dorsal set represents the right ribs)

Underpenetrated

Over penetrated

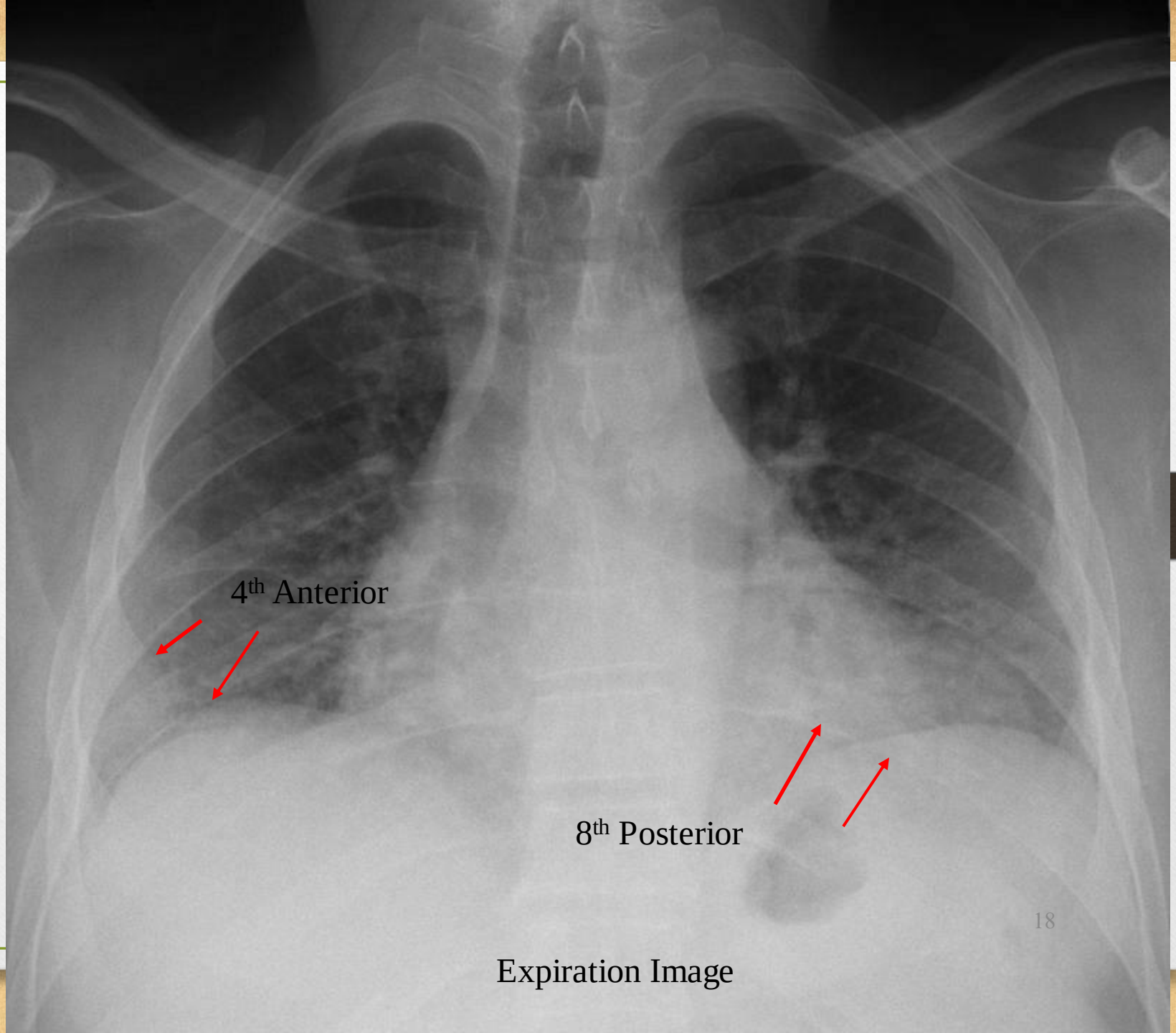
CXR -penetration

-The spine darkens (increased radioluscency) as we go caudally
- sternum should be seen edge on
-Two sets of ribs posteriorly (the wider and more dorsal set represents the right ribs)

Approach to Chest Radiograph: Technical Factors

5. Inspiration vs expiration

- The normal X-ray is an inspiratory film.
- normal inspiratory film shows 6 anterior ribs or 10 – 11 posterior ribs. The posterior ribs are the horizontal ones and they appear more clear than the anterior ones in PA.
- Expiration
  - Heart size appears larger
  - Mediastinum is wider

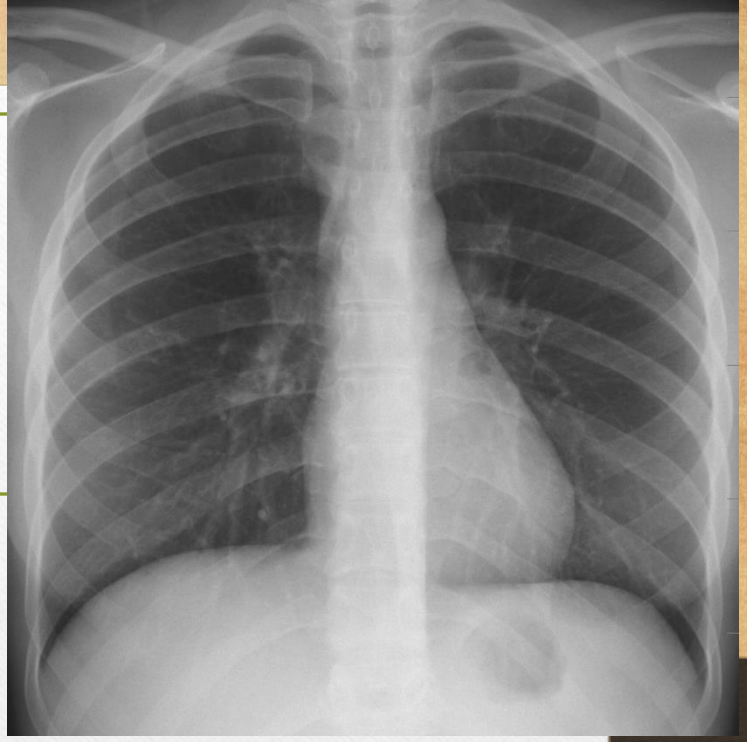


Expiration Image

Expiration

Inspiration: Same Patient

Radiographic Density



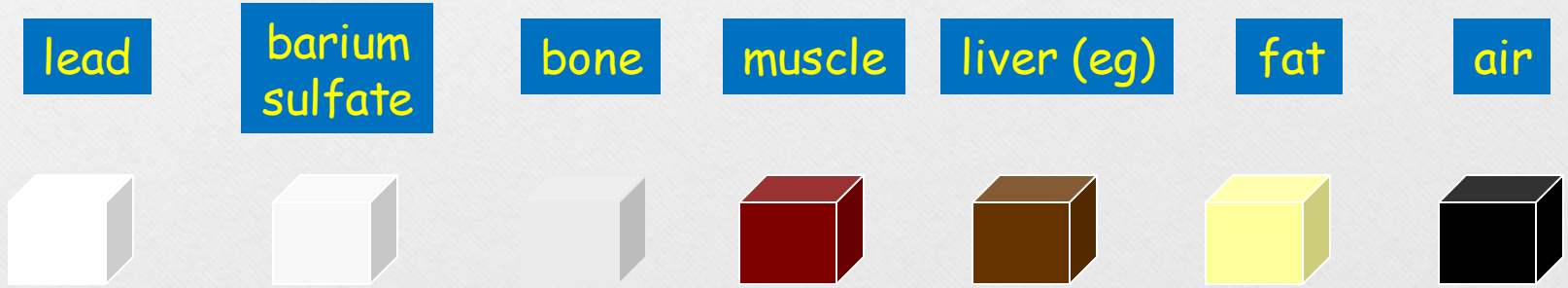
4 Basic Radiographic Densities

-Bone (white)

-Soft tissue/ water

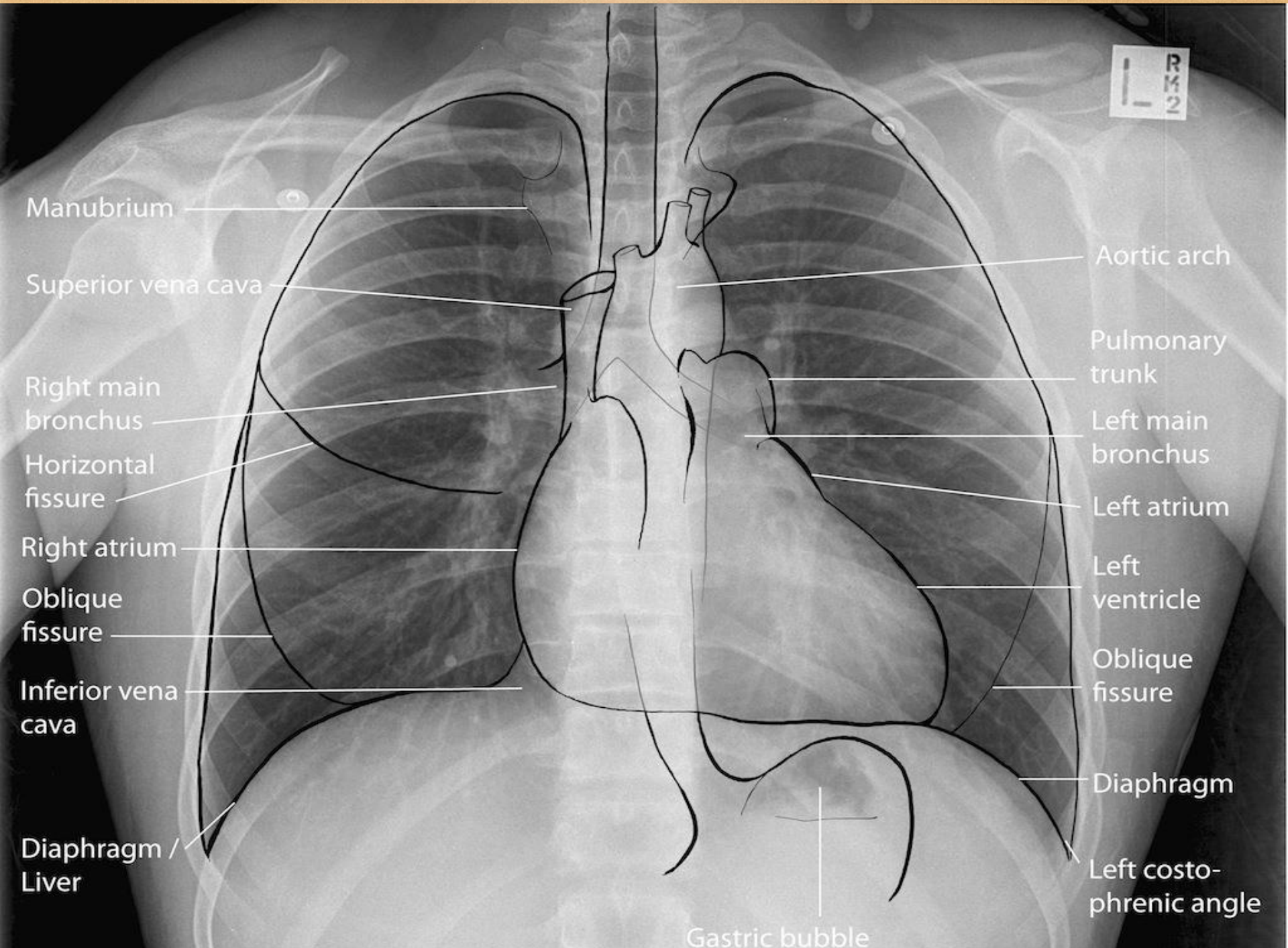
- Fat

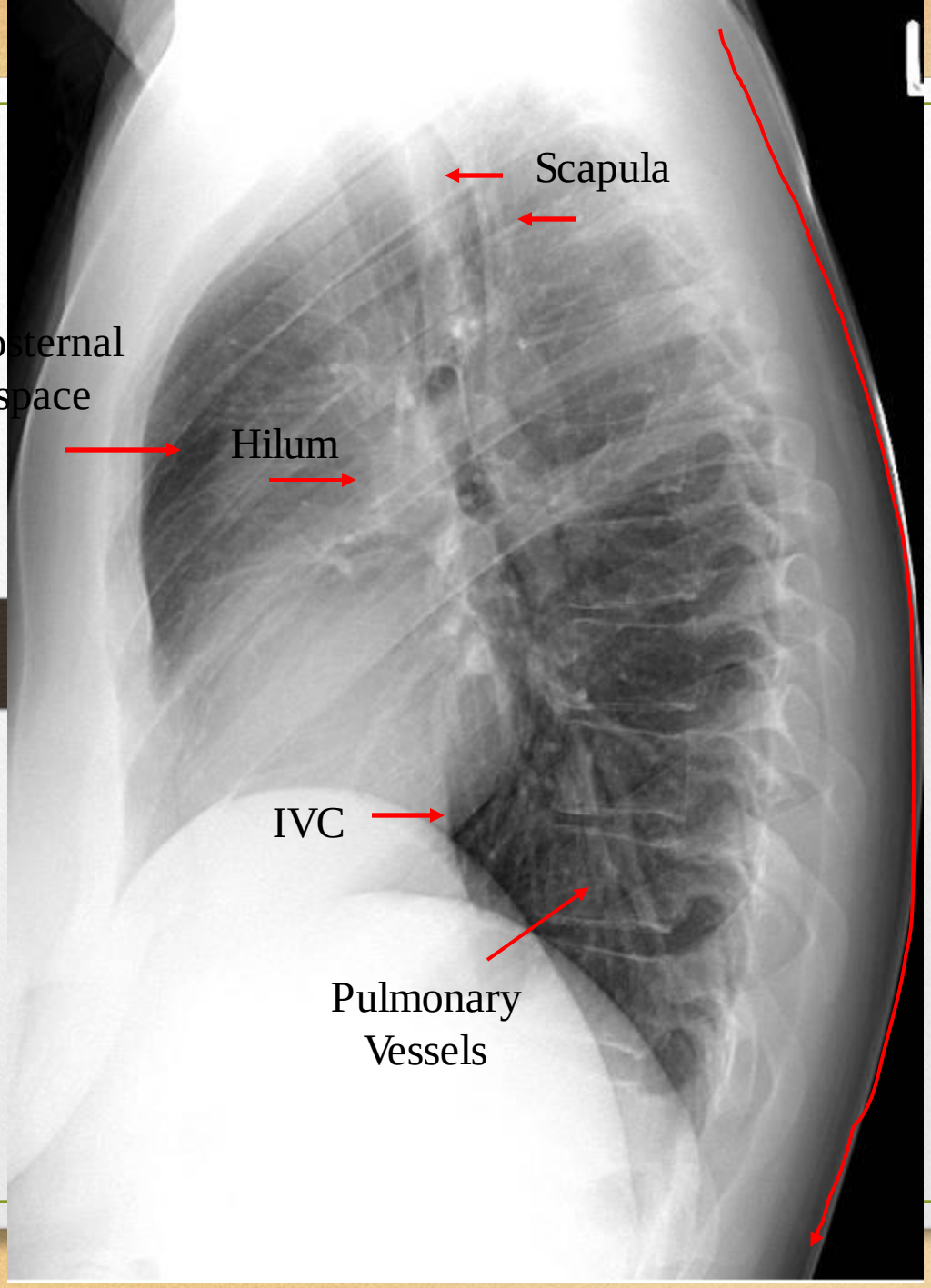
- Air (black)



X-ray film

Normal Anatomy


Manubrium
Superior vena cava
Right main bronchus
Horizontal fissure
Right atrium
Oblique fissure
Inferior vena cava
Diaphragm / Liver
Aortic arch
Pulmonary trunk
Left main bronchus
Left atrium
Left ventricle
Oblique fissure
Diaphragm
Left costo-phrenic angle
Gastric bubble

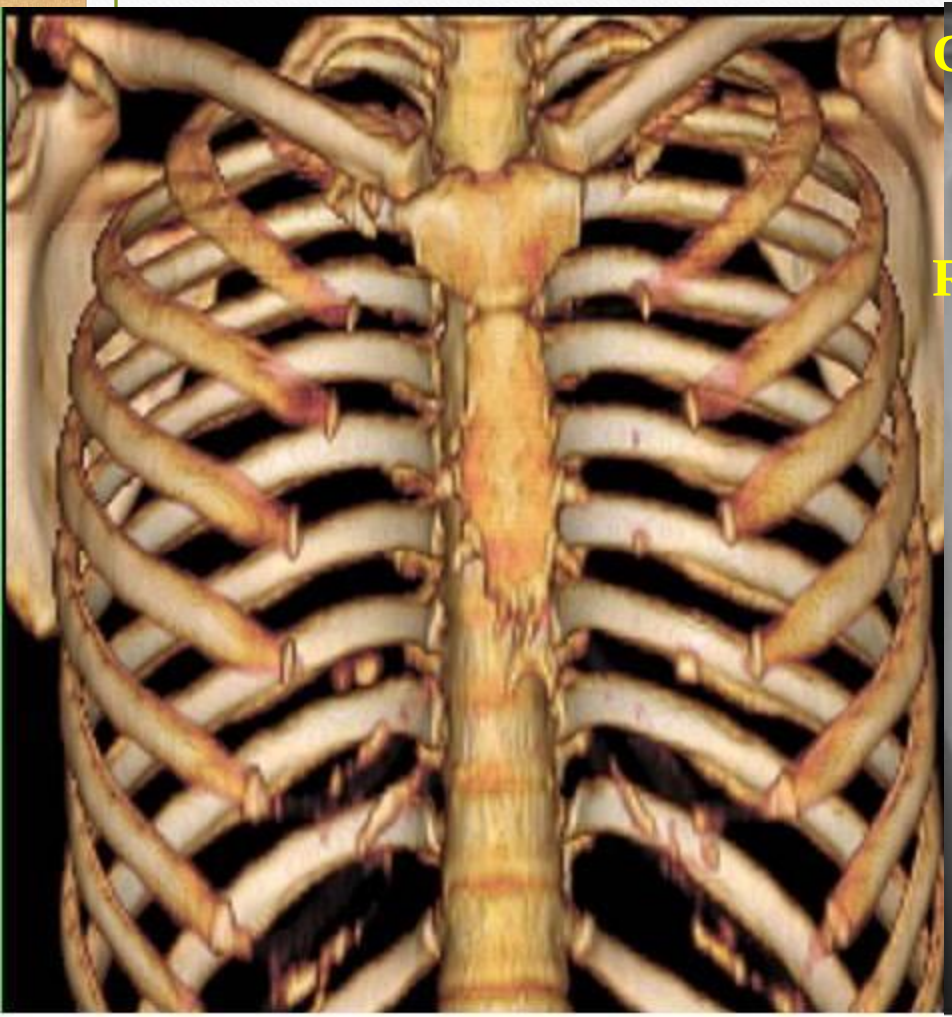


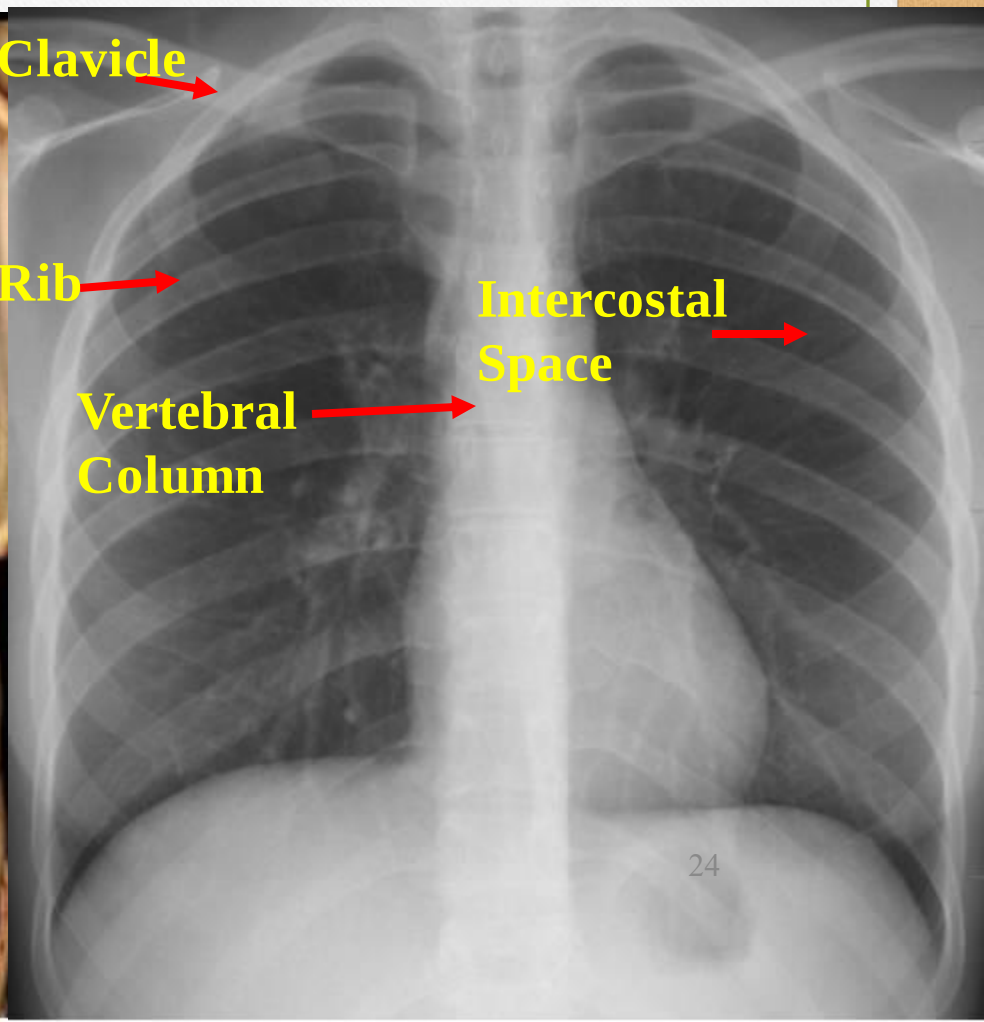
Lungs posteriorly should get darker as you go down more inferiorly
except in the case of effusion, Mediastinal mass.. Etc

Normally you can't see more than two fingers size of the left ventricle behind the inferior vena cava except in the case of left ventricular enlargement.

