Imaging of Chest & CVS

Anatomy Review

2017

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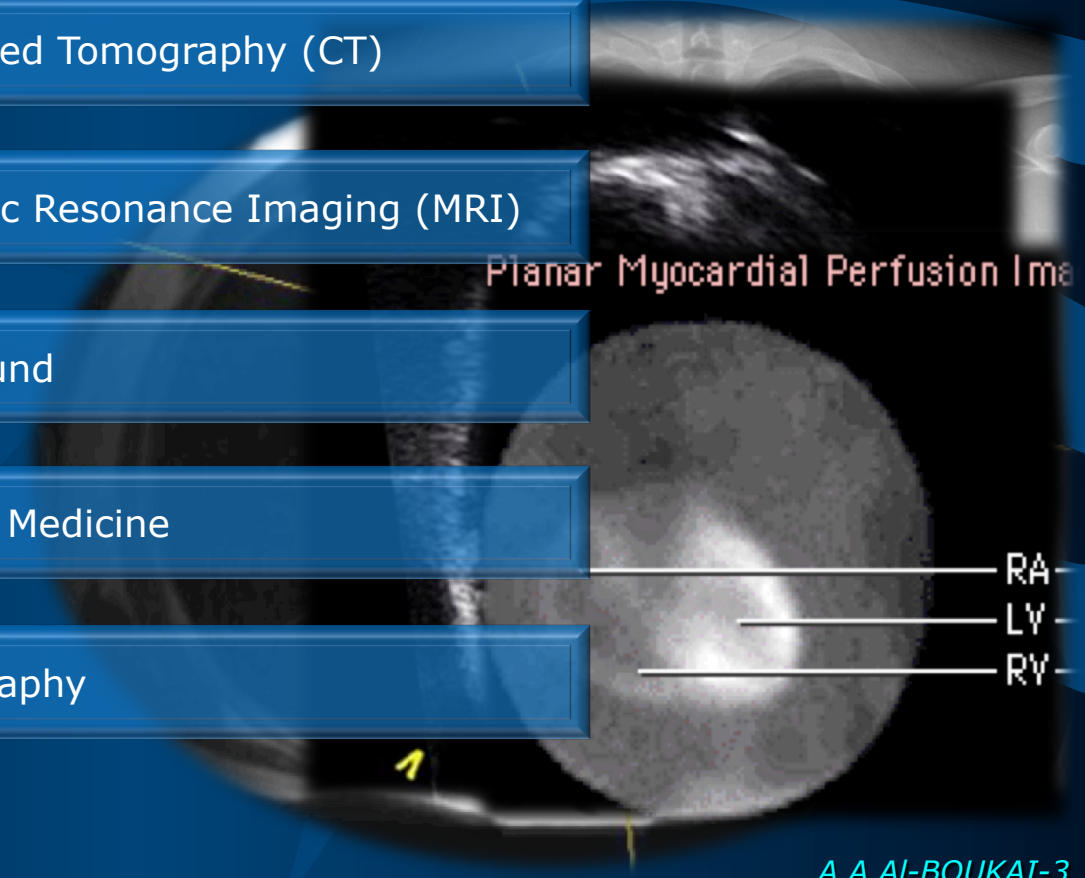
OBJECTIVES & GOALS

Students at the end of the lecture will be able to:

- Recognize the different modalities utilized in imaging the chest & cardiovascular system
- Recognize the basic technical factors affecting image quality
- Recognize the radiological anatomy of chest and cardiovascular system

MODALITIES UTILIZED

- Plain X-Ray
- Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)
- Ultrasound
- Nuclear Medicine
- Angiography



MODALITIES UTILIZED

- Plain X-Ray

X-ray:

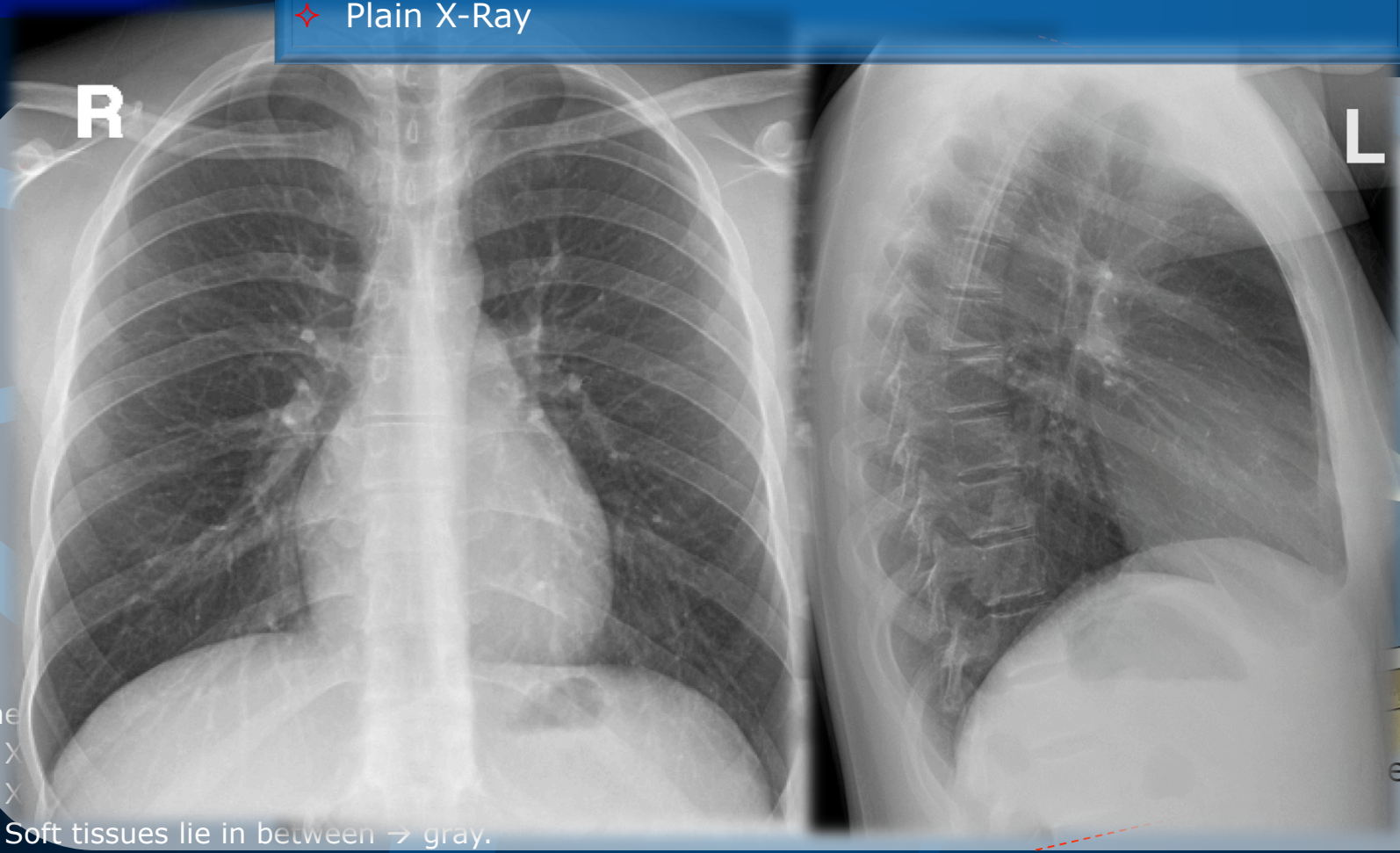
- Electromagnetic radiation
- The image is the result of interaction of X-ray beam and body tissue
- X-rays that pass through a structure easily are least absorbed and t blackening on the radiograph (air-lung).
- Whereas structure that absorbs or reflects x-ray most appear whit
- Soft tissues lie in between → gray. According to thickness of these differ.
- Projections are usually described by the path of the x-ray beam. Th (poster anterior) view designates that the beam passes from the ba standard projection for a routine chest film.
- The image on an x-ray film is two-dimensional. All the structures along beam are projected on to the same portion of the film (superimposed). Th is often necessary to take at least two views to gain information about the third dimension

The image is the result of interaction of X-ray beam and body tissue

- X-rays pass through a structure → blackening on the radiograph (air-lung).
- X-rays absorbed or reflected → white on radiograph (bone-metallic).
- Soft tissues lie in between → gray.