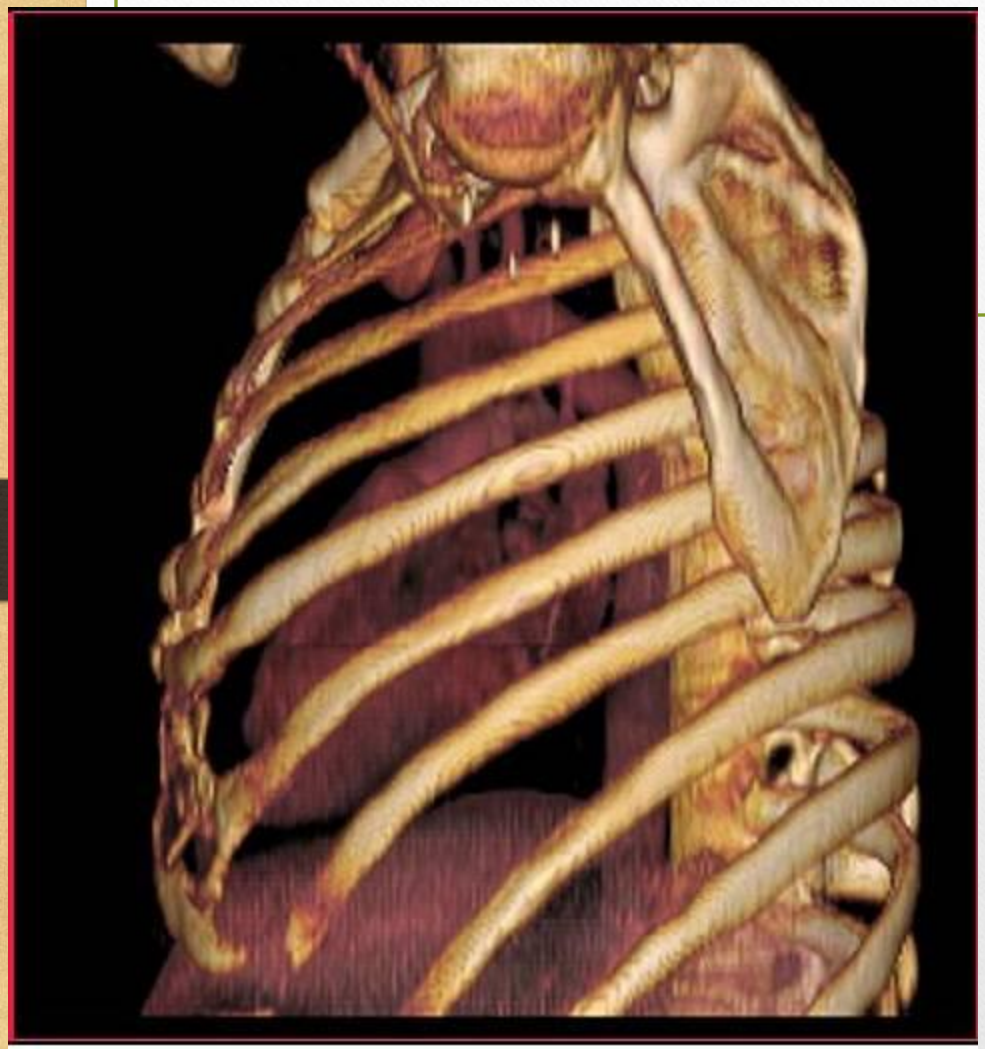
Bone-CT Reconstruction

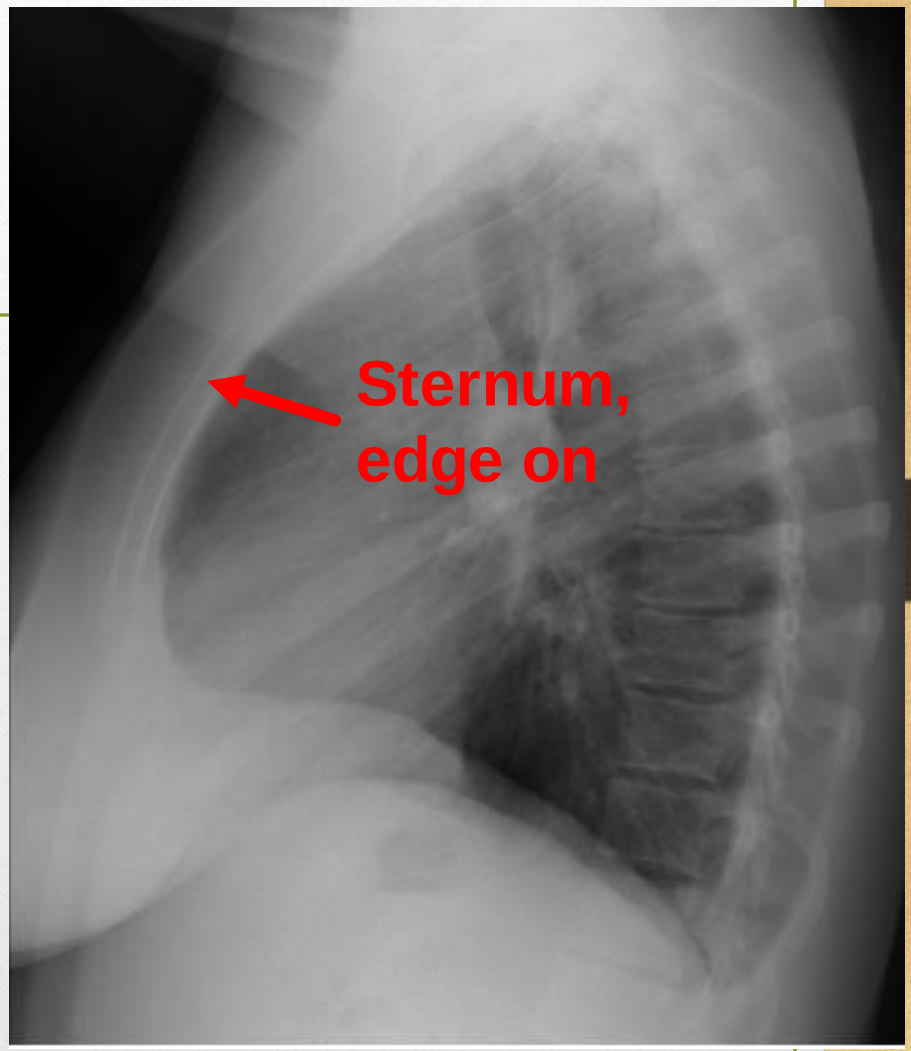
PA View





Bone Anatomy



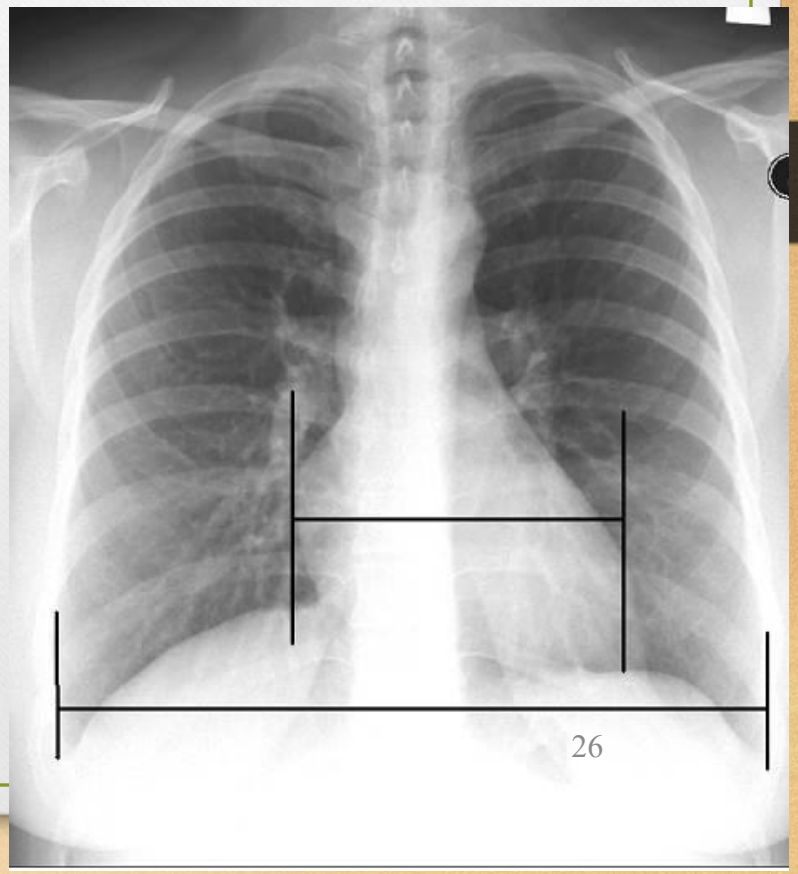


Heart Size, PA view

Cardiothoracic ratio

$$\frac{\textit{maximal horizontal cardiac diamet}}{\textit{maximal horizontal thoracic diame}}$$

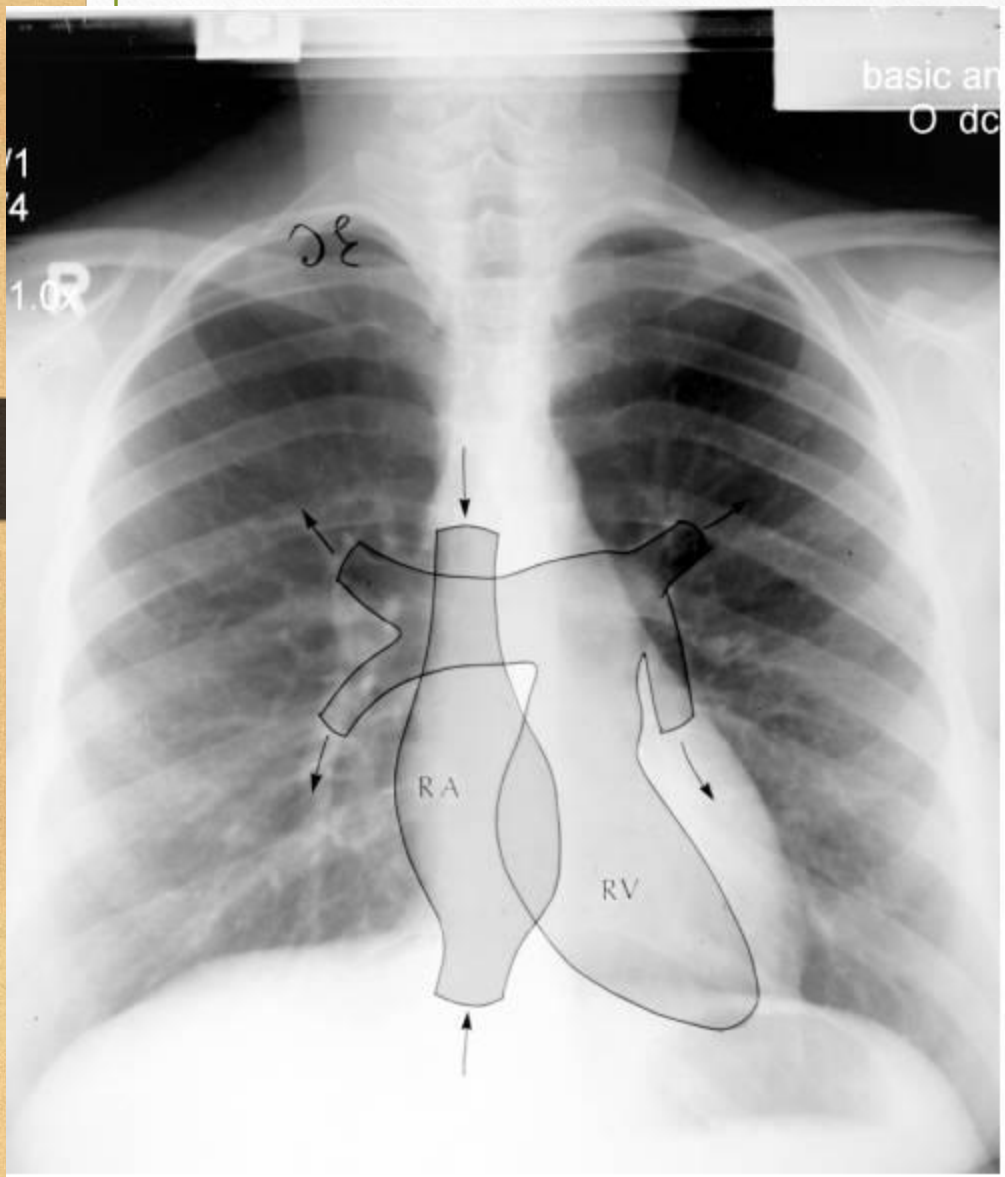
- The maximal horizontal diameter represents the farthest point in the right side from midline + the farthest point in the left side. "not necessarily both points to be at the same level" .
- Normal is <50% on PA upright, full inspiration radiograph.

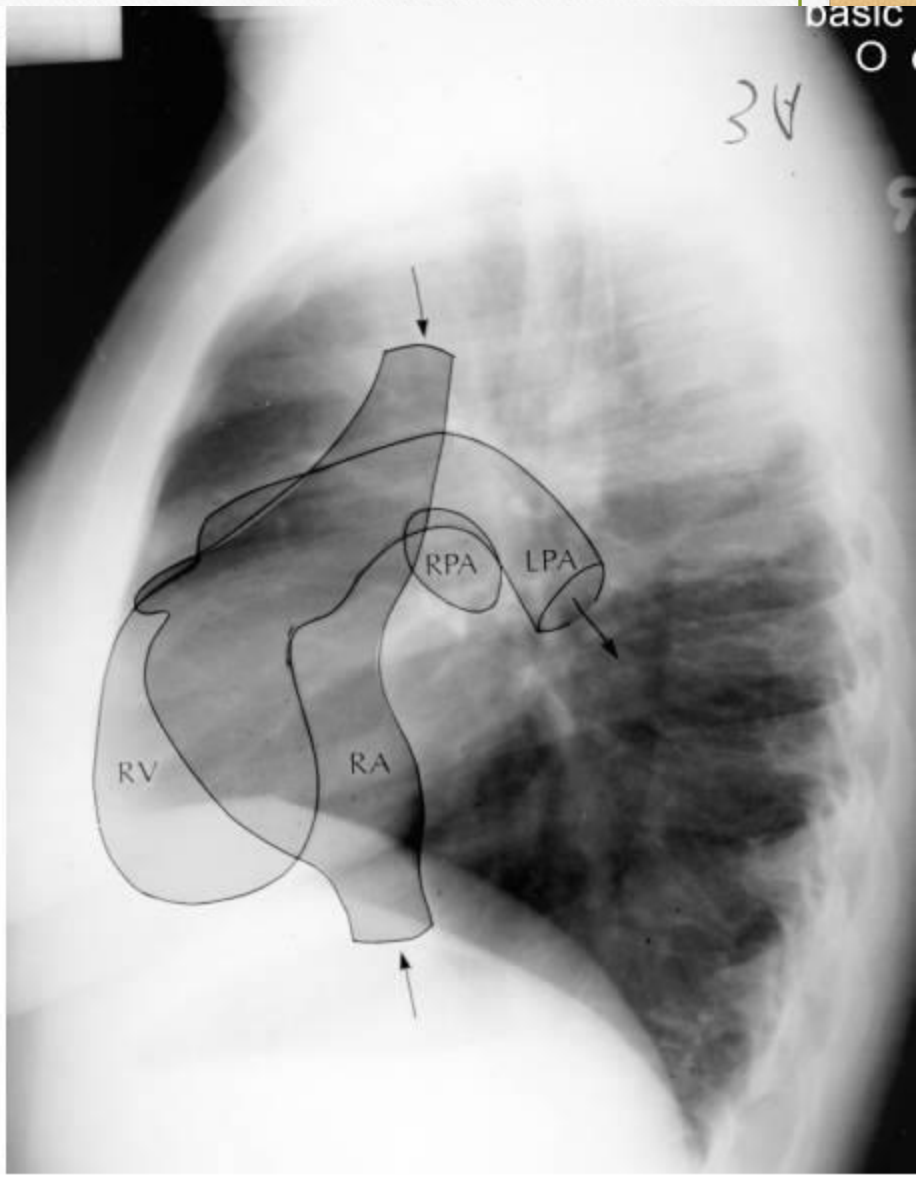


Heart size, Lateral view

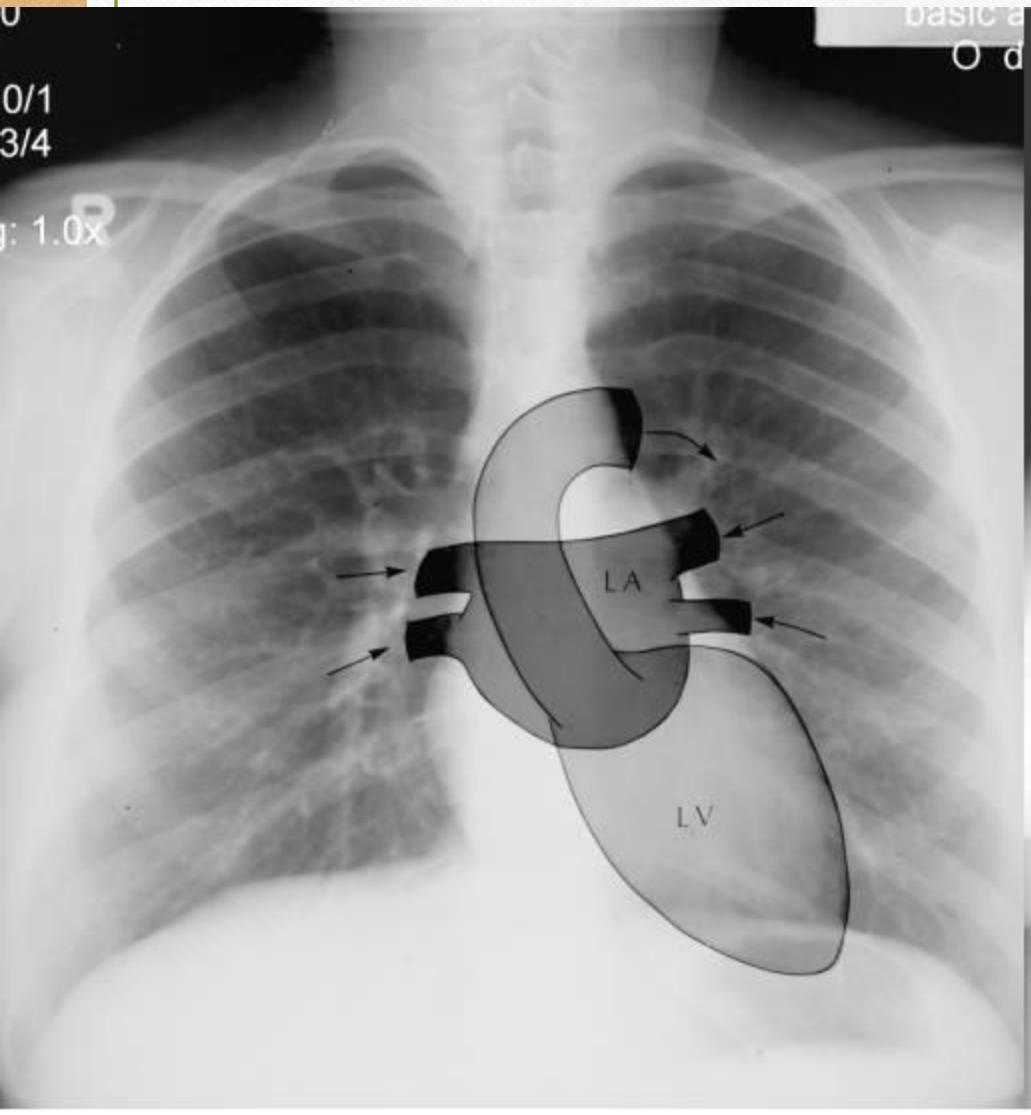
As the heart enlarges, the posterior border of the heart may extend to, or overlap, the anterior border of the thoracic spine.