MODALITIES UTILIZED

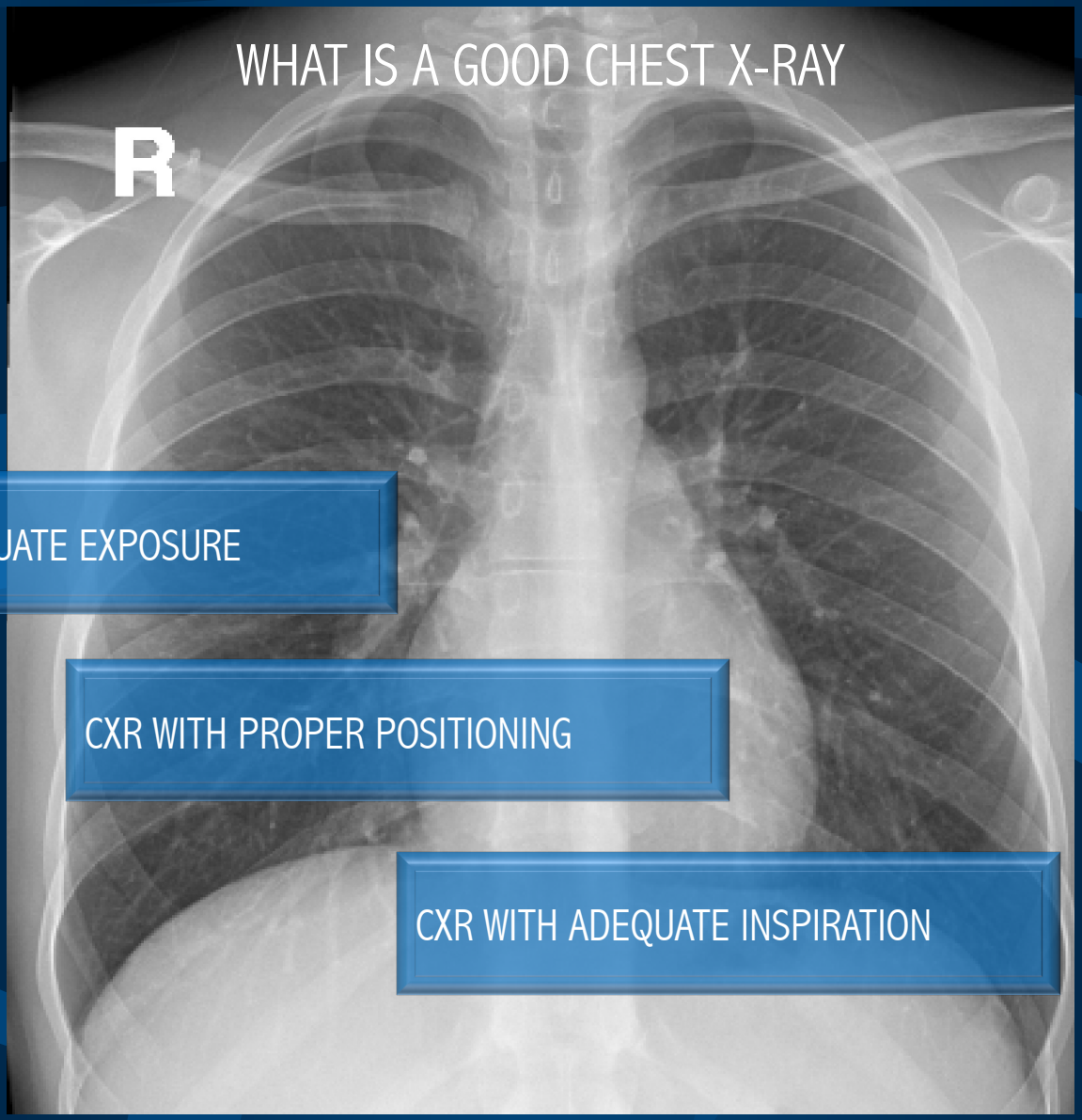
- Plain X-Ray



The
- X
- X
- Soft tissues lie in between → gray.

is
ension

TECHNICAL FACTORS



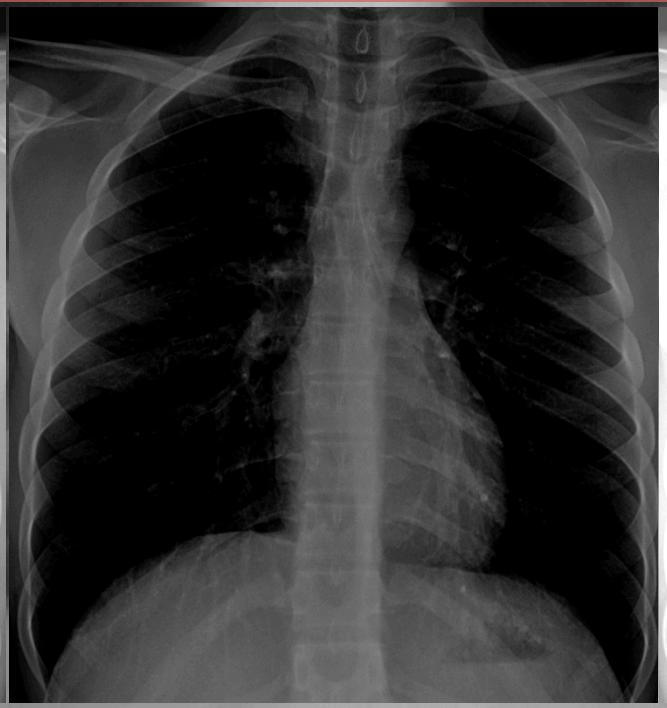
- CXR WITH ADEQUATE EXPOSURE
- CXR WITH PROPER POSITIONING
- CXR WITH ADEQUATE INSPIRATION

TECHNICAL FACTORS

WHAT IS ADEQUATE EXPOSURE?