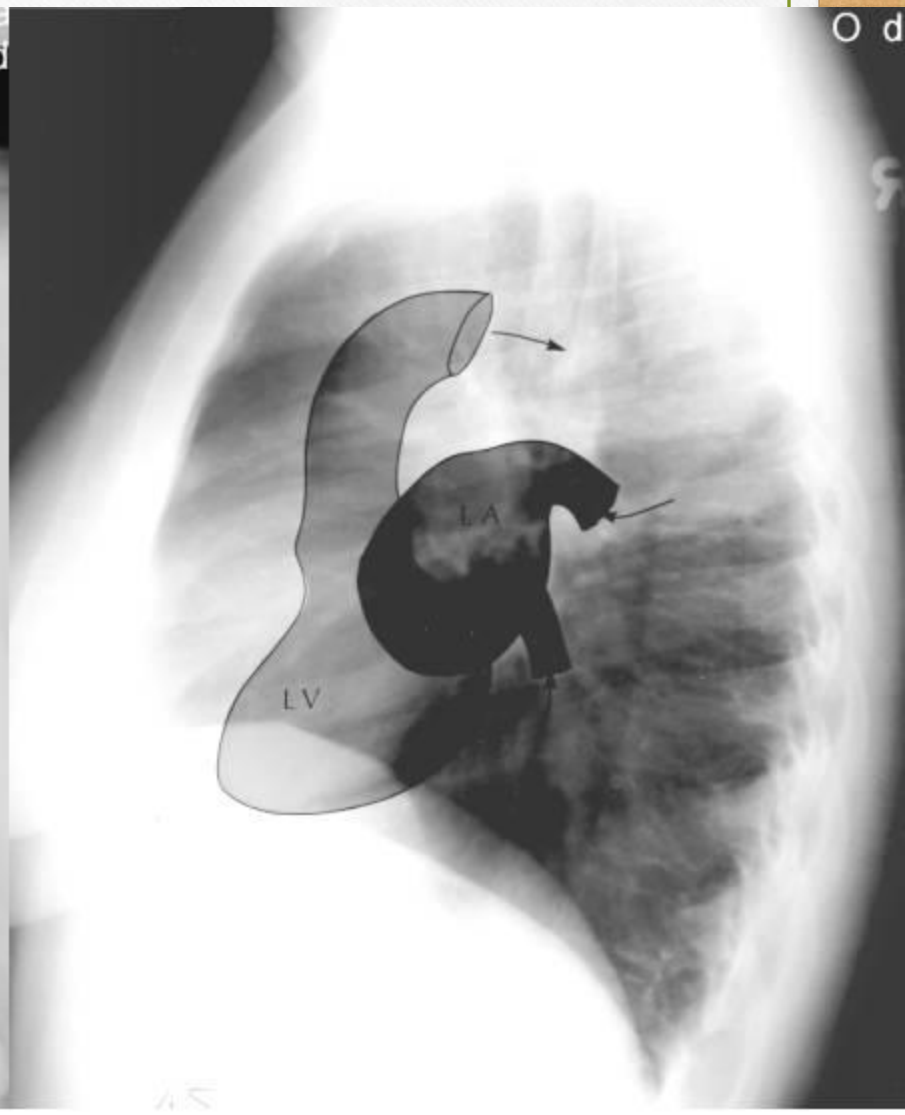
Cardiac Anatomy: Right Sided Chambers



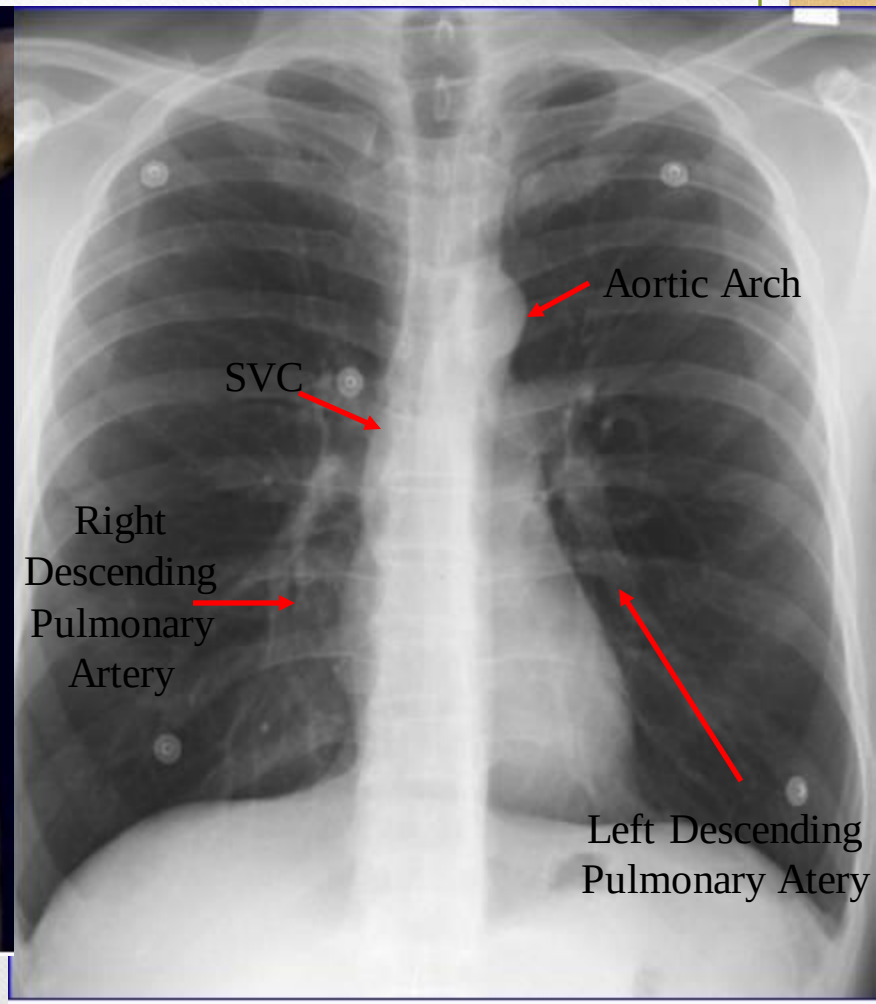


Cardiac Anatomy: Left Sided Chambers





Vascular anatomy on CXR

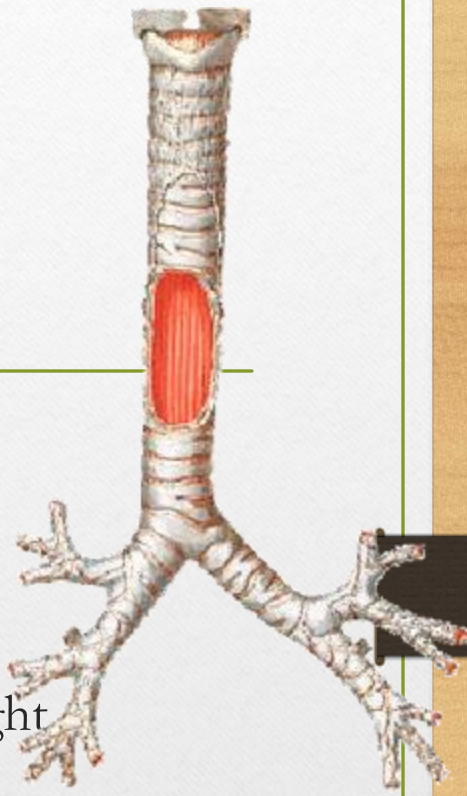


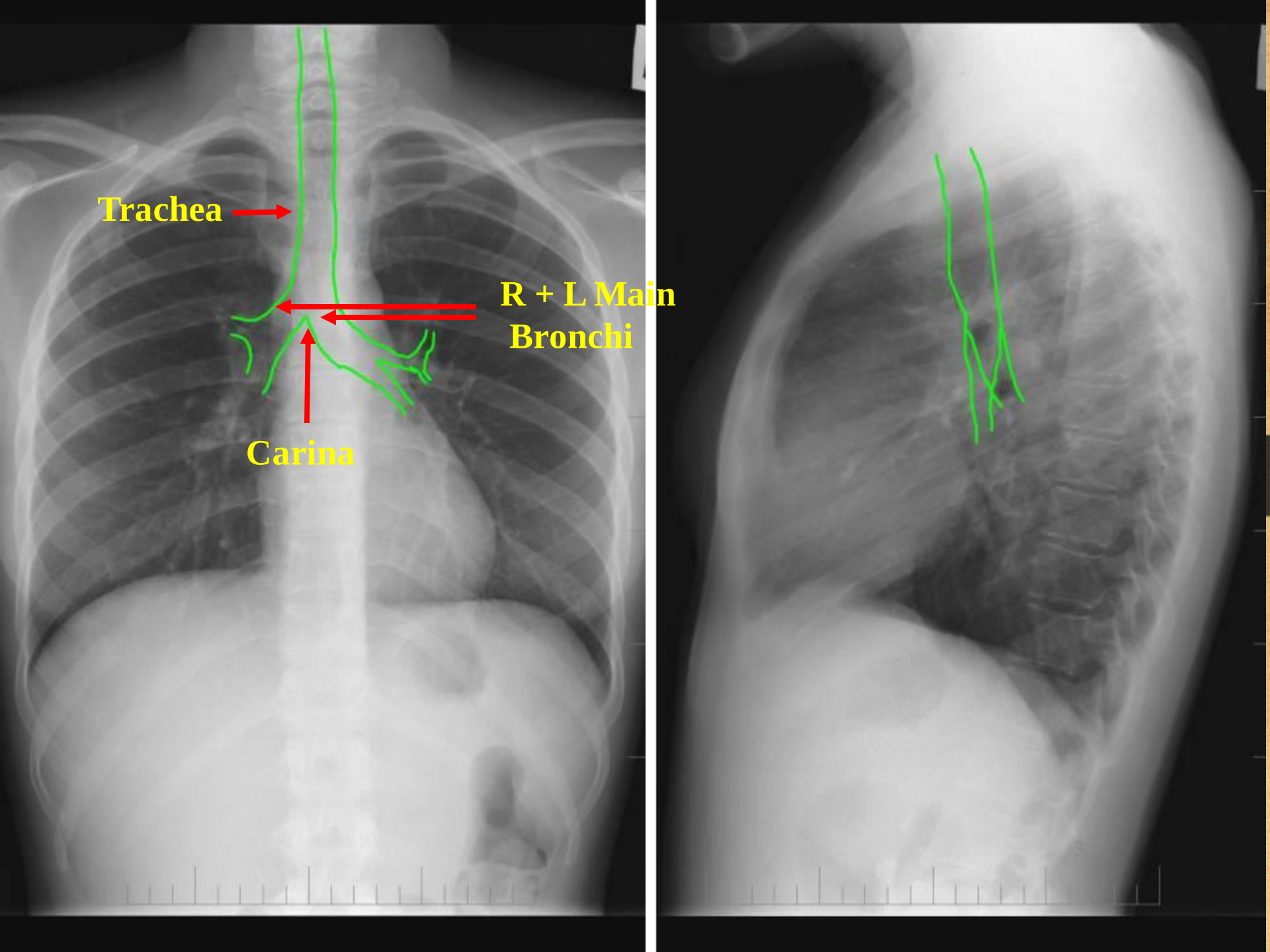
Left hemidiaphragm is lower than the right because of the heart position. In isolated dextrocrdia, the right hemidiaphragm is lower than the left one.

- On the right side of chest x-ray we can see the following structures: (from superior to inferior);
  Superior vena cava, ascending aorta, and right atrium.
- On the left side we can see: aortic arch, pulmonary vessels, and the left ventricle
- Between the left-sided structures we can see two concavities:
  - aortopulmonary window 2- the region of the left atrial appendage

Airway Anatomy

- Trachea
  - Cartilage
  - Membranous posteriorly
- Carina
  - Bifurcation
- Bronchus
  - Left and right, the right one is wider and more straight
  - Lobar (RUL,RML,LUL,LLL)
  - Segmental (8 left, 10 right)

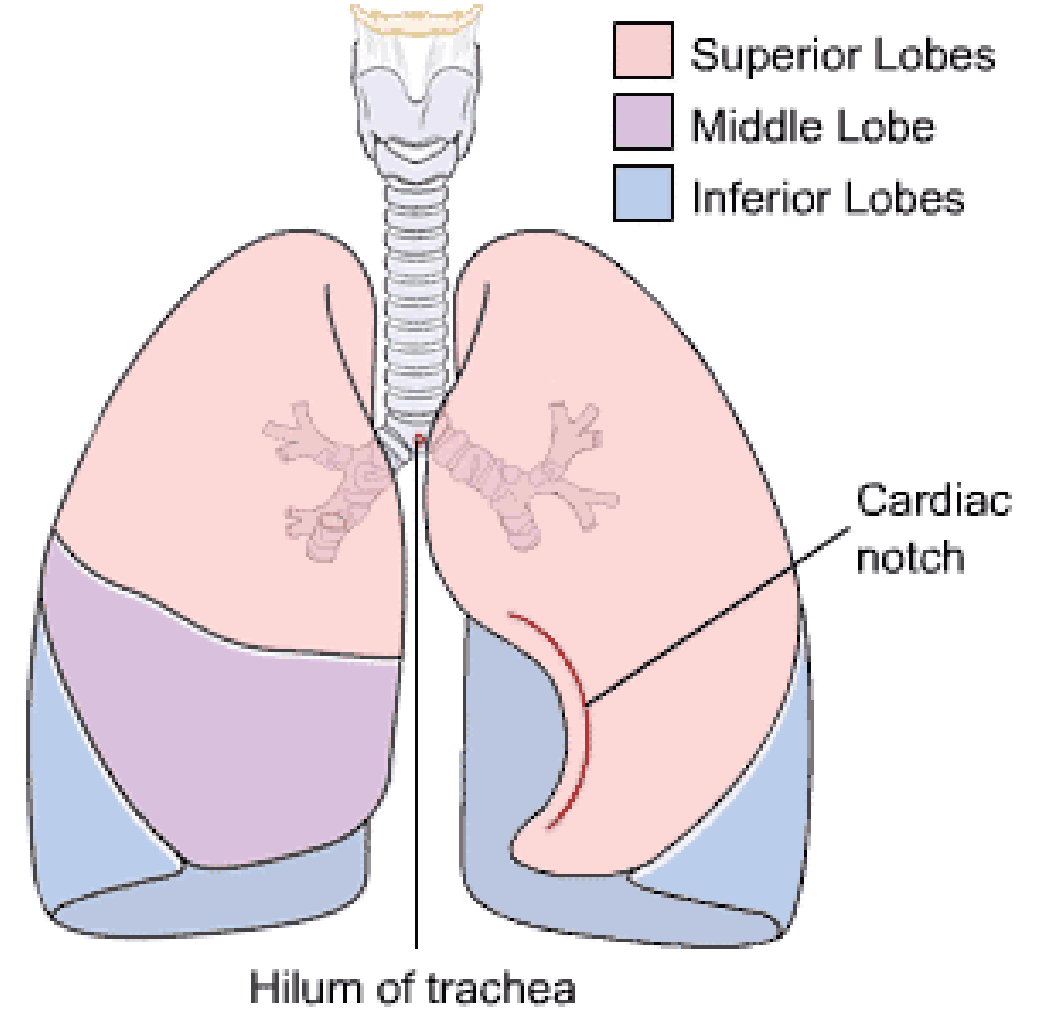



Trachea
R + L Main Bronchi
Carina

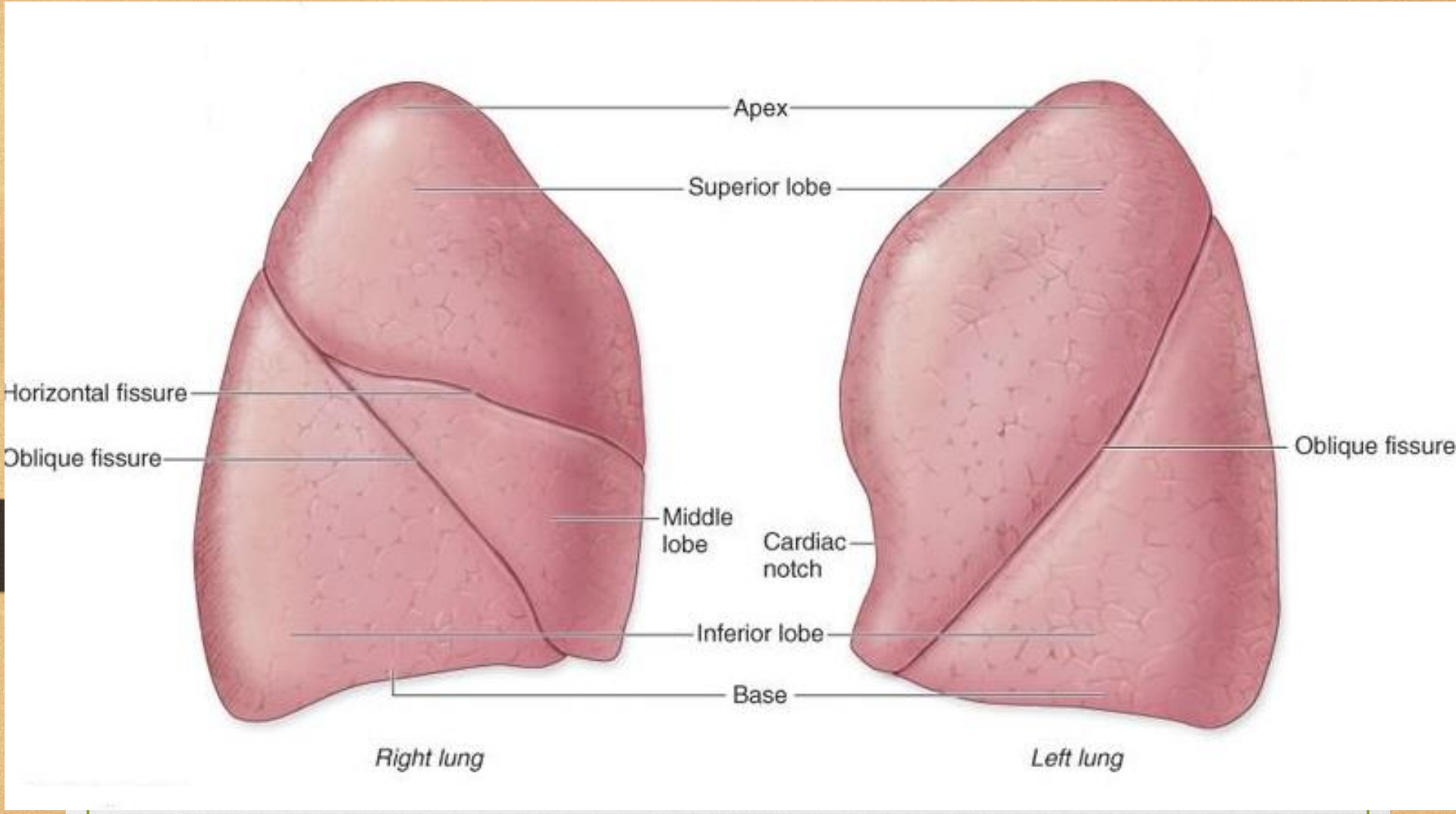
Lung Anatomy

- Lobes are separated by fissures
- Right
  - Upper Lobe
  - Middle Lobe
  - Lower Lobe

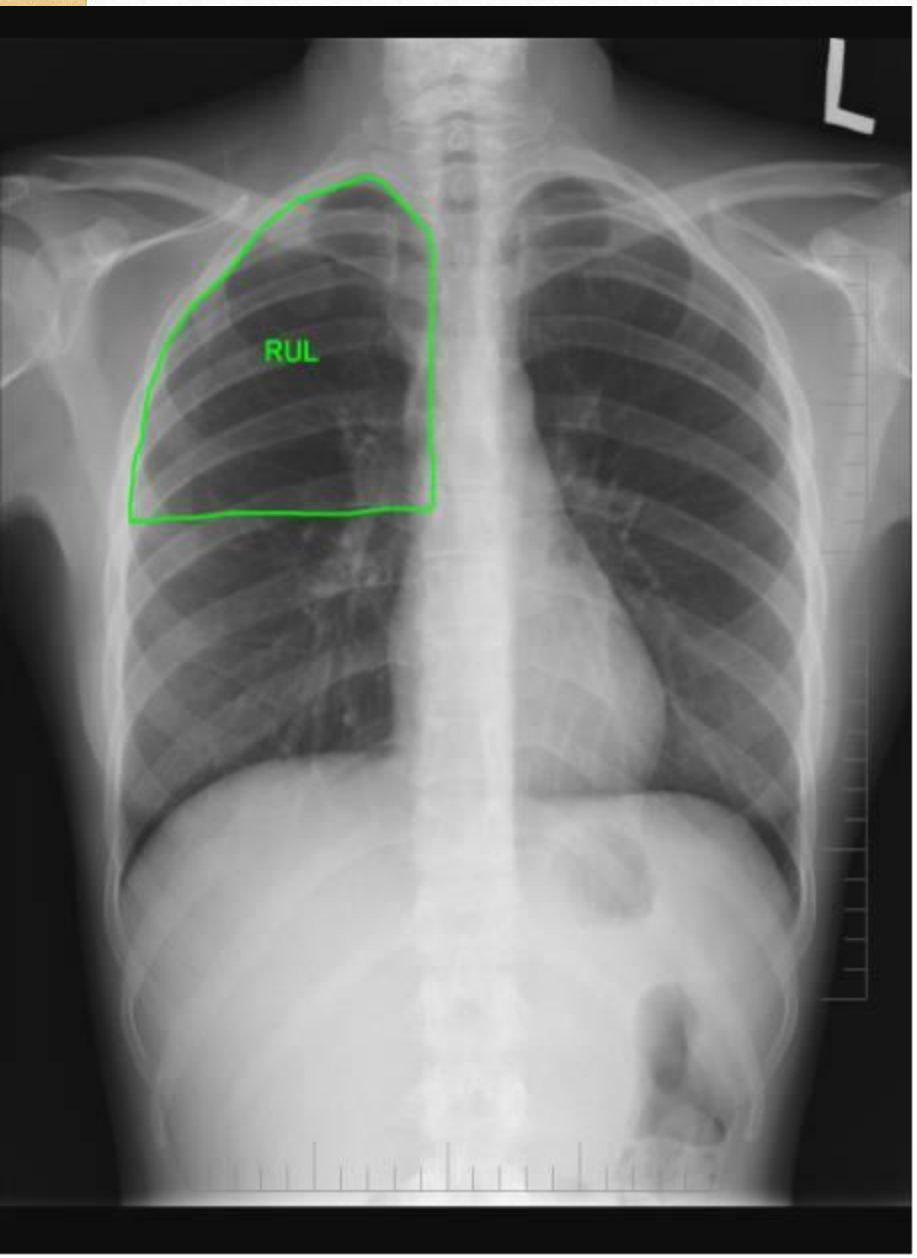
  upper and middle lobes are separated by the transverse fissure (minor fissure). Upper and lower lobes are separated by oblique fissure (major
- Left
  - Upper Lobe (includes lingula)
  - Lower Lobe