IS
- Exposure that allow visualization of lung markings even through cardiac shadow
- Assessed by seeing spine through heart shadow

ADEQUATE

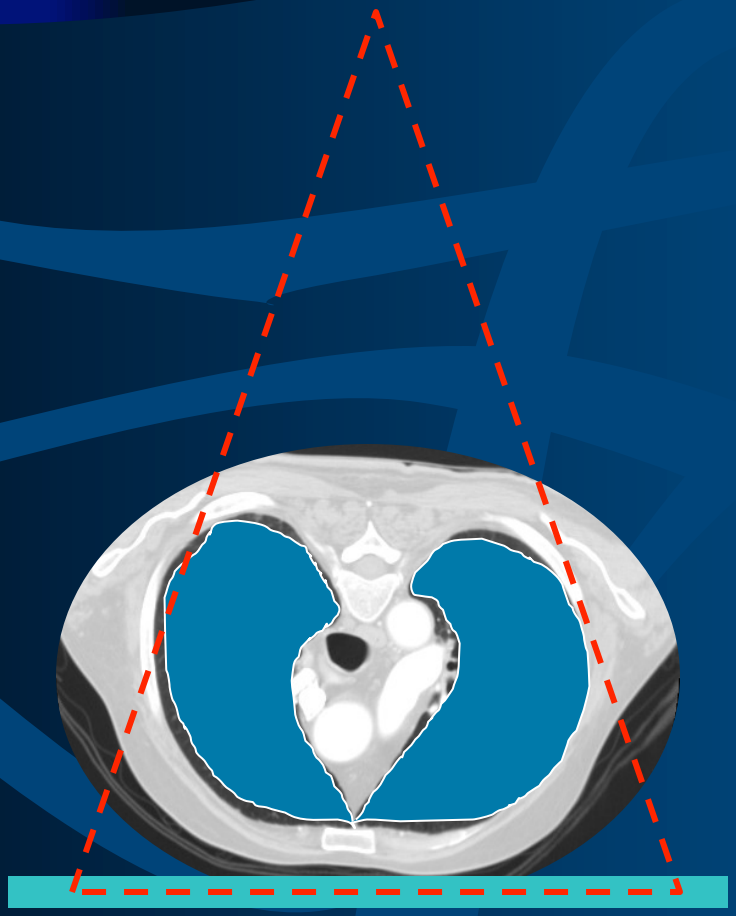


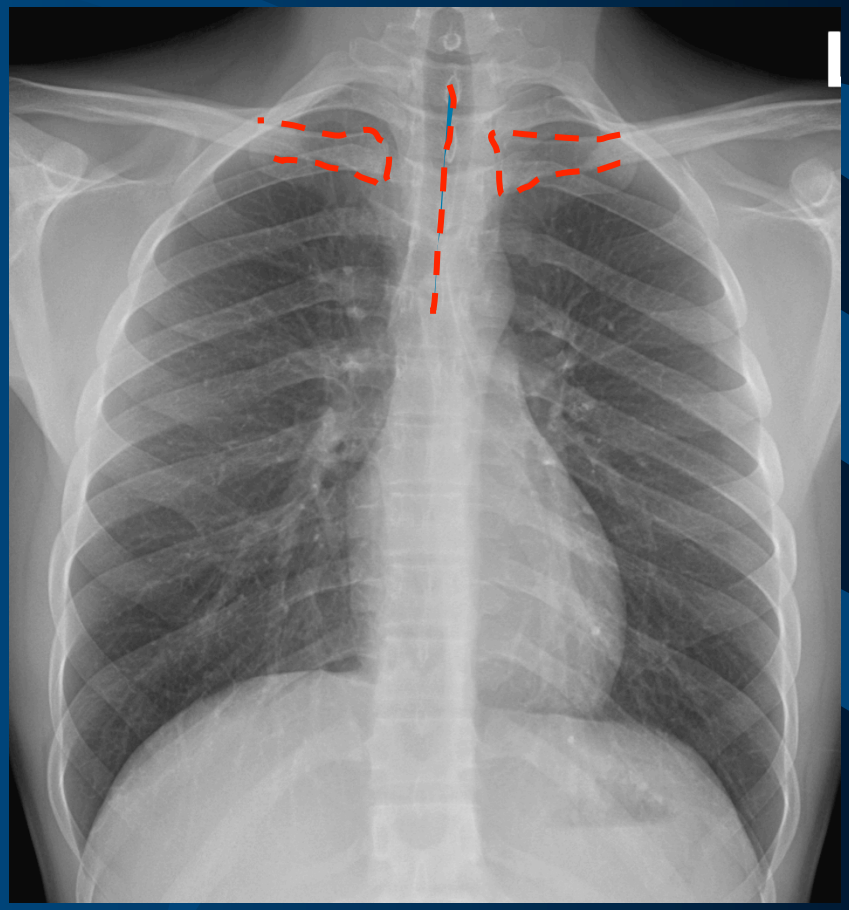
OVER

UNDER

TECHNICAL FACTORS

WHAT IS PROPER POSITIONING?