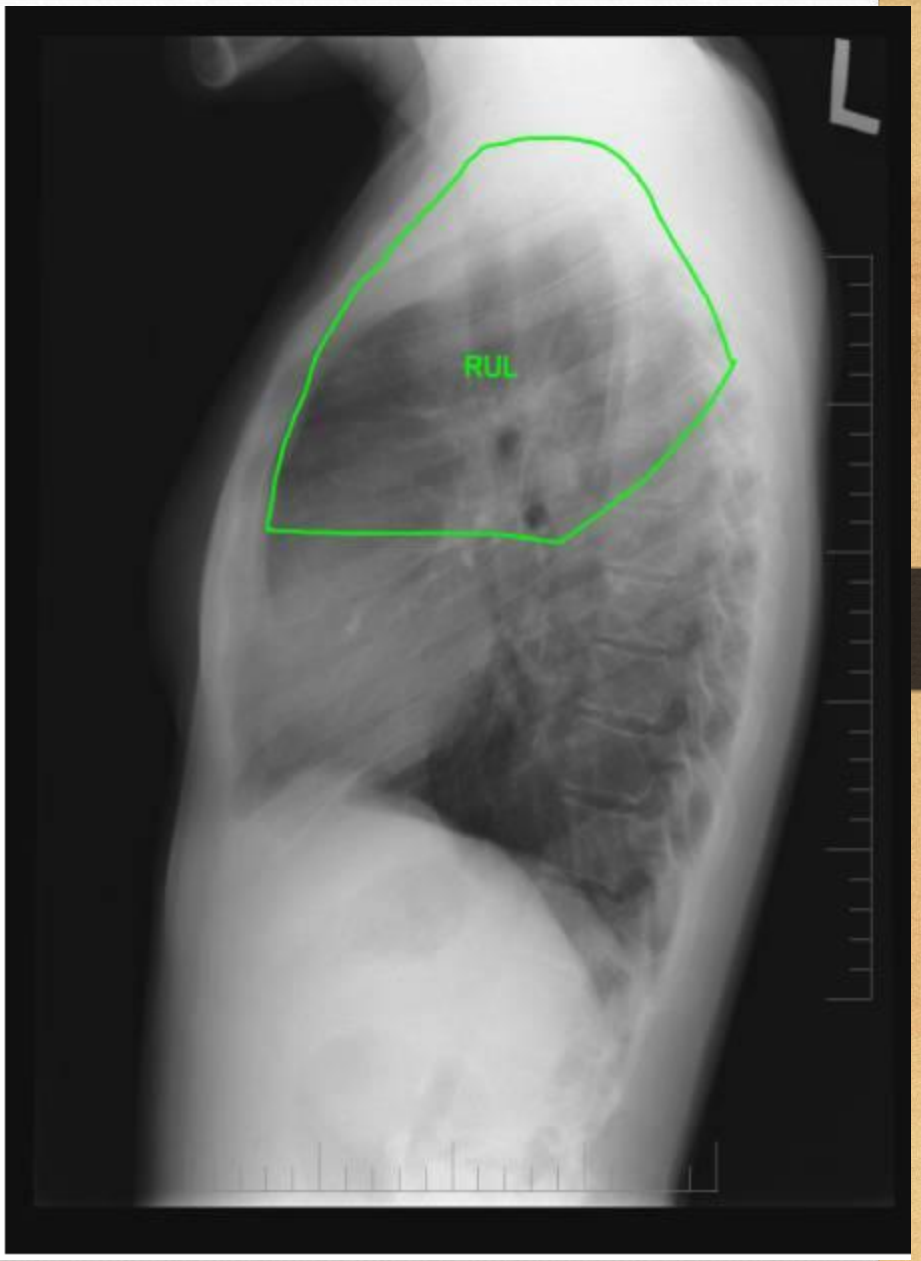


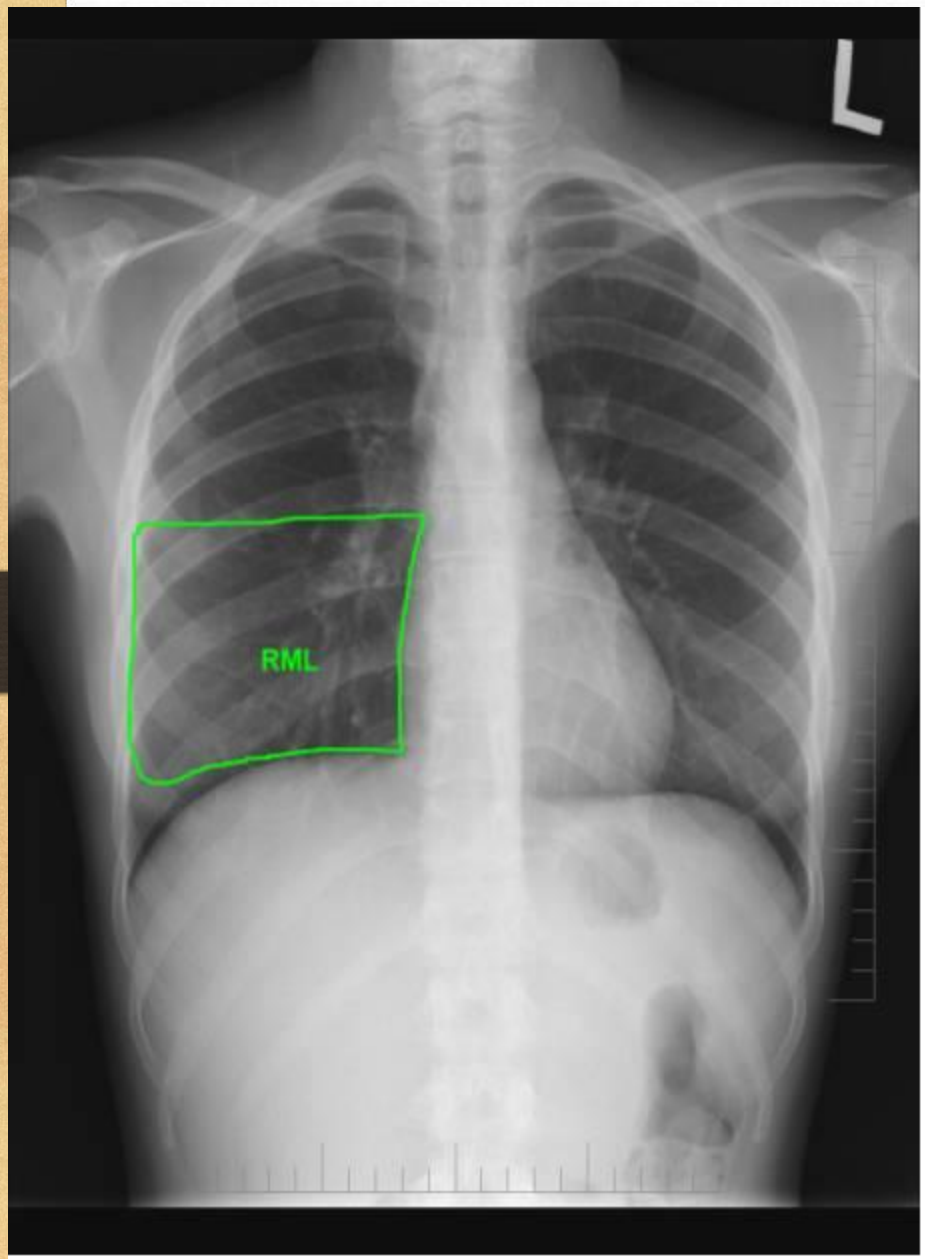
Lung lobes, anterior view

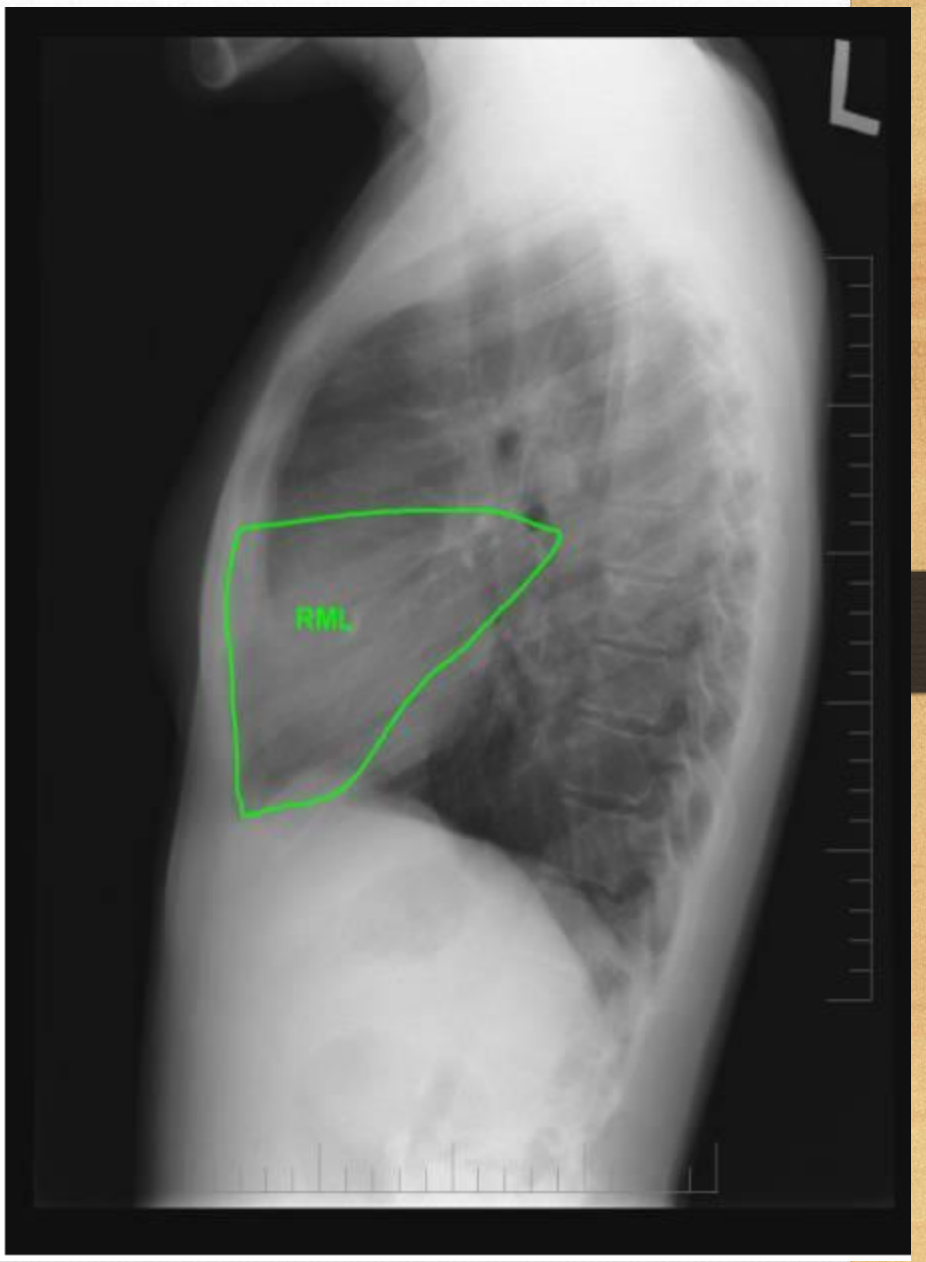


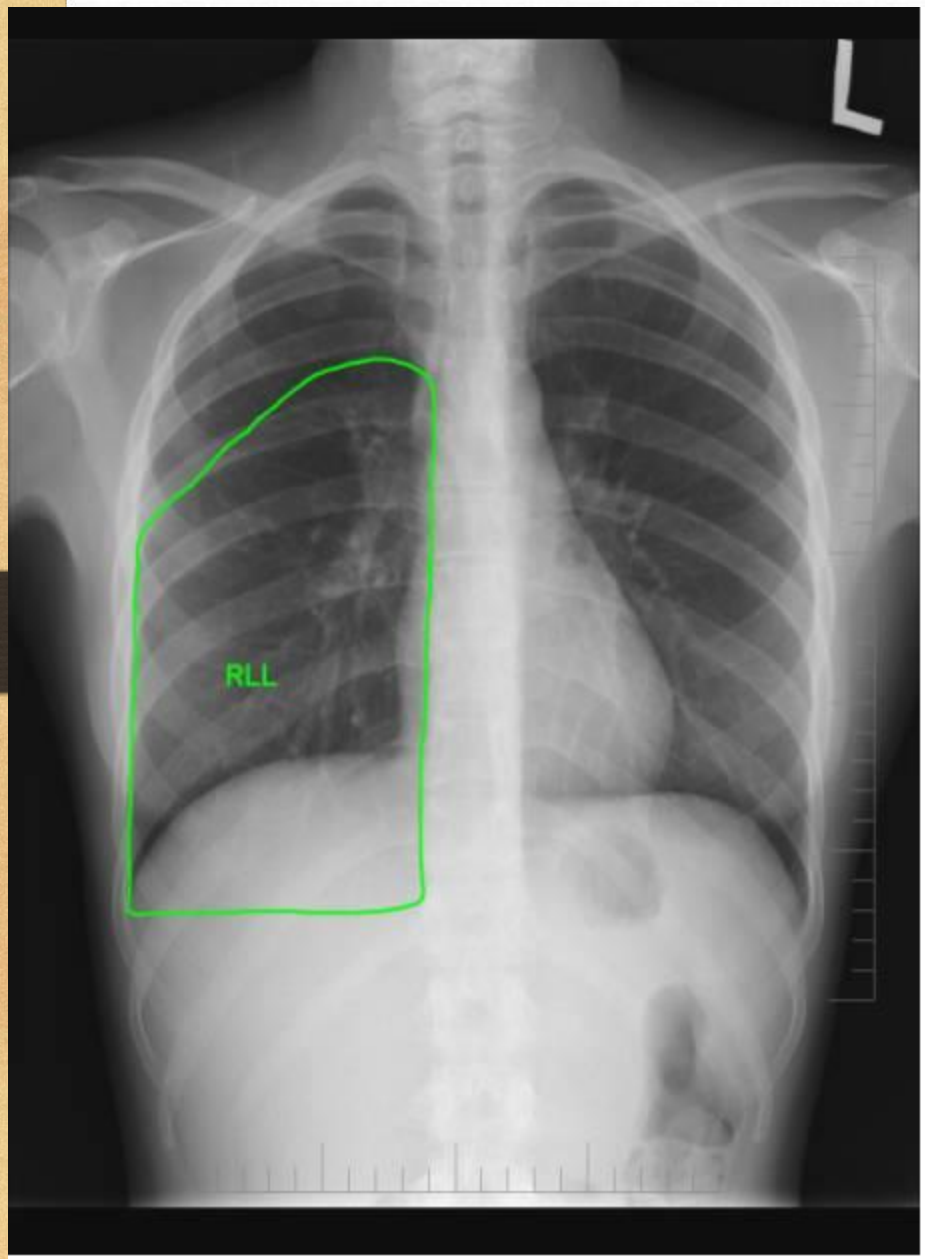
Lung lobes, lateral view

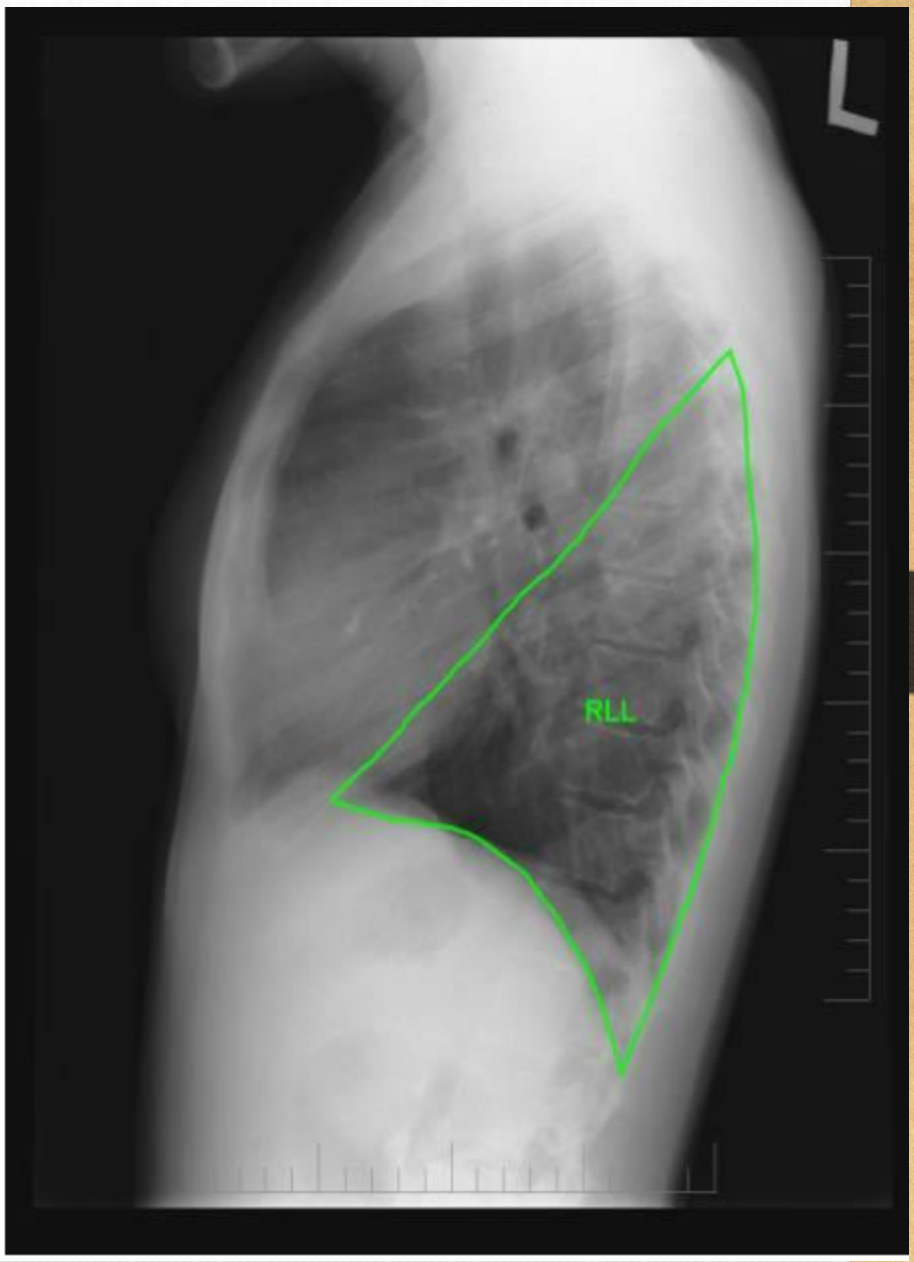

L
RUL

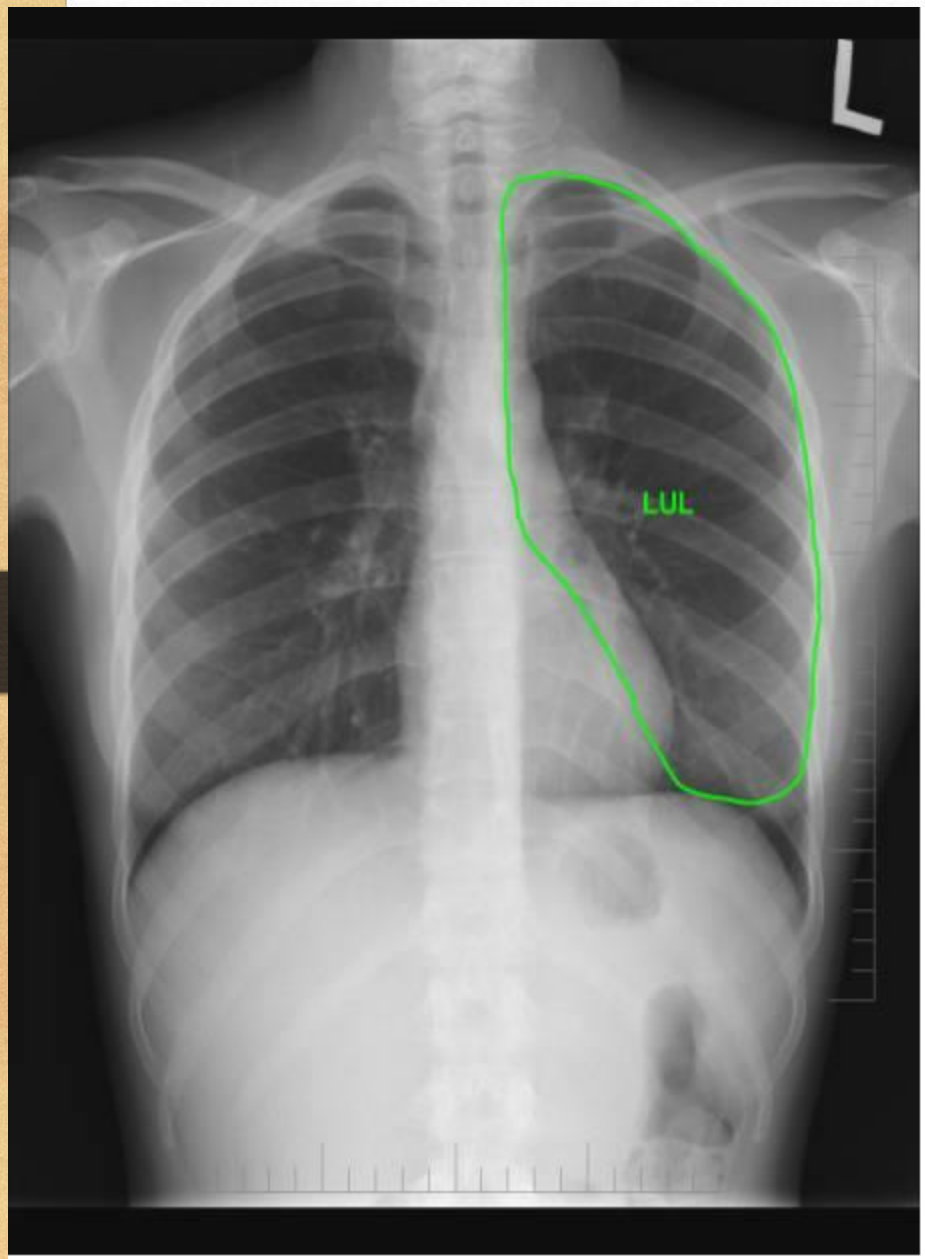

L
RUL


L
RML

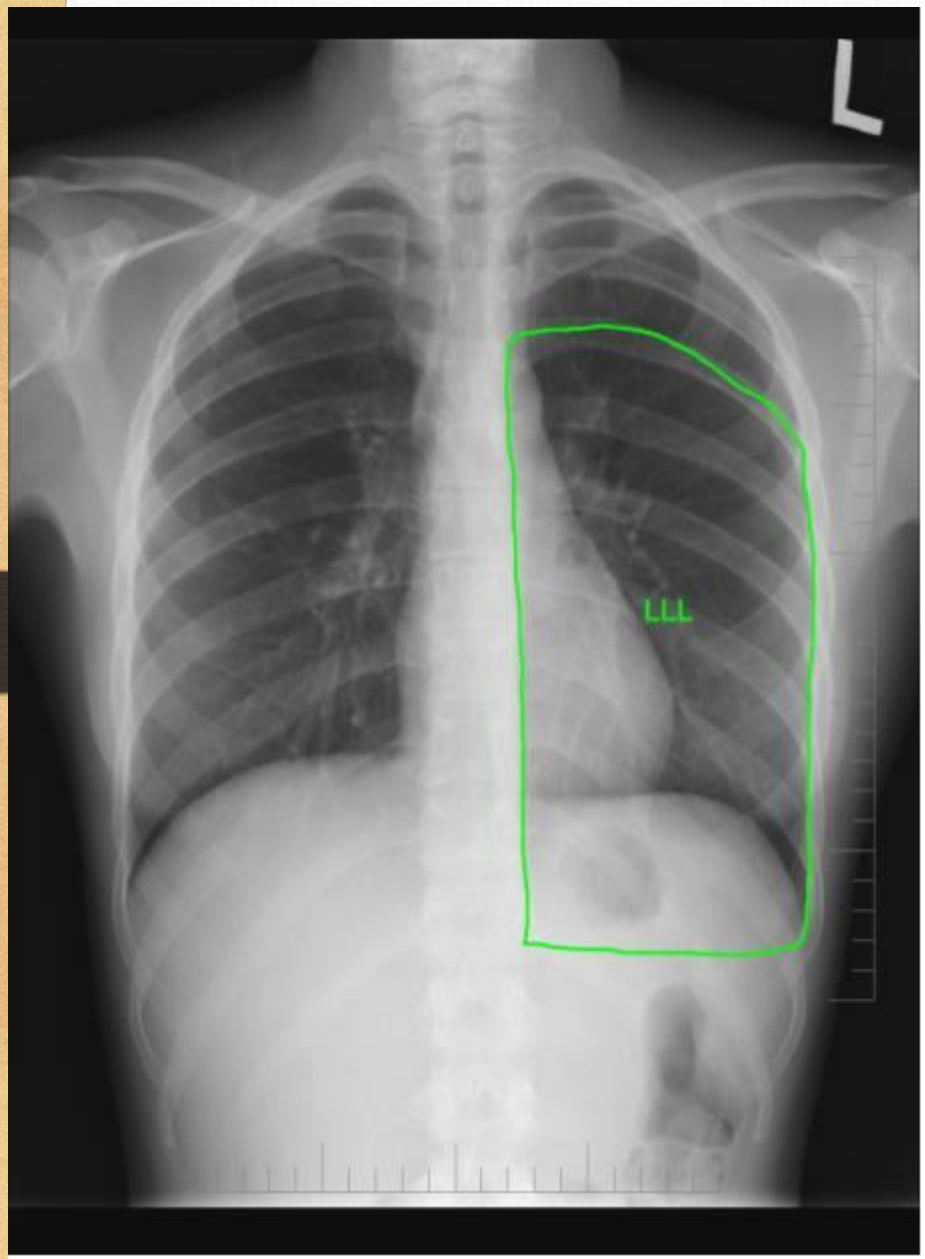

L
RML

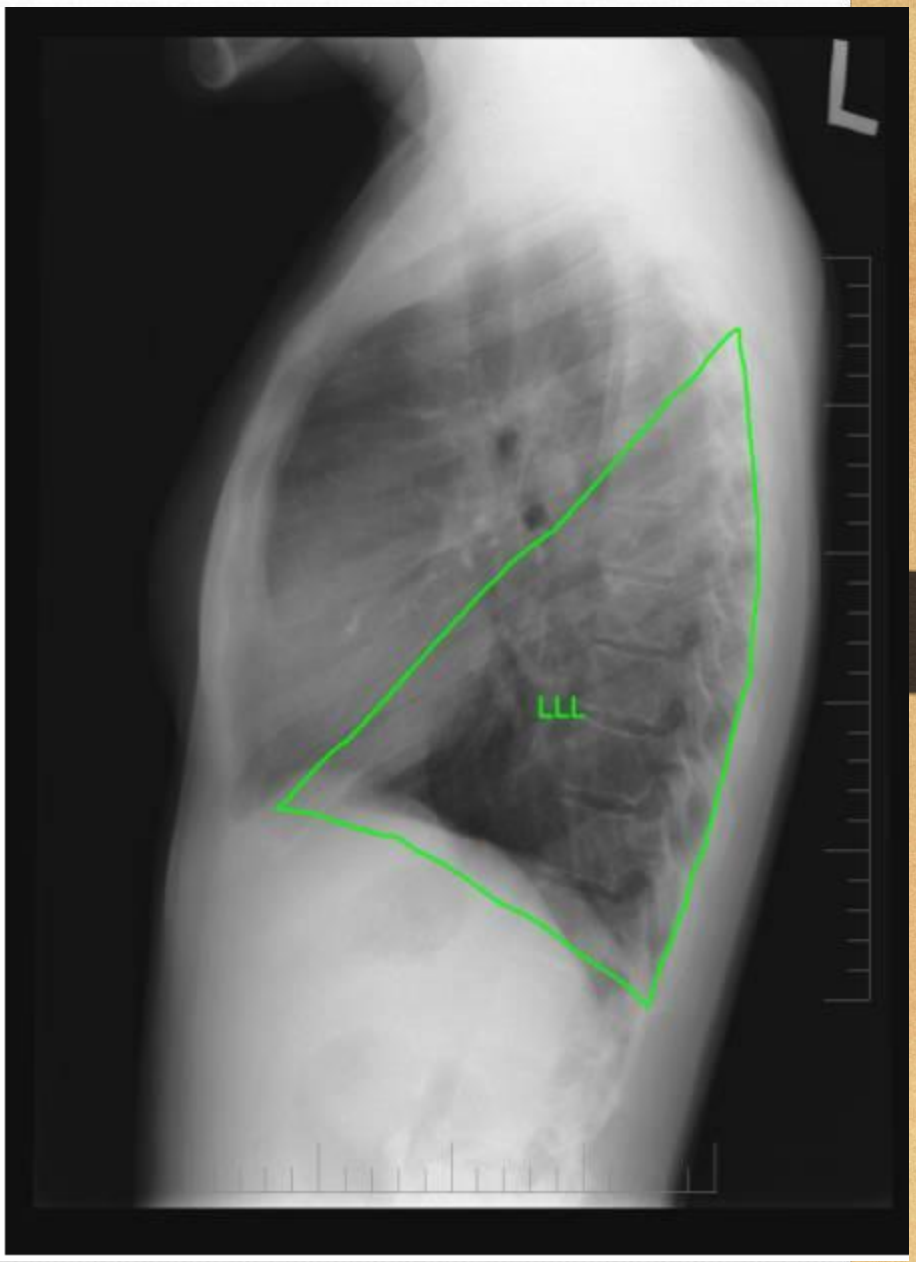

L
RLL


L
RLL

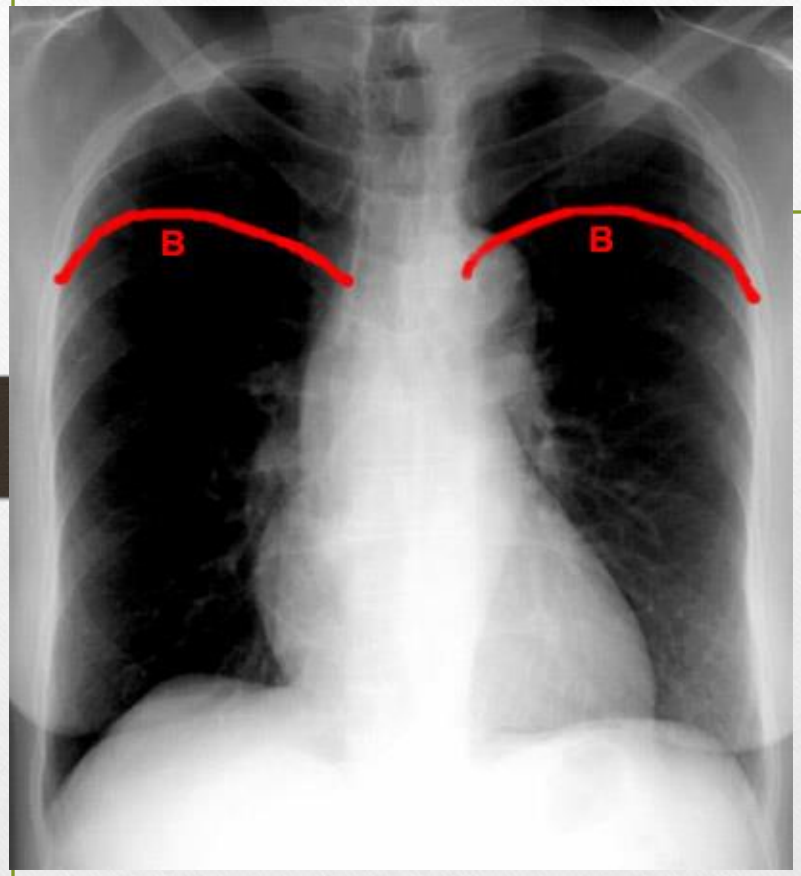

L
LUL

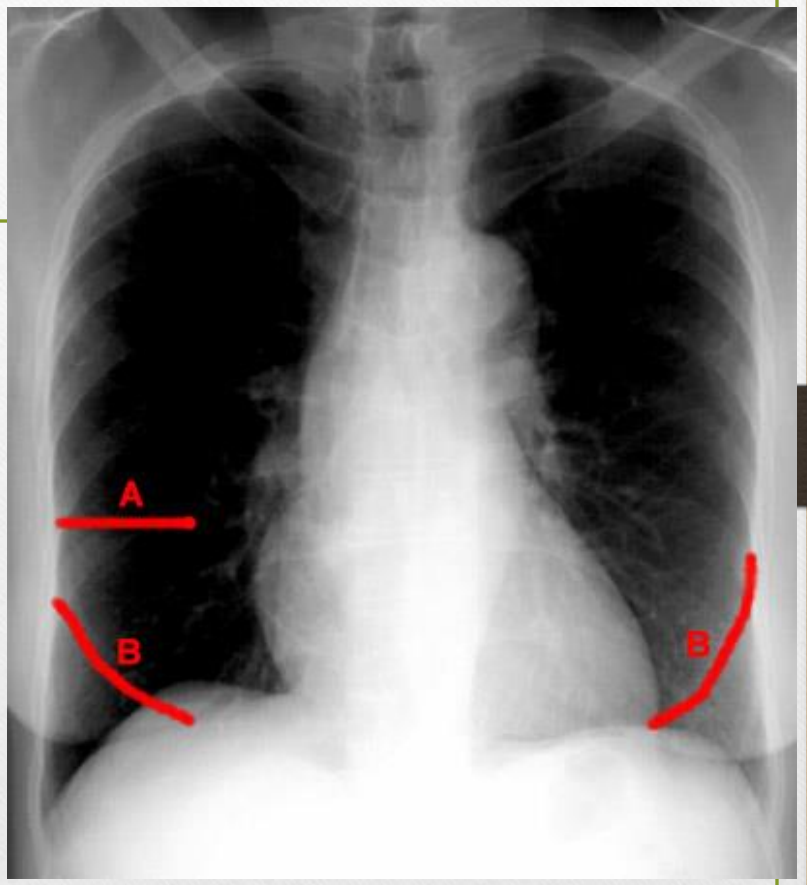

L
LUL


L
LLL


L
LLL

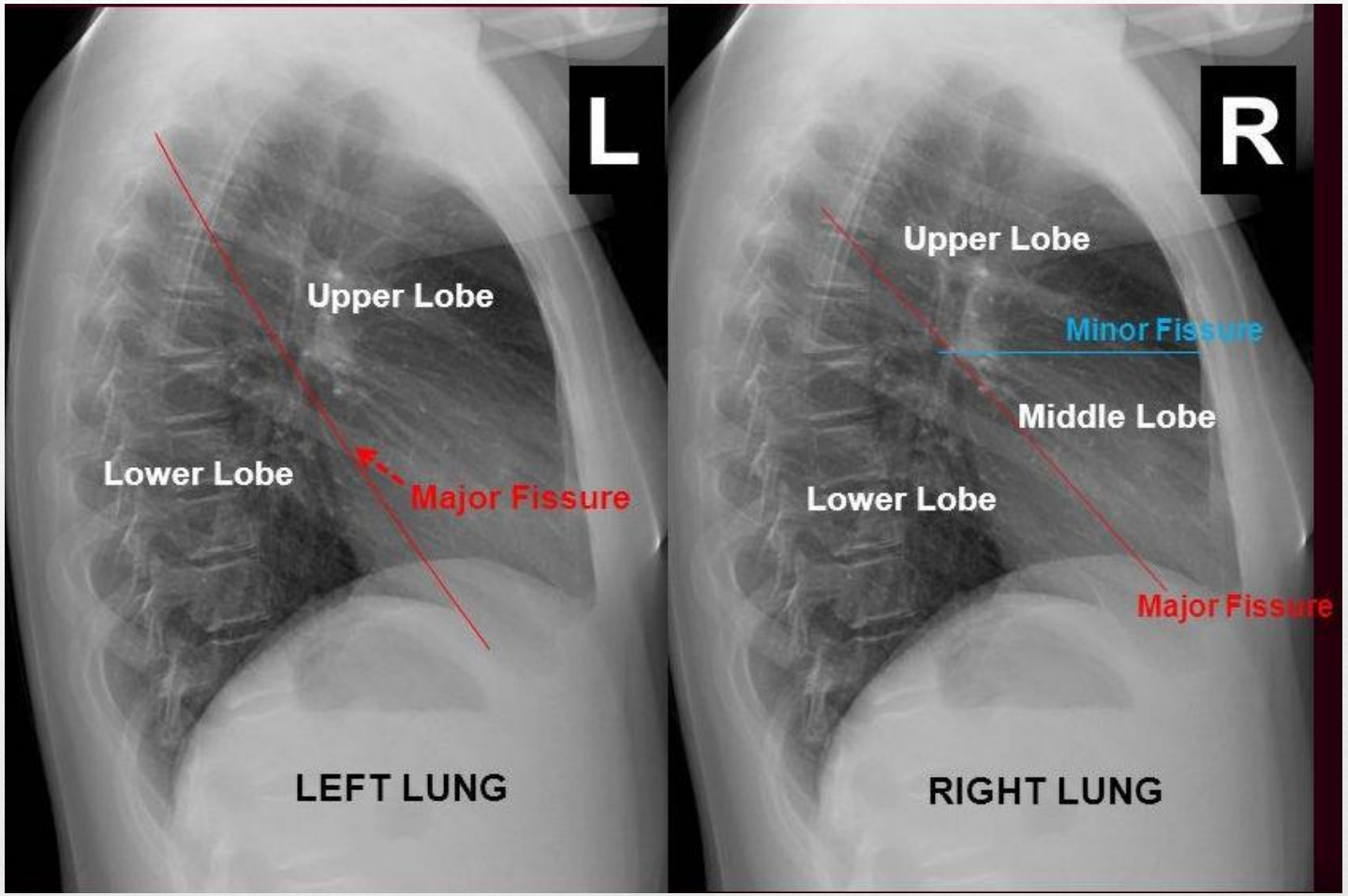
Lung fissures



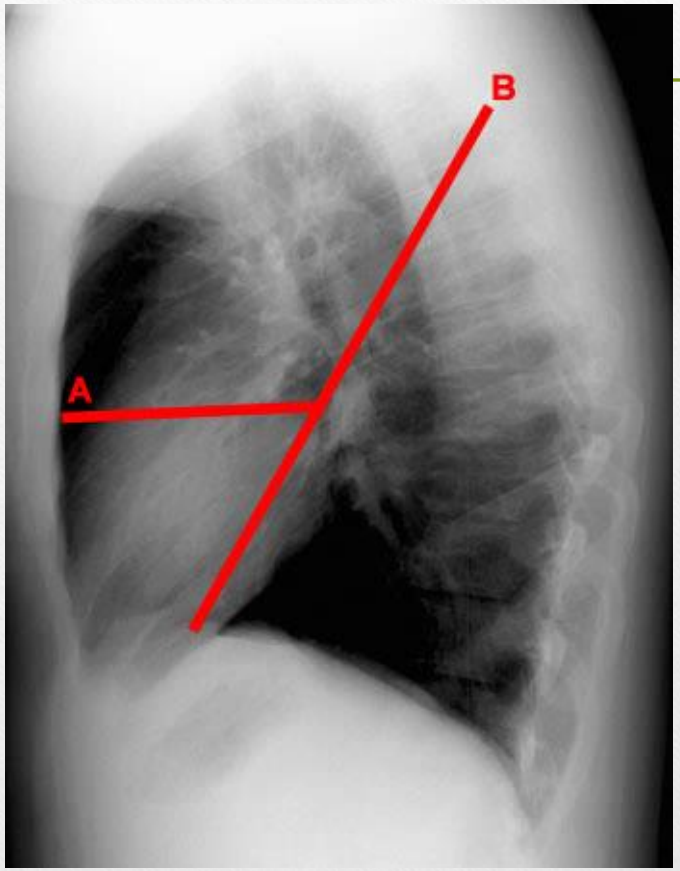


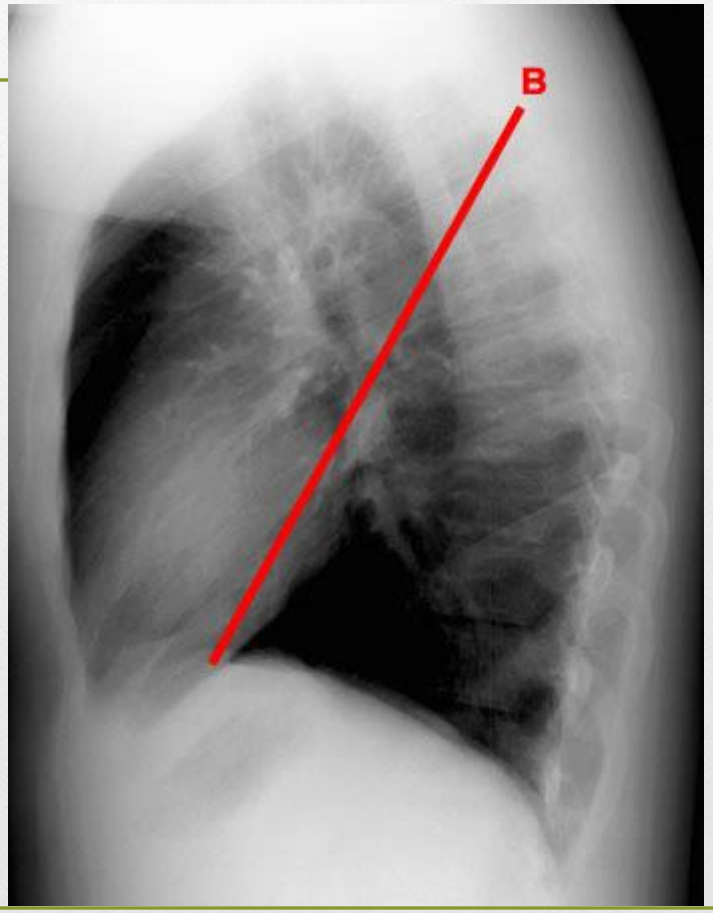
B represents the oblique fissure
A represents the horizontal fissure

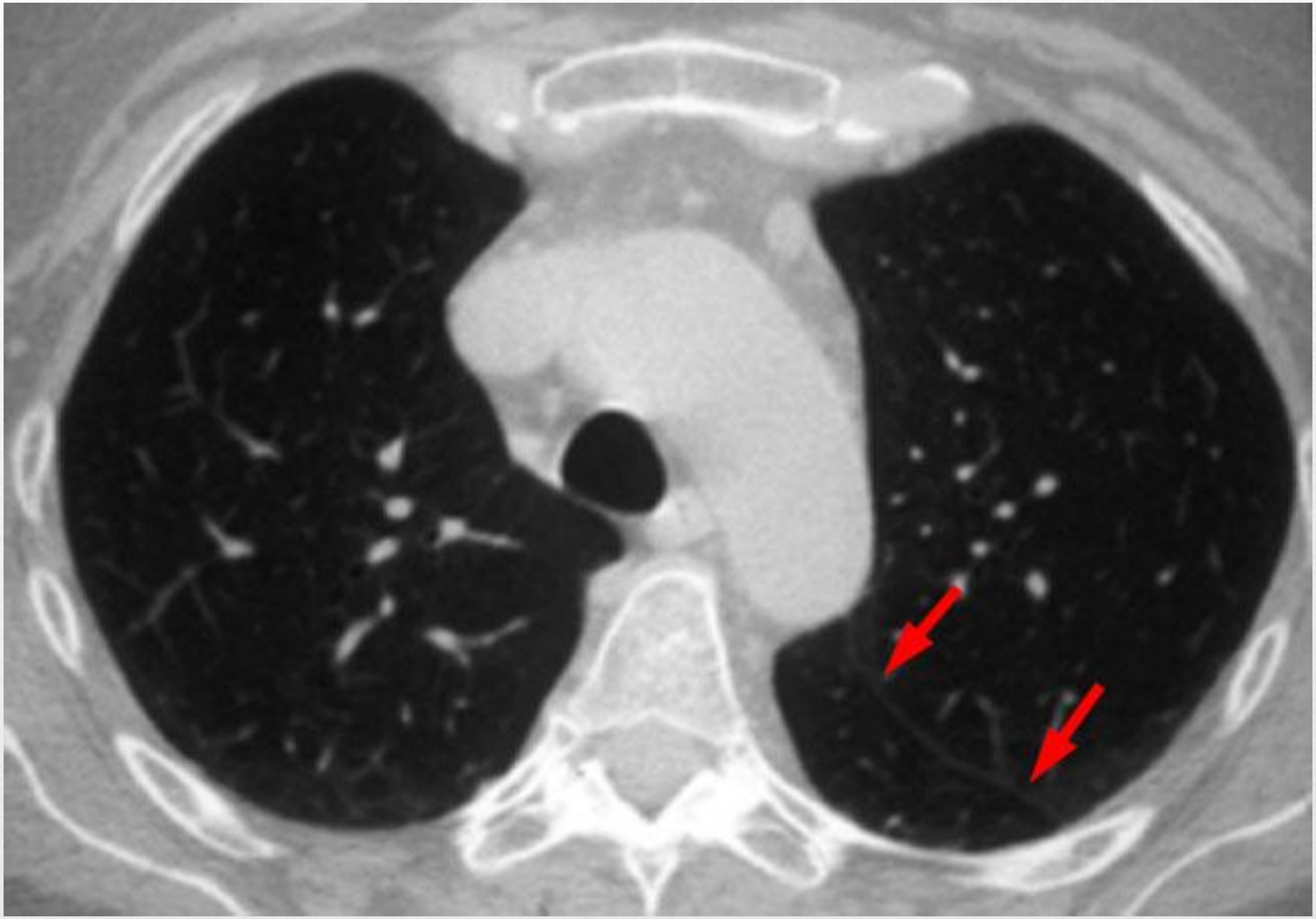
Lateral CXR


L
Upper Lobe
Lower Lobe
Major Fissure
LEFT LUNG
R
Upper Lobe
Minor Fissure
Middle Lobe
Lower Lobe
Major Fissure
RIGHT LUNG