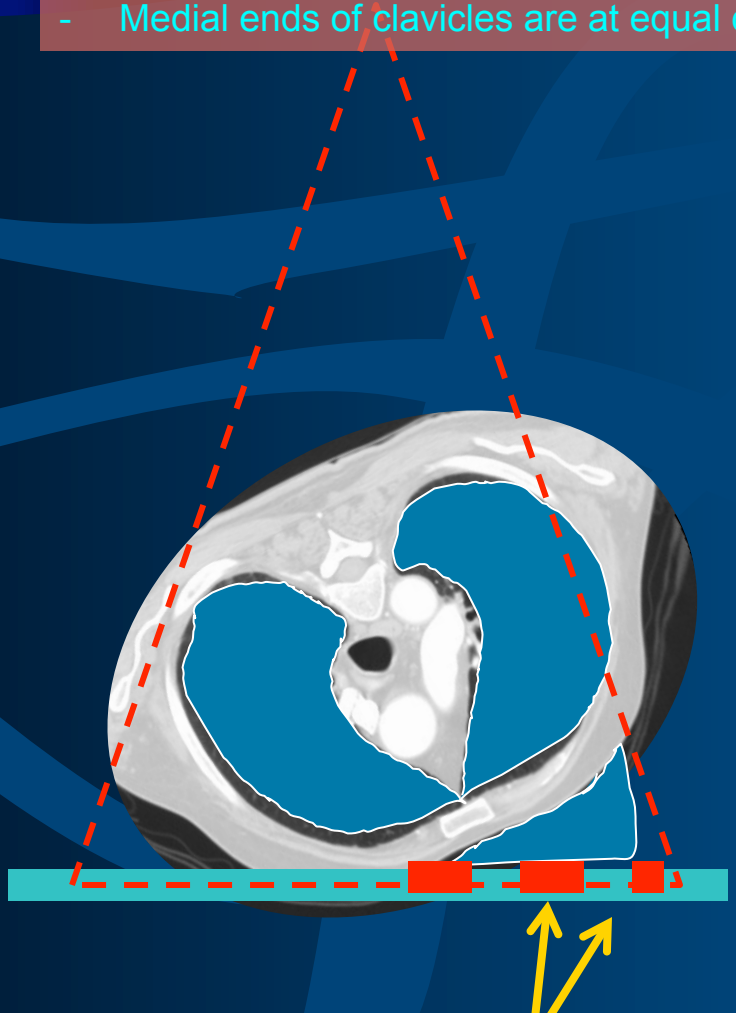


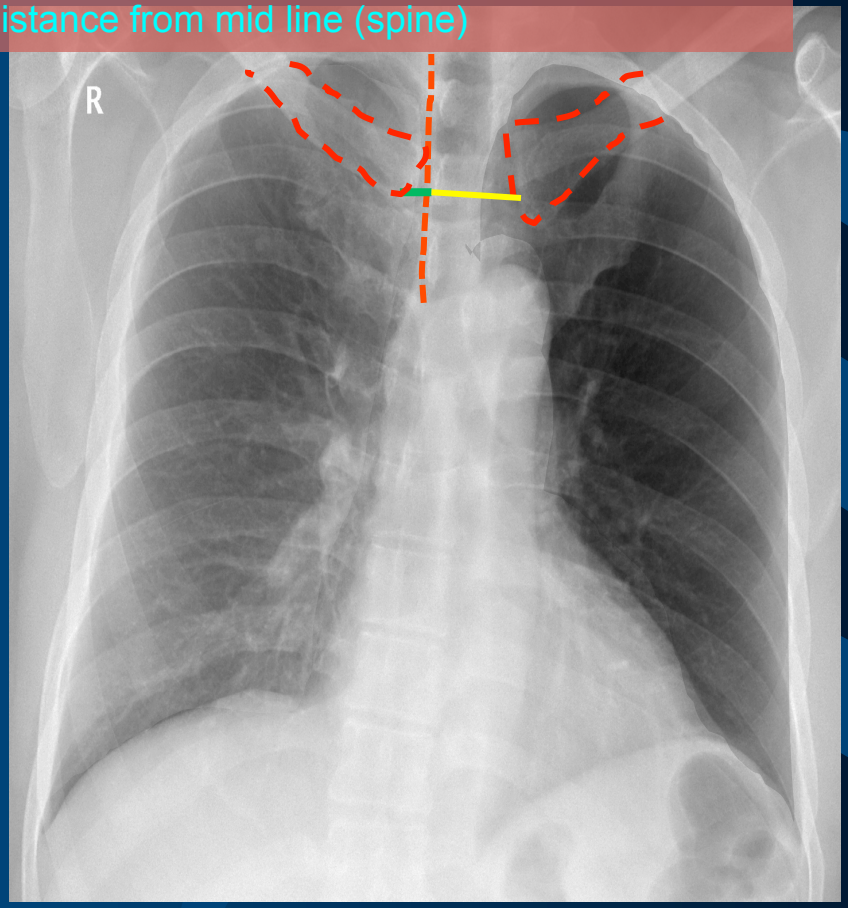
TECHNICAL FACTORS

WHAT IS PROPER POSITIONING?