Lung-Fissures

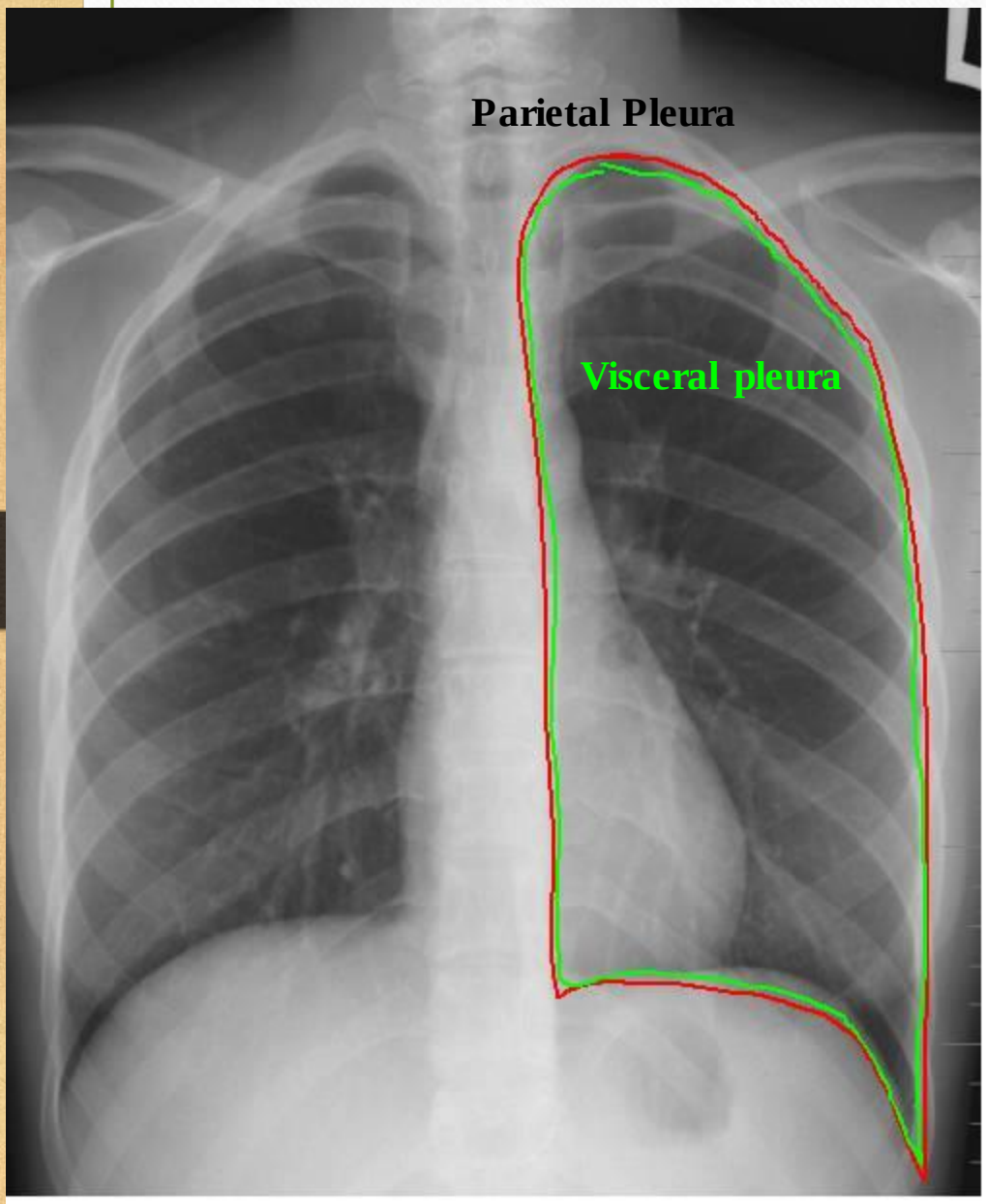


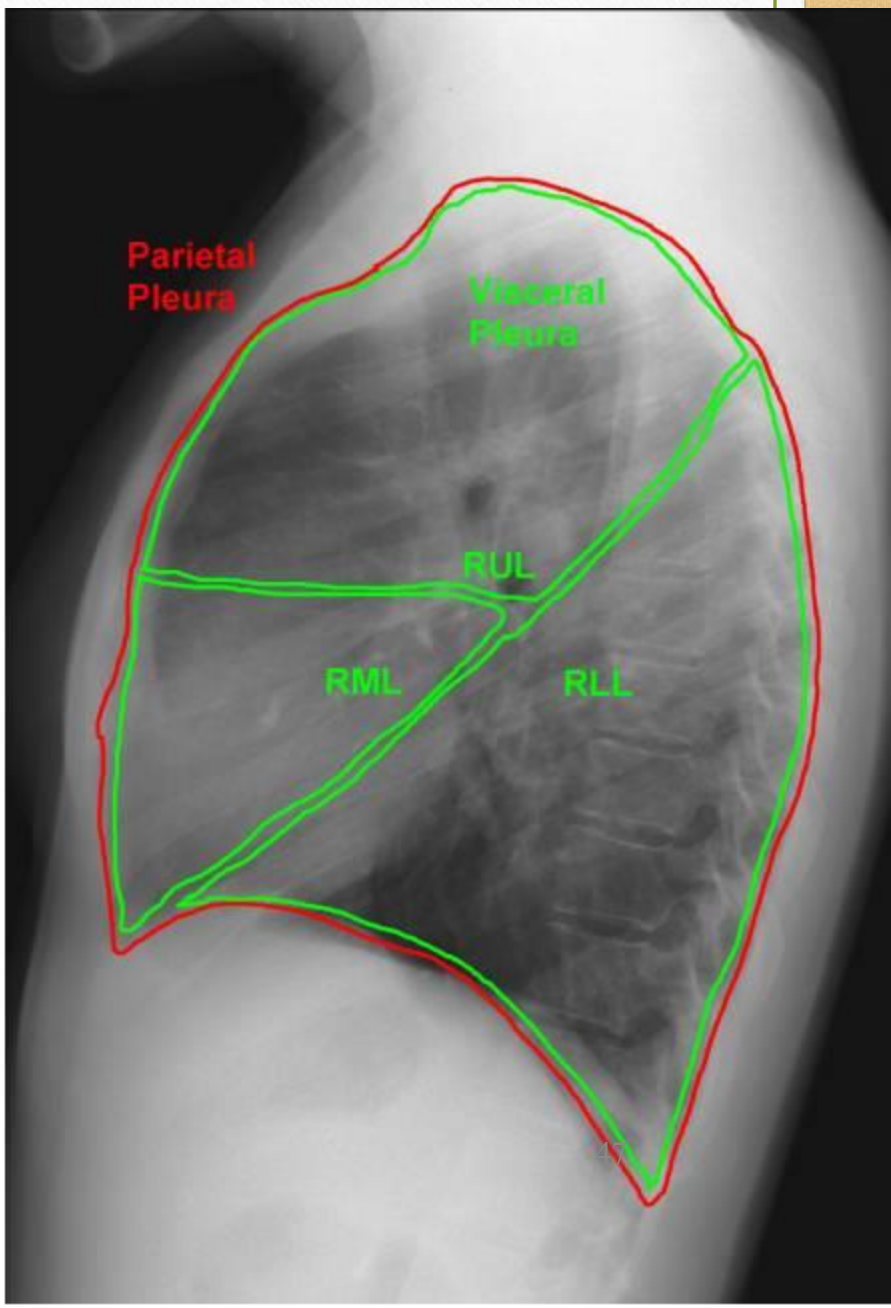




Pleura

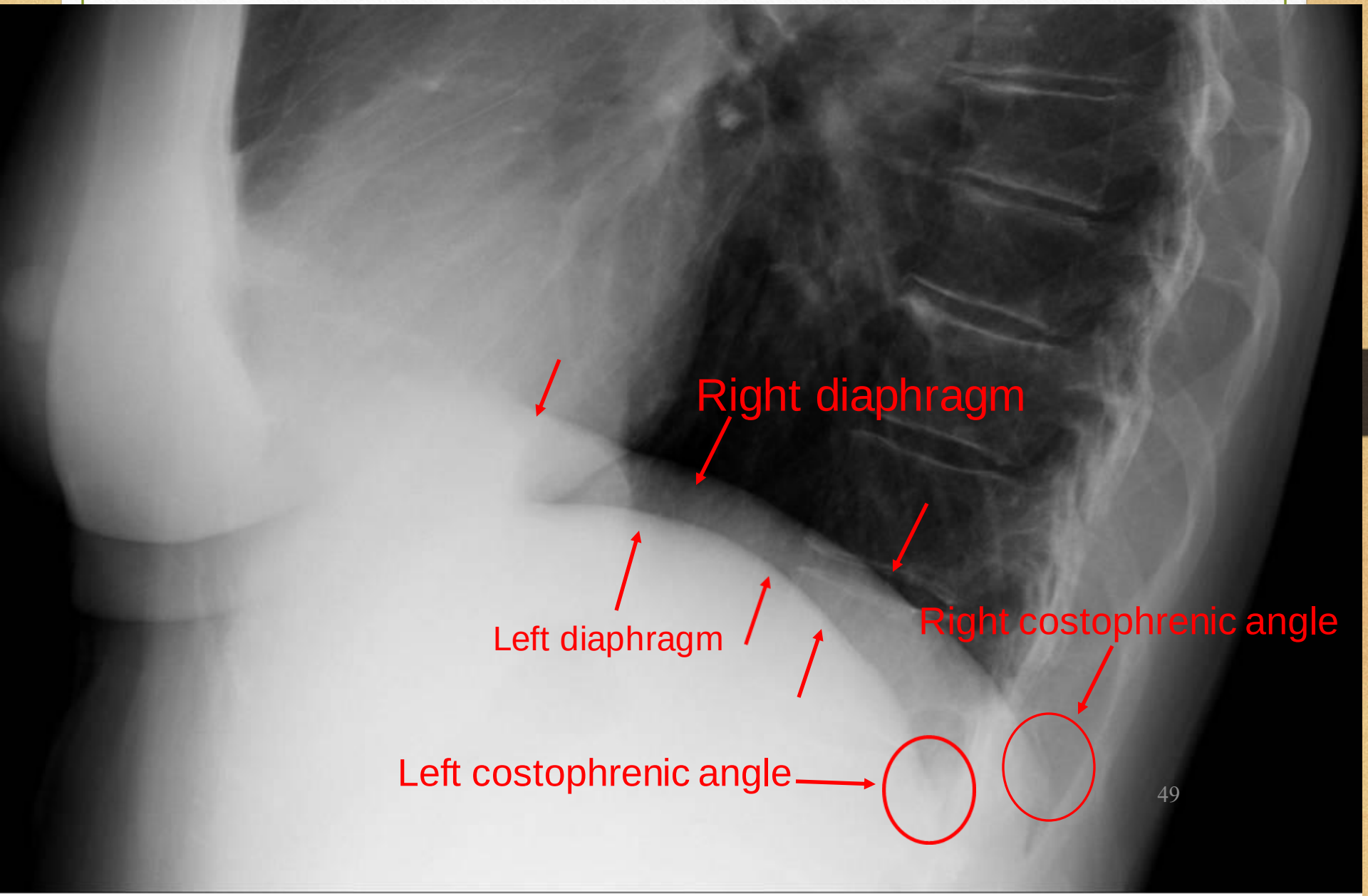
- Pleura
  - Lubricates and prevents friction during respiration
  - Potential Space that contains about 10 cc of serous fluid – Don't see unless abnormal (effusion, chylothorax, empyema, hemothorax)
- Parietal pleura: Lines chest wall, mediastinal and diaphragmatic surfaces
- Visceral pleura: Lines lungs, fissures

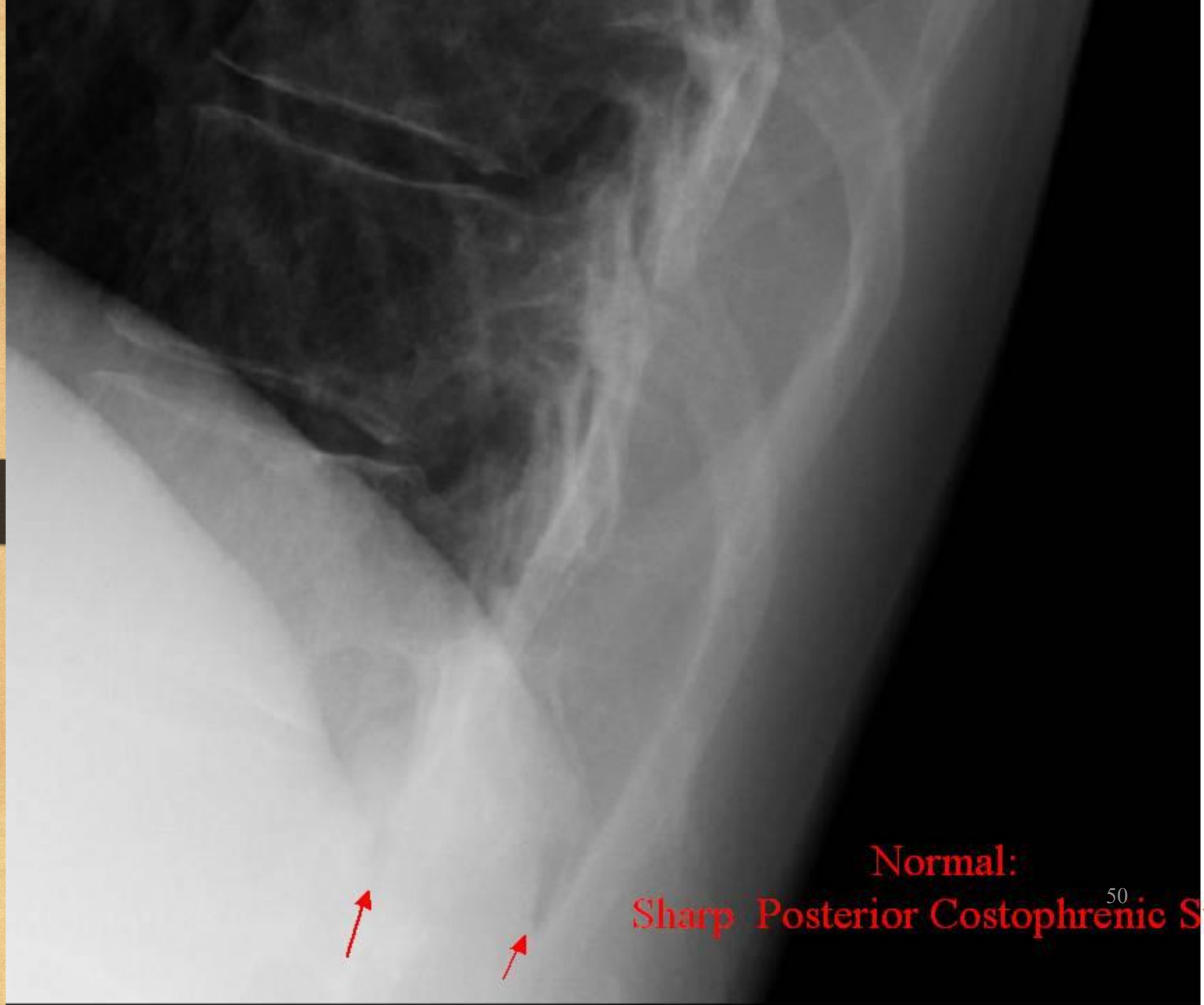

Parietal Pleura
Visceral pleura

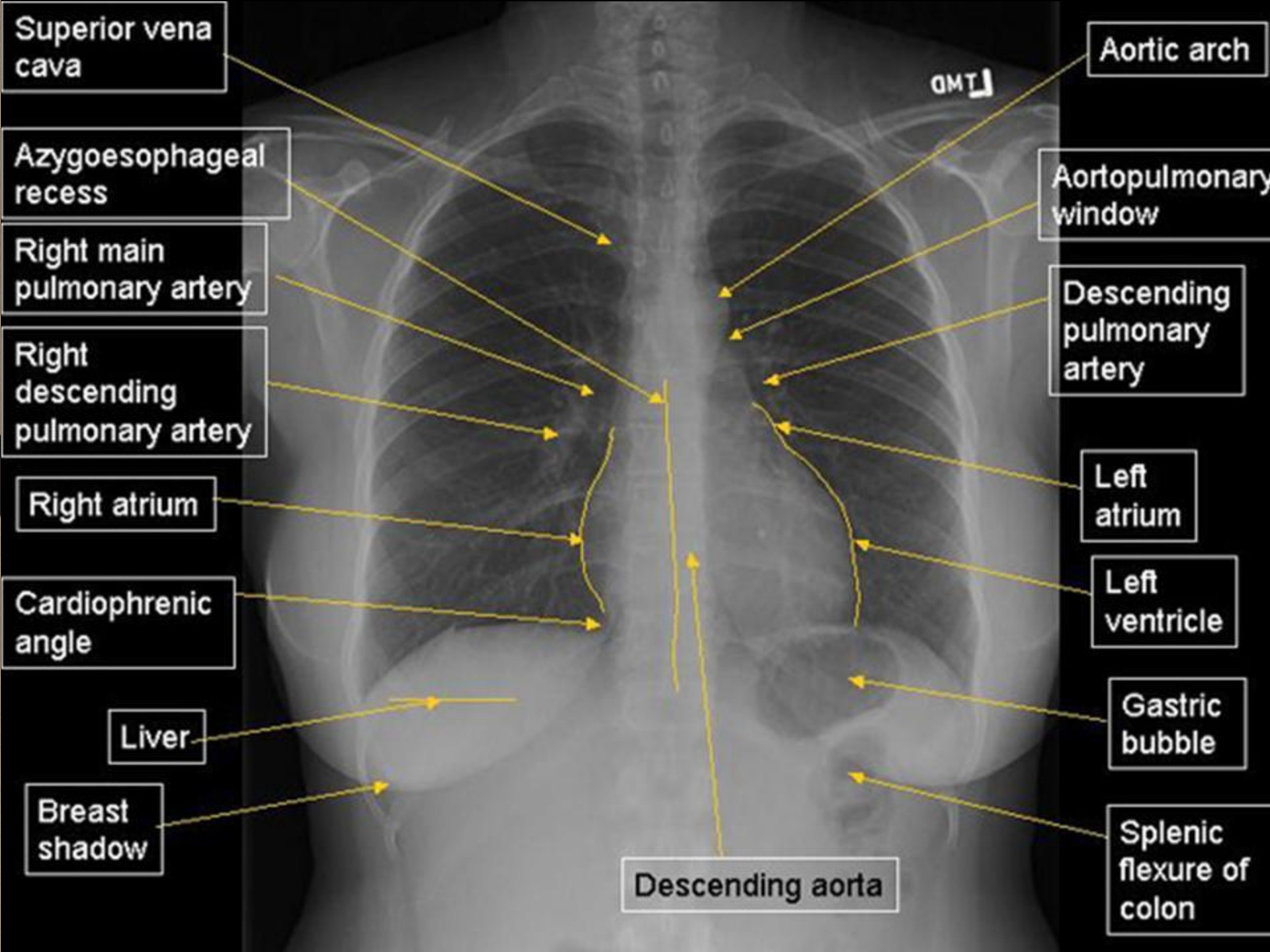

Parietal Pleura
Visceral Pleura
RUL
RML
RLL

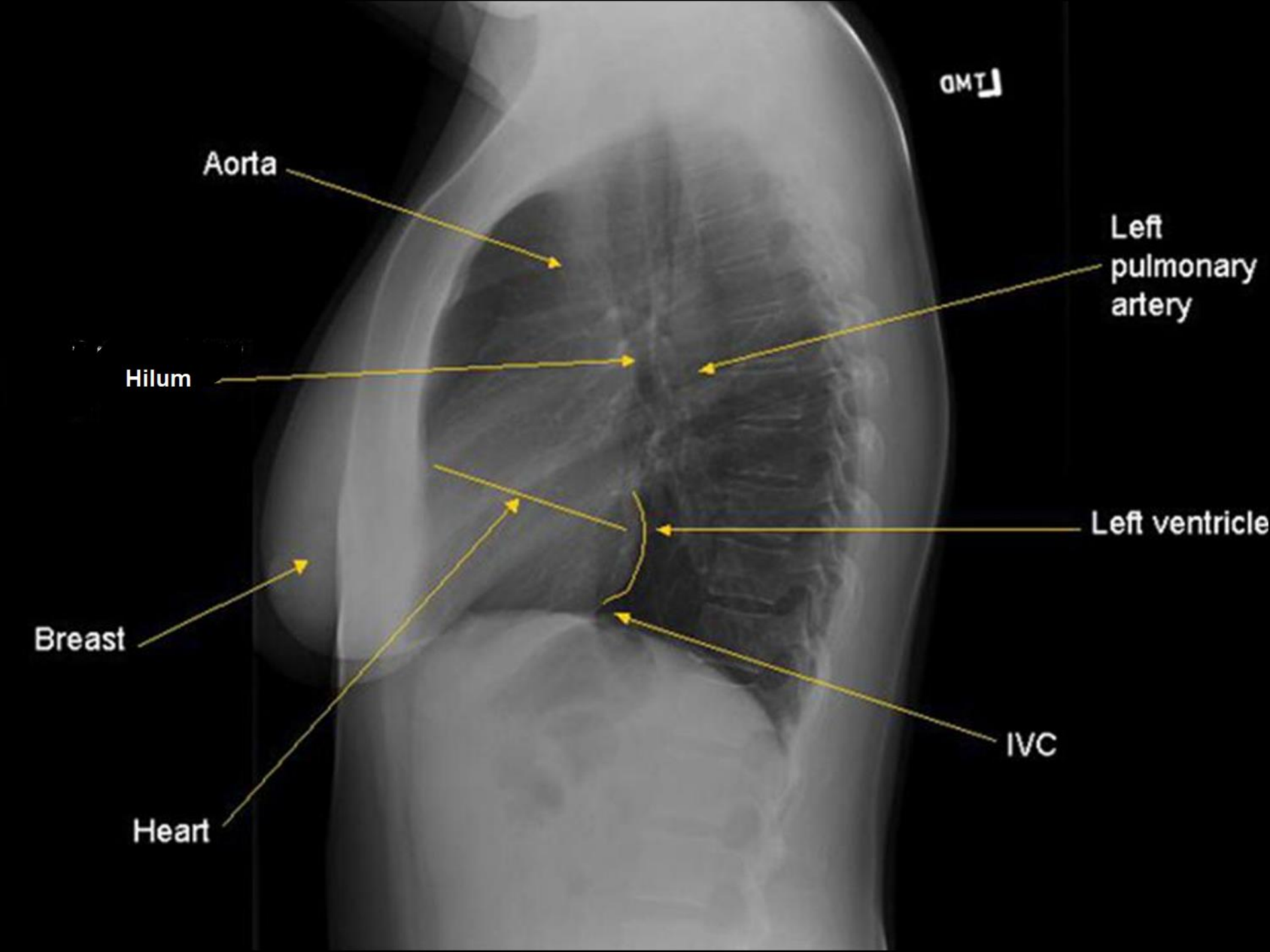

L

Left diaphragm : left is lower because of the heart position




Normal:
Sharp Posterior Costophrenic Sulci


Superior vena cava
Azygoesophageal recess
Right main pulmonary artery
Right descending pulmonary artery
Right atrium
Cardiophrenic angle
Liver
Breast shadow
Aortic arch
Aortopulmonary window
Descending pulmonary artery
Left atrium
Left ventricle
Gastric bubble
Splenic flexure of colon
Descending aorta


Aorta
Left pulmonary artery
Hilum
Left ventricle
Breast
IVC
Heart

ABCDE Steps to Chest X Ray Interpretation

A structured approach is the best way to interpret the chest X ray.
Don't be tempted to rush in and talk about the first thing you see.
These are the 7 steps you need.