Assessed by seeing

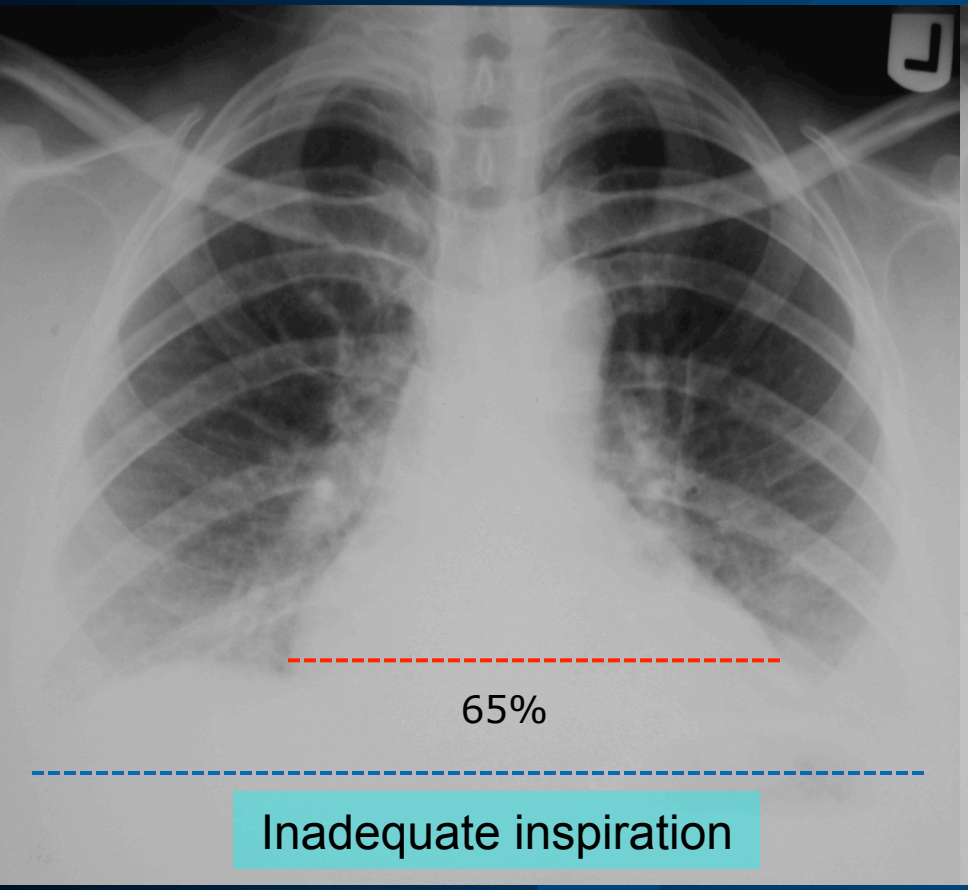
- Medial ends of clavicles are at equal distance from mid line (spine)