Technicals

STEP 01

Right Patient?
Good Exposure?
Any Rotation?
Good Expansion?
PA or AP?

Airway

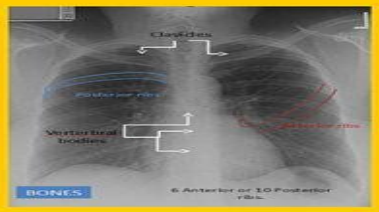
STEP 02

Deviation?
Central?
Angle at Carina < 90 degrees

Bones

STEP 03

Count number of ribs:
10 posterior or 6 anterior
Check all bones for lucency/opacity
Check vertebral bodies.



Cardiac

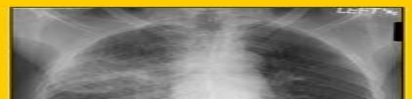
STEP 04

Size of heart....not more than half size of thorax.
Silhouette sign
Size of mediastinum.

Diaphragm

STEP 05

Left higher than right?
Air below diaphragm?
Gastric bubble.
Costophrenic and cardiophrenic angles



Equal Lung Fields

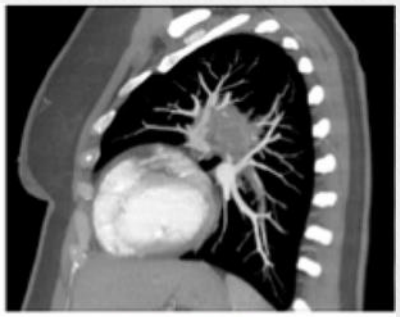
STEP 06

Left and right lung fields the same?

Terms…
axial, coronal, sagittal

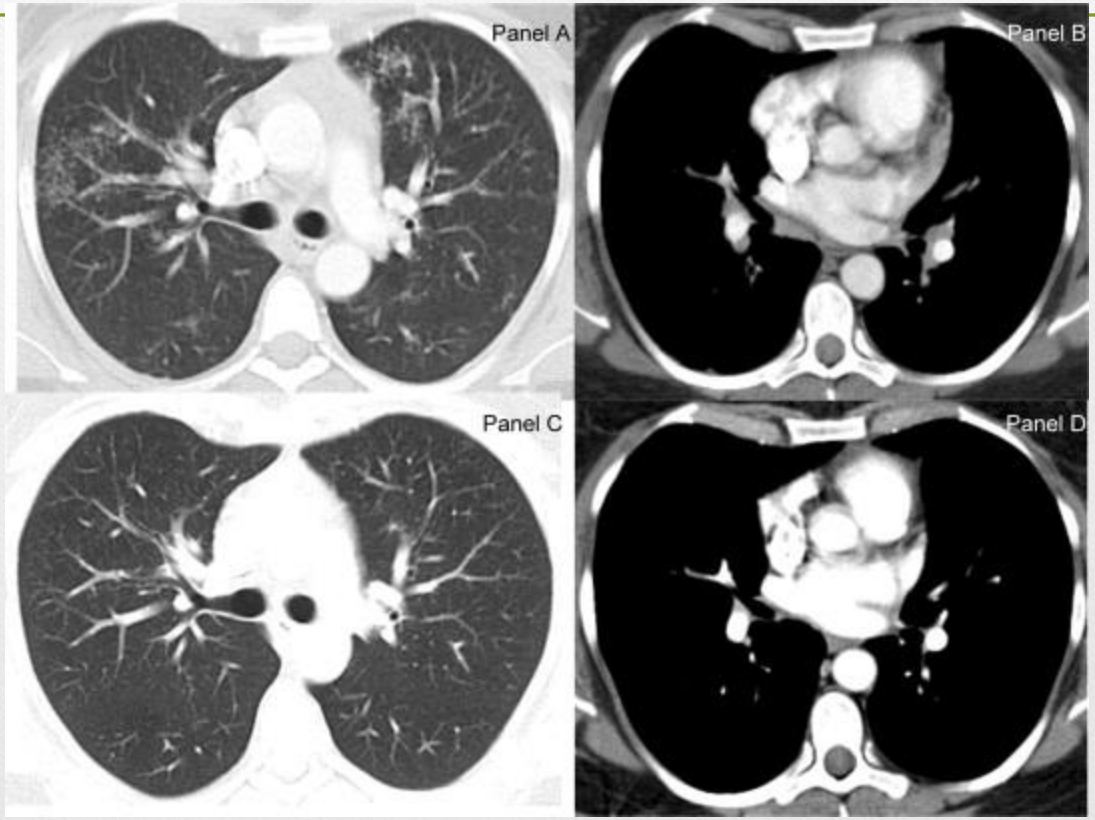
Axial view
Top to bottom

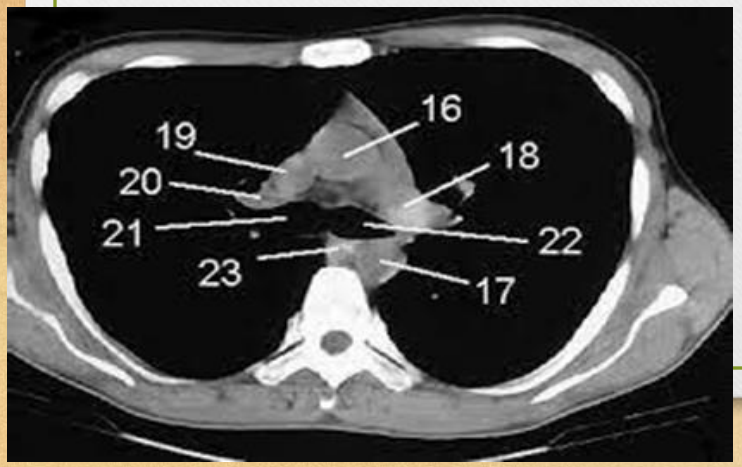
Coronal view
Front to back



Sagittal view
Side to side

Terms …
Mediastinal and lung window




19
16
18
20
21
22
23
17

Mediastinal window is better to show;

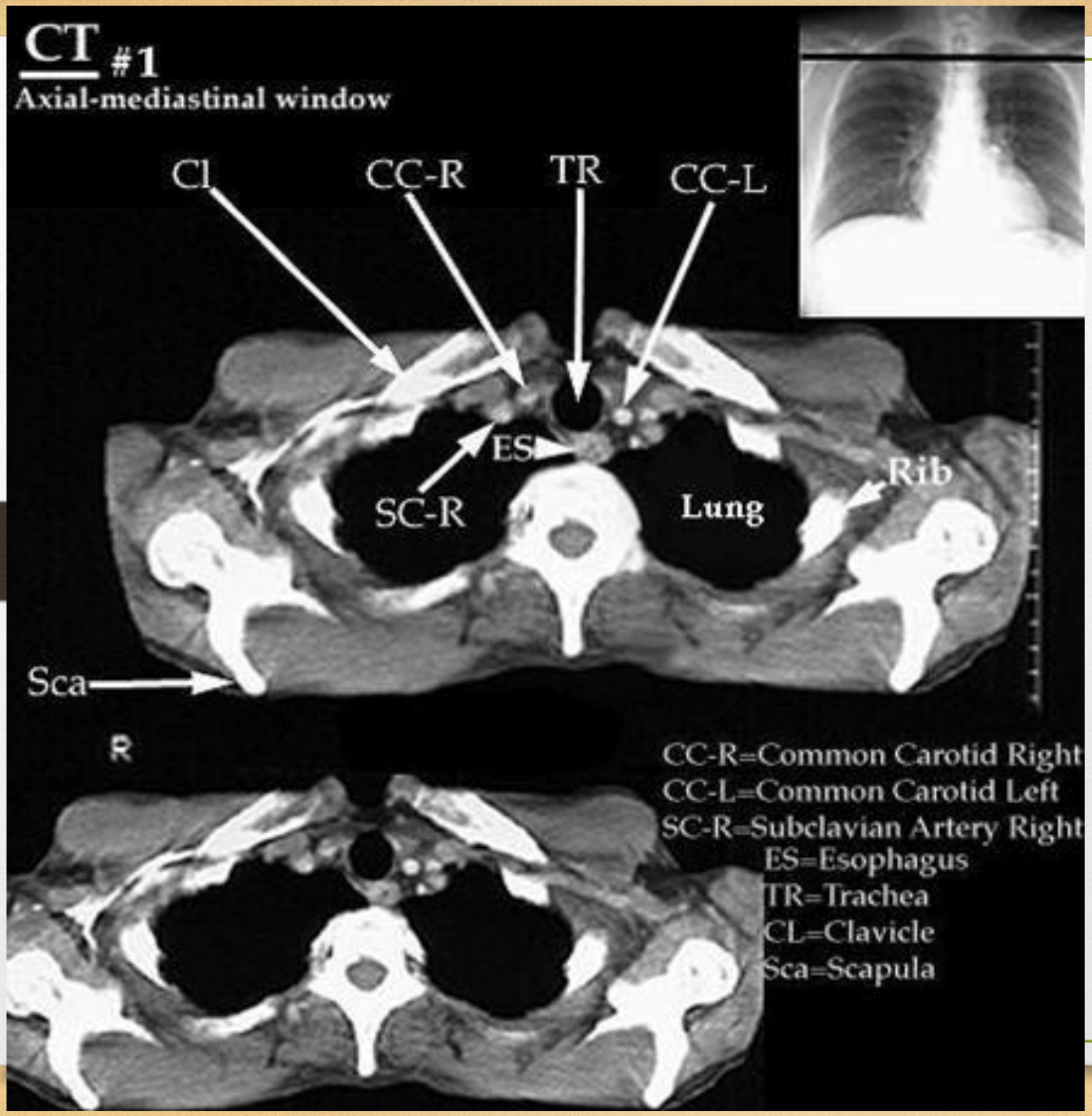
- Vessels
- Mediastinal masses
- Pleural effusion

Chest CT scan: Mediastinal window

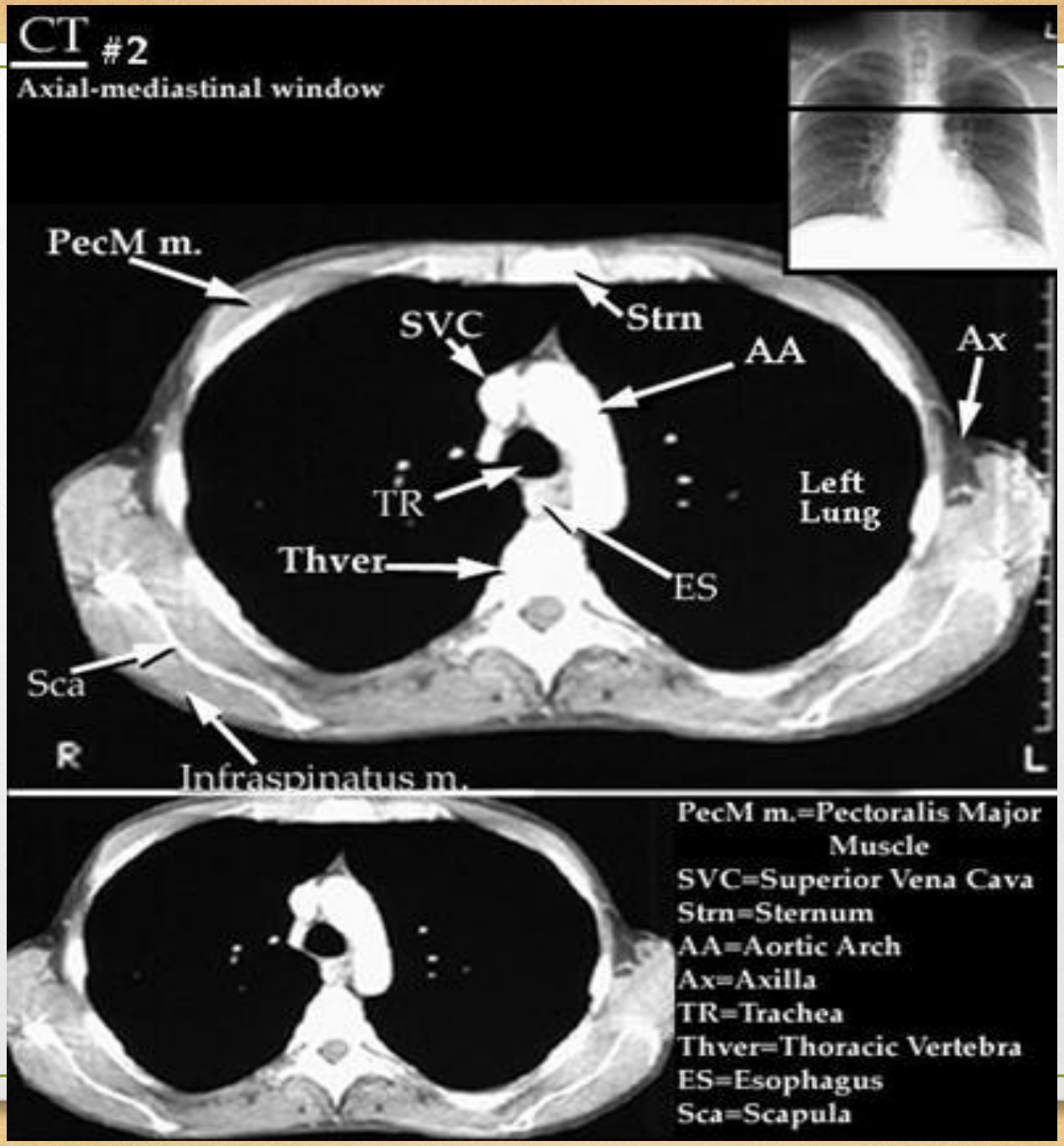
Lung window is better to show;

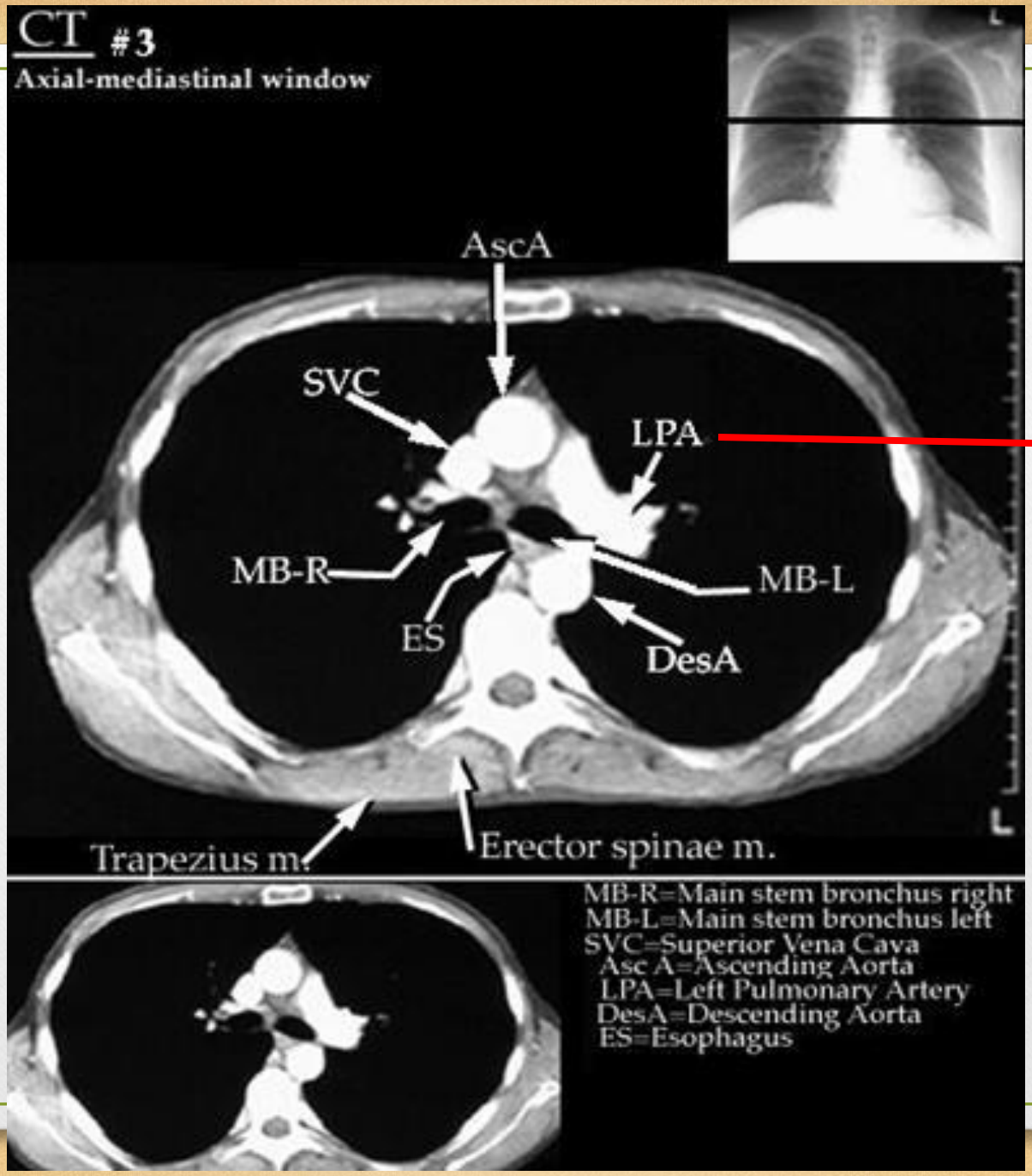
- Mets
- Cavitations
- Airways
- Pneumothorax
- Interstitial lung diseases, high resolution CT