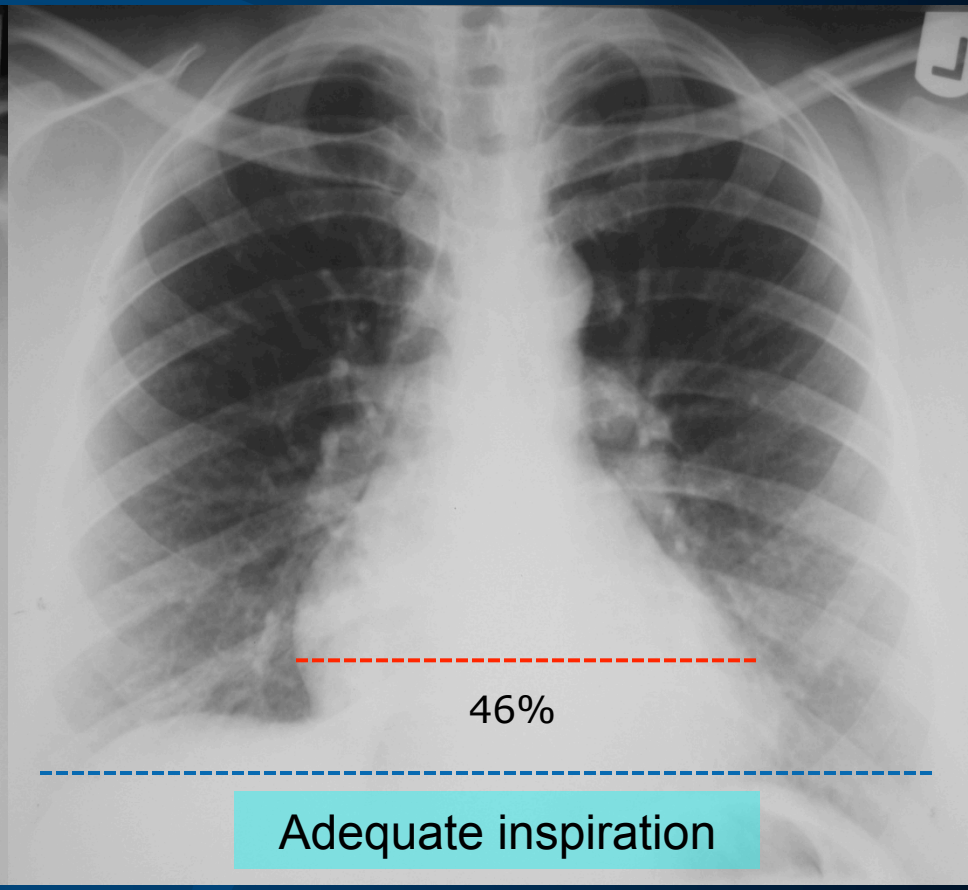
TECHNICAL FACTORS

WHAT IS ADEQUATE INSPIRATION?