Chest CT scan: Lung window

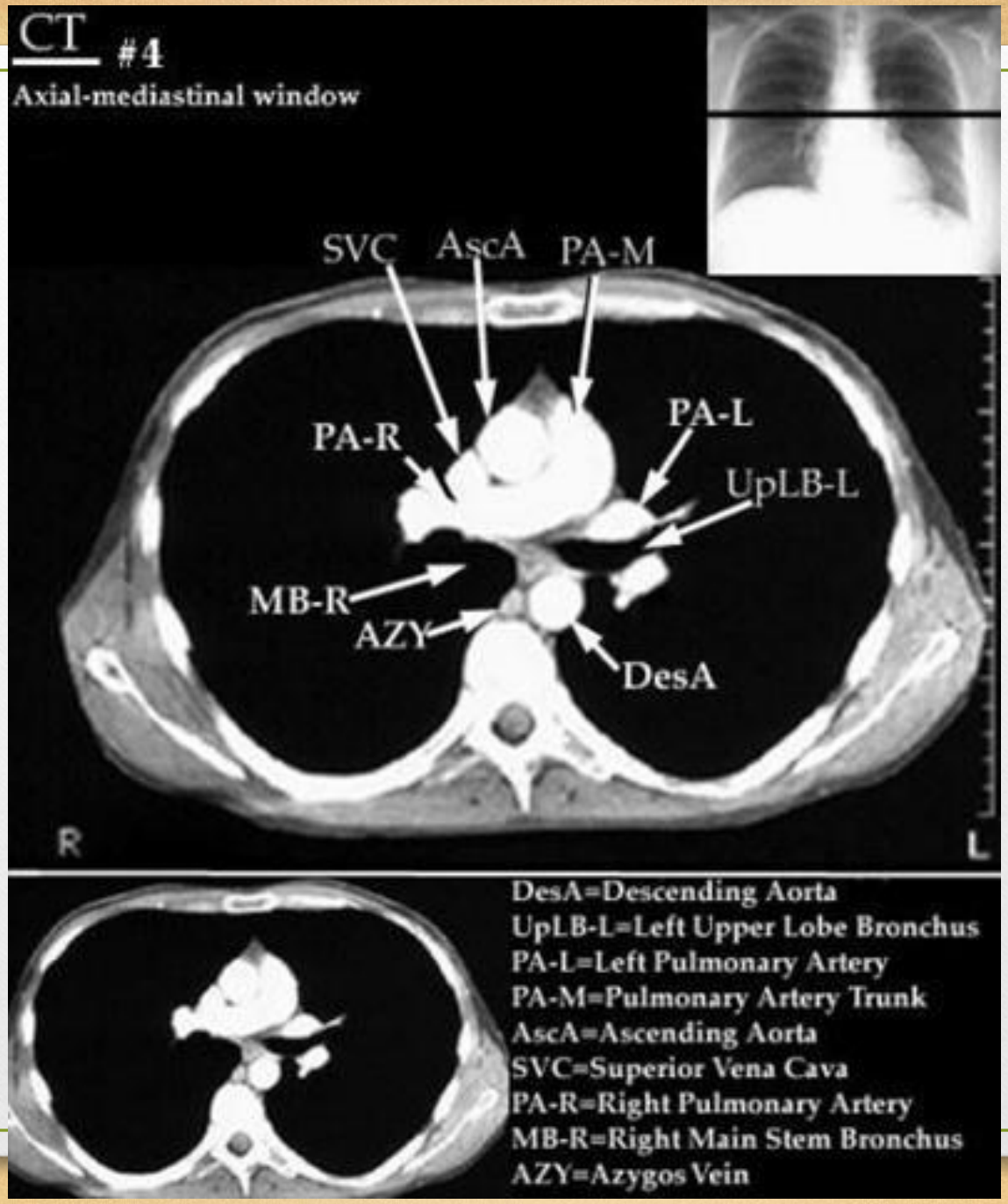


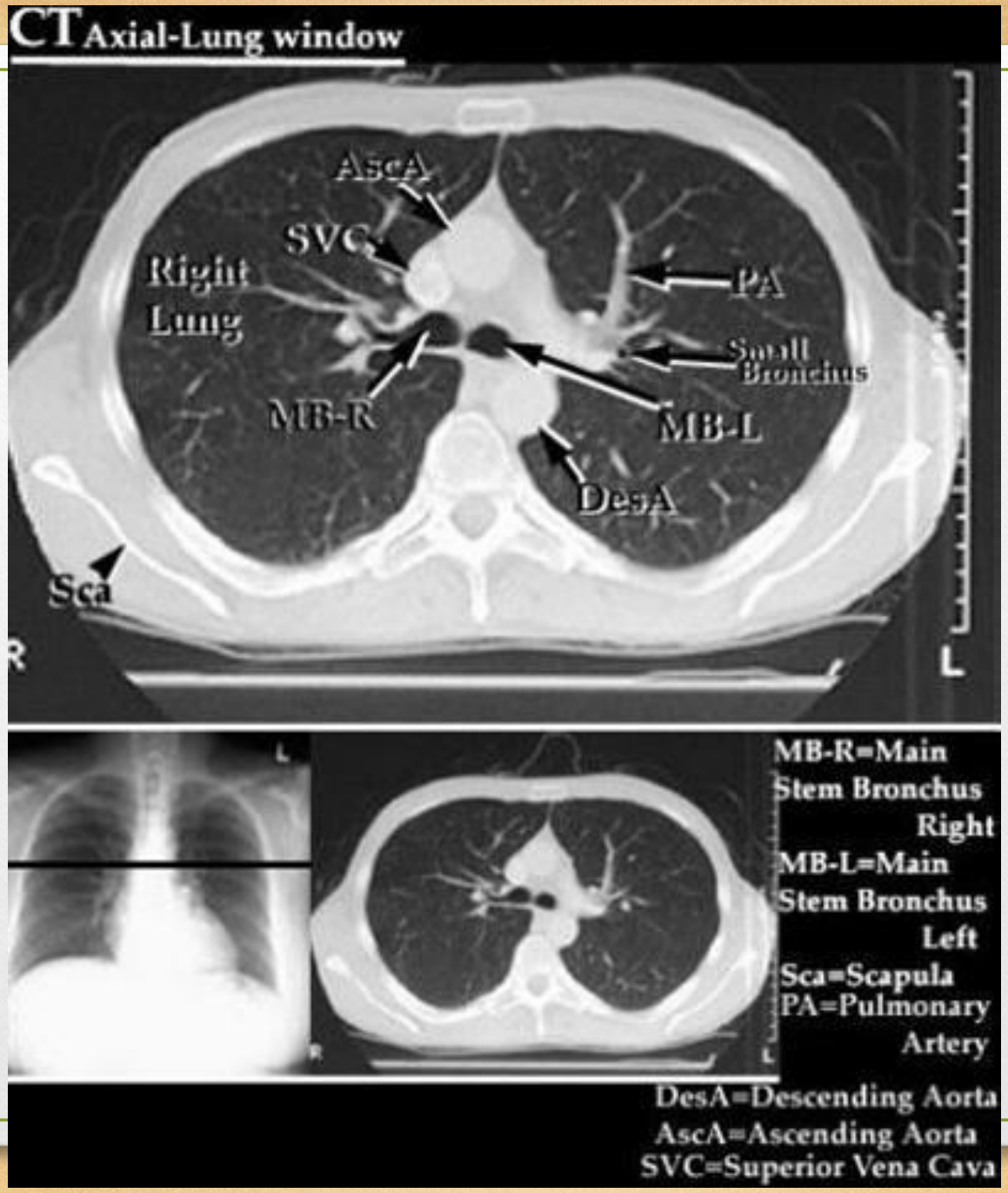
The doctor tracked the structures in all the following CT images, so track them ☺

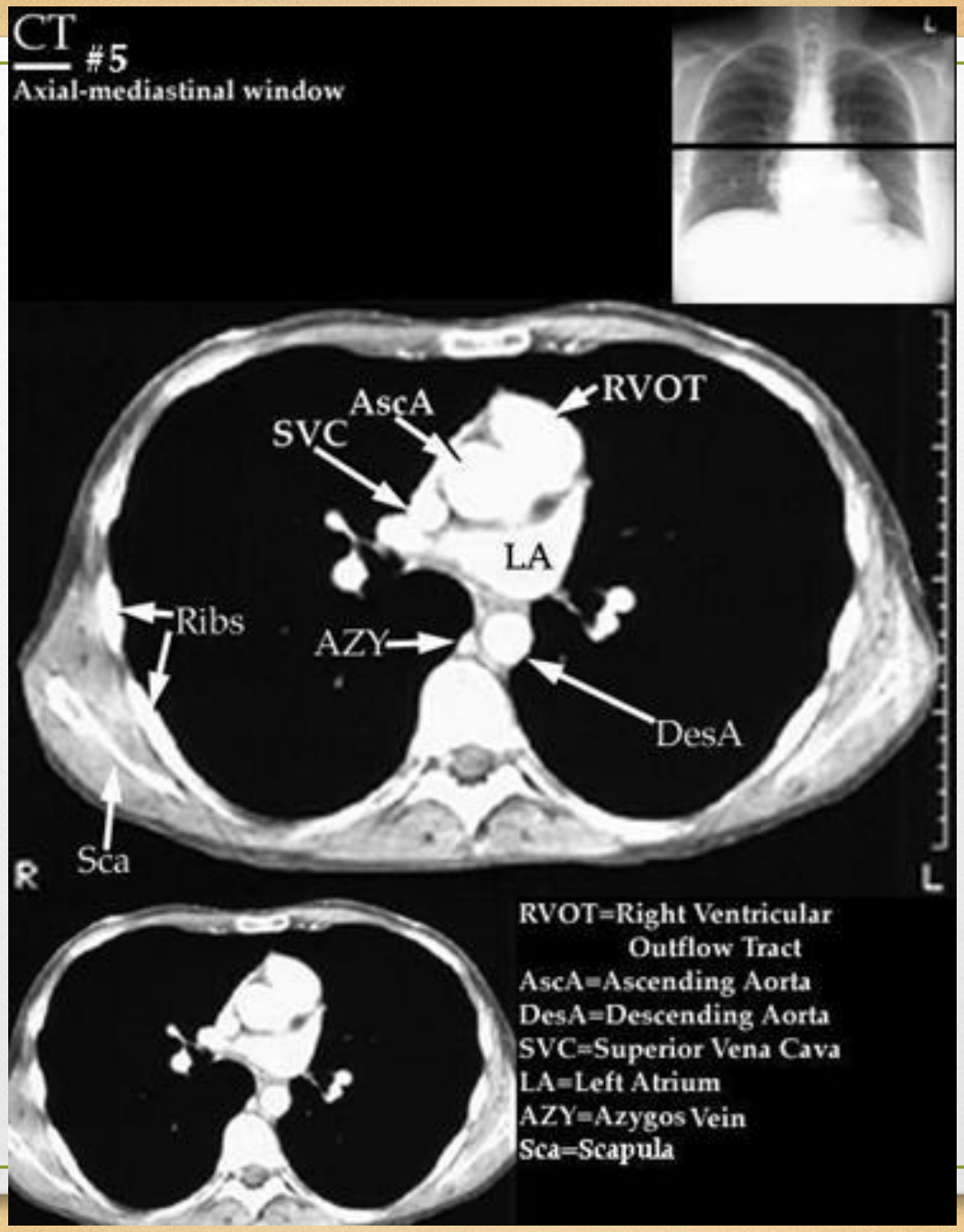

CT #2
Axial-mediastinal window
PecM m.
SVC
Strn
AA
Ax
TR
Left Lung
Thver
ES
Sca
R
Infraspinatus m.
L
PecM m.=Pectoralis Major Muscle
SVC=Superior Vena Cava
Strn=Sternum
AA=Aortic Arch
Ax=Axilla
TR=Trachea
Thver=Thoracic Vertebra
ES=Esophagus
Sca=Scapula

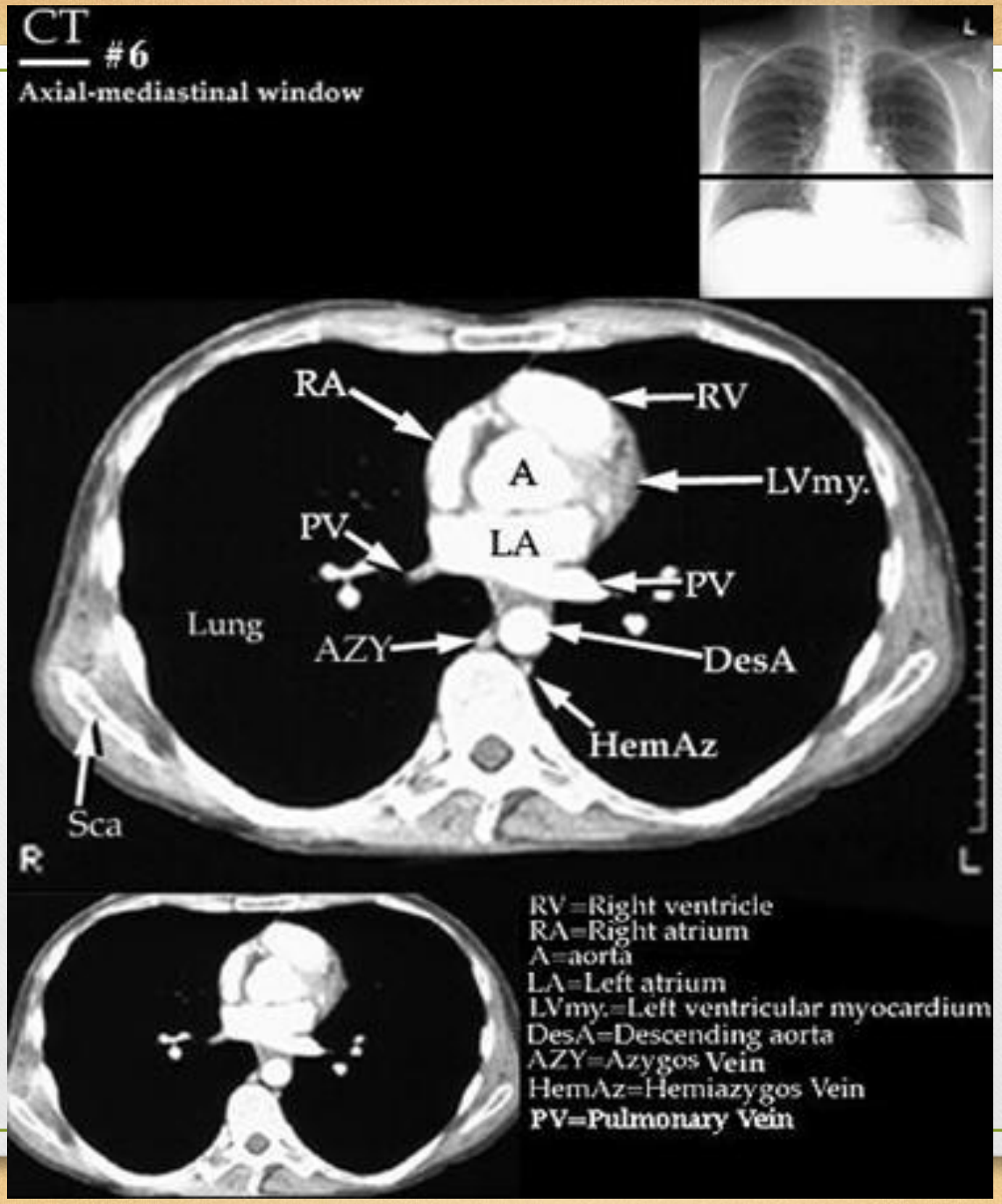


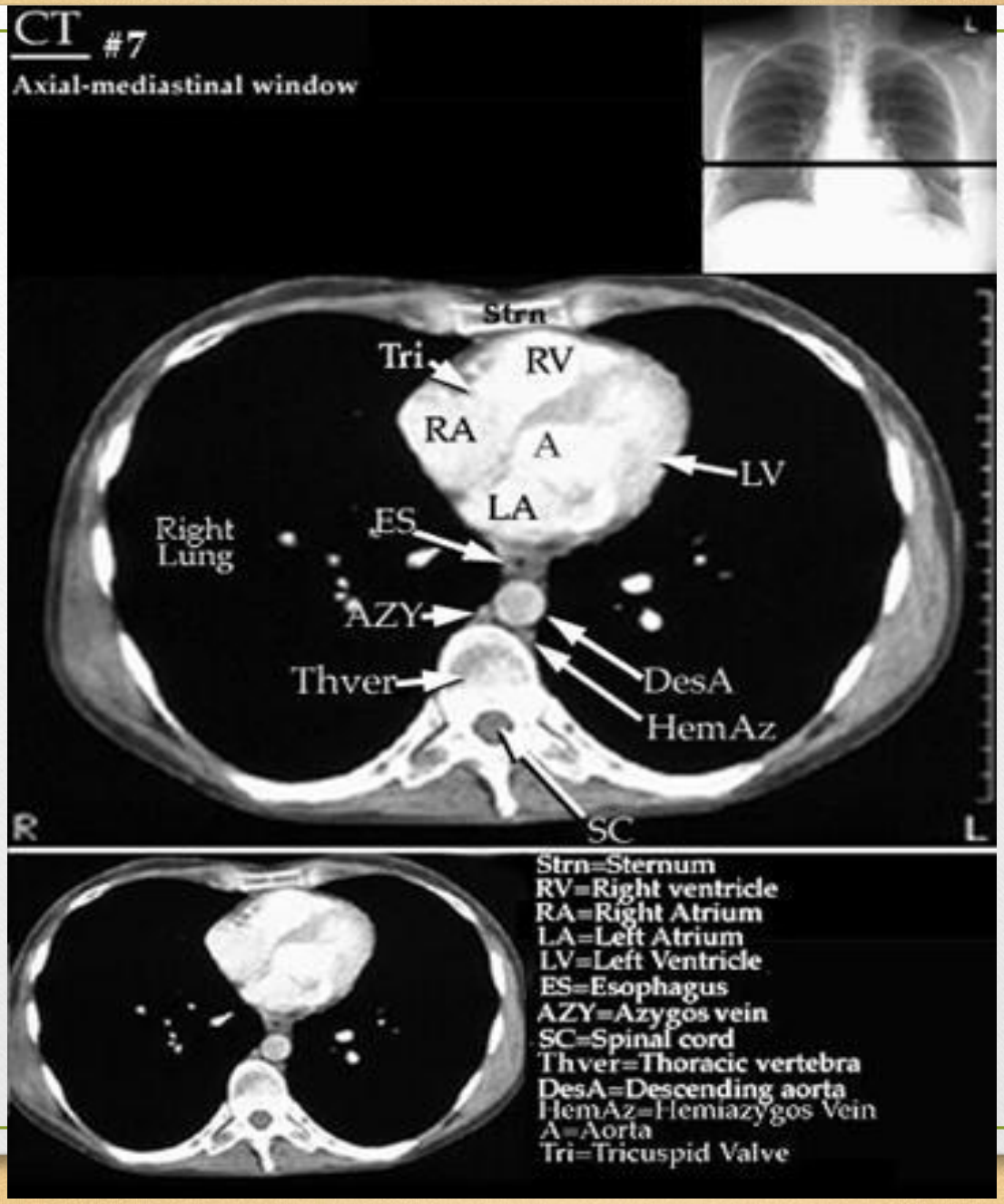
Appears at a higher level than RPA

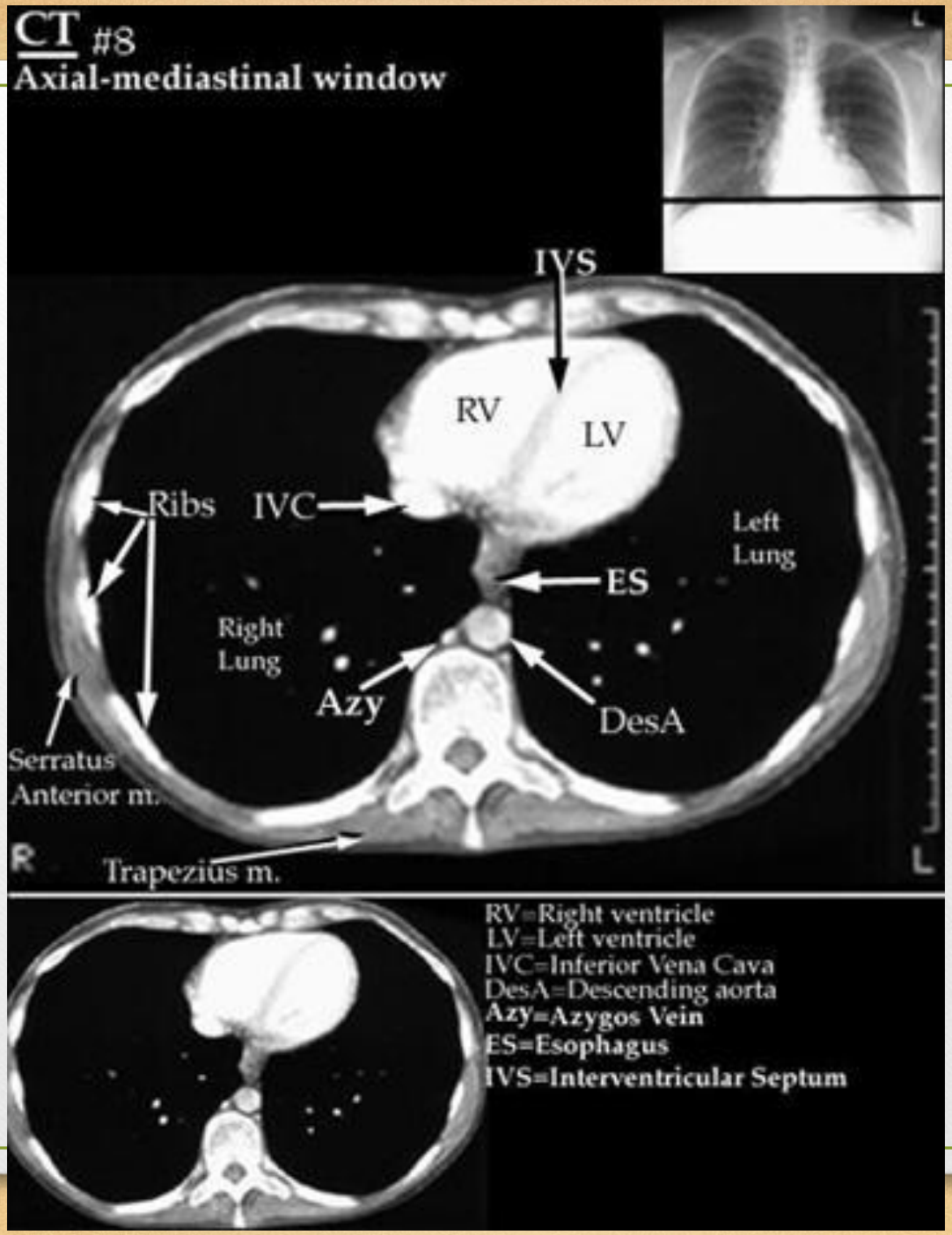

CT #4
Axial-mediastinal window
SVC
AscA
PA-M
PA-R
PA-L
UpLB-L
MB-R
AZY
DesA
R
L
DesA=Descending Aorta
UpLB-L=Left Upper Lobe Bronchus
PA-L=Left Pulmonary Artery
PA-M=Pulmonary Artery Trunk
AscA=Ascending Aorta
SVC=Superior Vena Cava
PA-R=Right Pulmonary Artery
MB-R=Right Main Stem Bronchus
AZY=Azygos Vein


CT Axial-Lung window
AscA
SVC
Right Lung
PA
Small Bronchus
MB-R
MB-L
DesA
Sca
R
L
MB-R=Main Stem Bronchus Right
MB-L=Main Stem Bronchus Left
Sca=Scapula
PA=Pulmonary Artery
DesA=Descending Aorta
AscA=Ascending Aorta
SVC=Superior Vena Cava


CT #5
Axial-mediastinal window
AscA
RVOT
SVC
LA
Ribs
AZY
DesA
Sca
R
L
RVOT=Right Ventricular Outflow Tract
AscA=Ascending Aorta
DesA=Descending Aorta
SVC=Superior Vena Cava
LA=Left Atrium
AZY=Azygos Vein
Sca=Scapula


CT #6
Axial-mediastinal window
RA
RV
A
LVmy.
PV
LA
PV
Lung
AZY
DesA
HemAz
Sca
R
L
RV=Right ventricle
RA=Right atrium
A=aorta
LA=Left atrium
LVmy.=Left ventricular myocardium
DesA=Descending aorta
AZY=Azygos Vein
HemAz=Hemiazygos Vein
PV=Pulmonary Vein


CT #7
Axial-mediastinal window
Strn
Tri
RV
RA
A
LV
LA
ES
Right Lung
AZY
Thver
DesA
HemAz
SC
R
L
Strn=Sternum
RV=Right ventricle
RA=Right Atrium
LA=Left Atrium
LV=Left Ventricle
ES=Esophagus
AZY=Azygos vein
SC=Spinal cord
Thver=Thoracic vertebra
DesA=Descending aorta
HemAz=Hemiazygos Vein
A=Aorta
Tri=Tricuspid Valve


CT #8
Axial-mediastinal window
IVS
RV
LV
Ribs
IVC
Left
Lung
ES
Right
Lung
Azy
DesA
Serratus
Anterior m.
Trapezius m.
RV=Right ventricle
LV=Left ventricle
IVC=Inferior Vena Cava
DesA=Descending aorta
Azy=Azygos Vein
ES=Esophagus
IVS=Interventricular Septum

Quiz