65%

Inadequate inspiration



46%

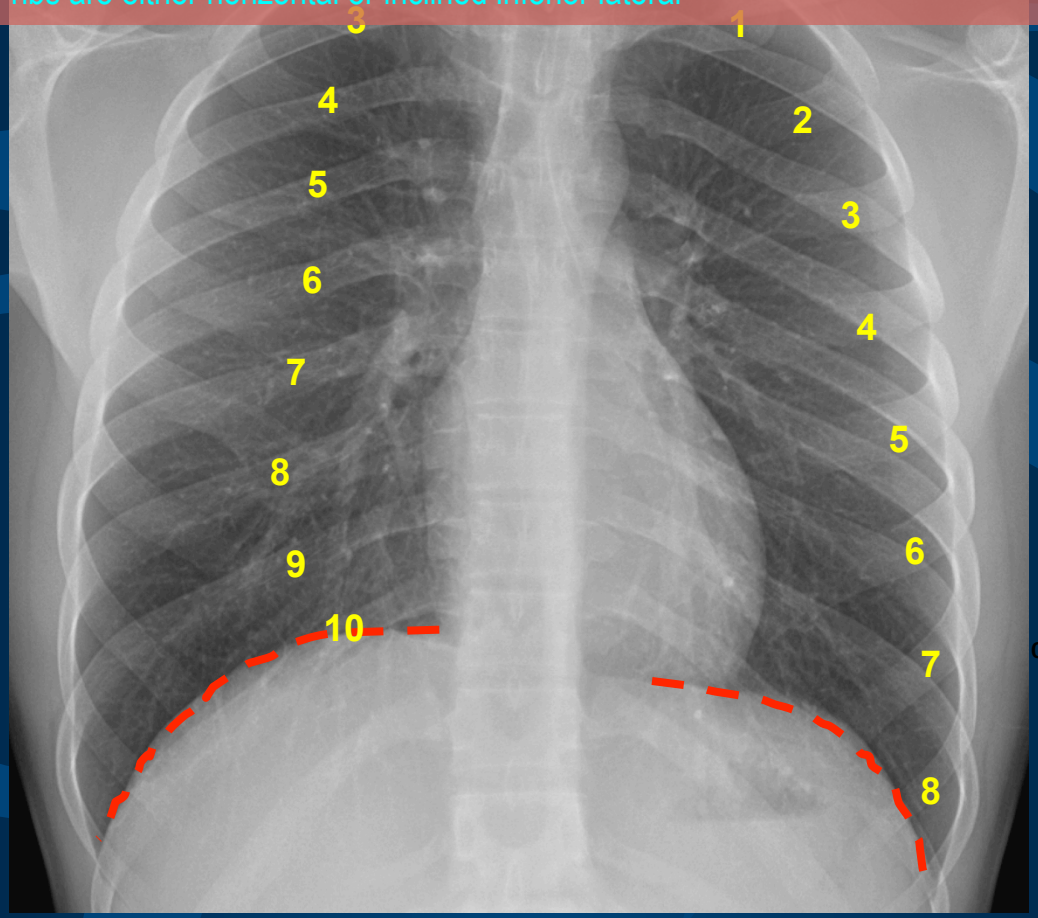
Adequate inspiration

TECHNICAL FACTORS

WHAT IS ADEQUATE INSPIRATION?

Assessed by seeing

- 6 anterior ribs above dome of diaphragm or 9 posterior ones.
- Anterior ribs are inclined inferior medial
- Posterior ribs are either horizontal or inclined inferior lateral



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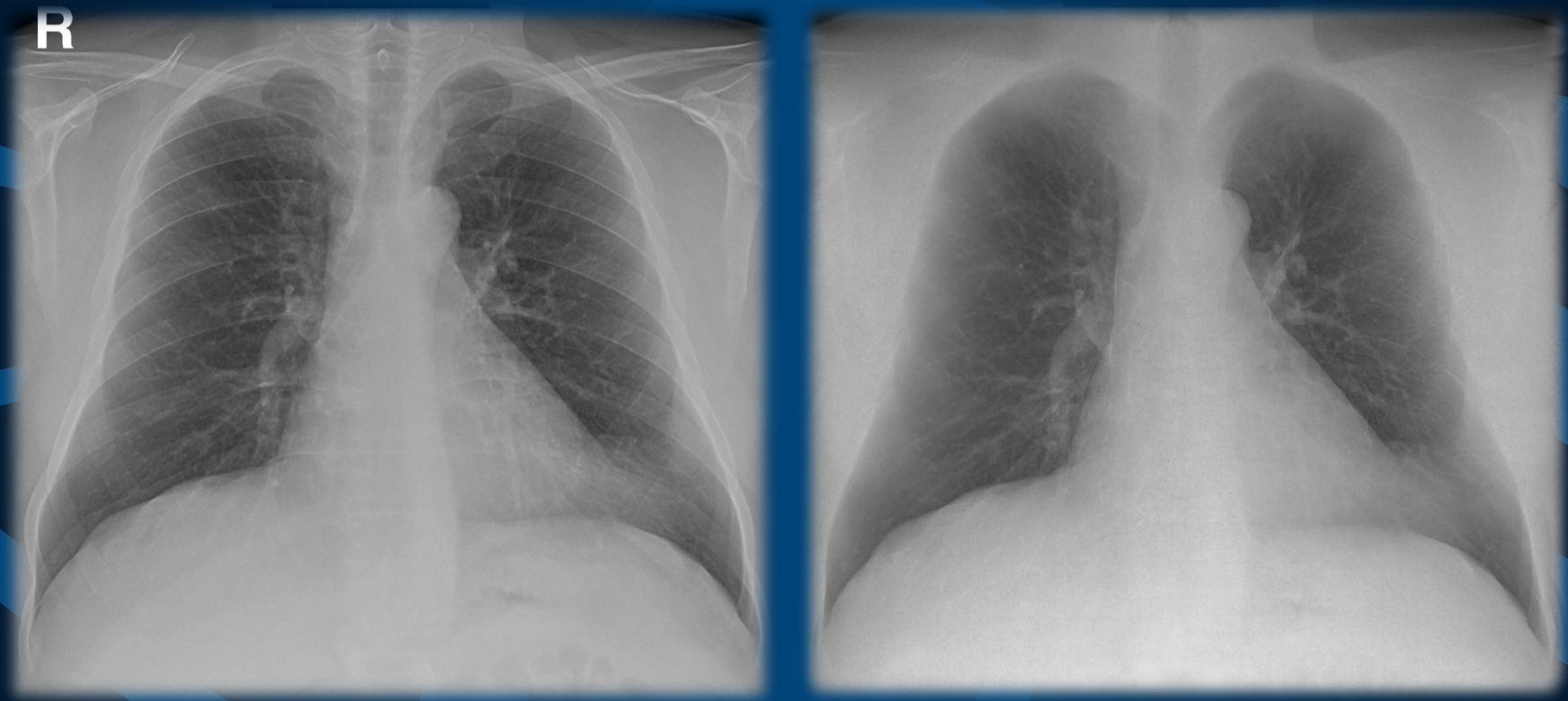
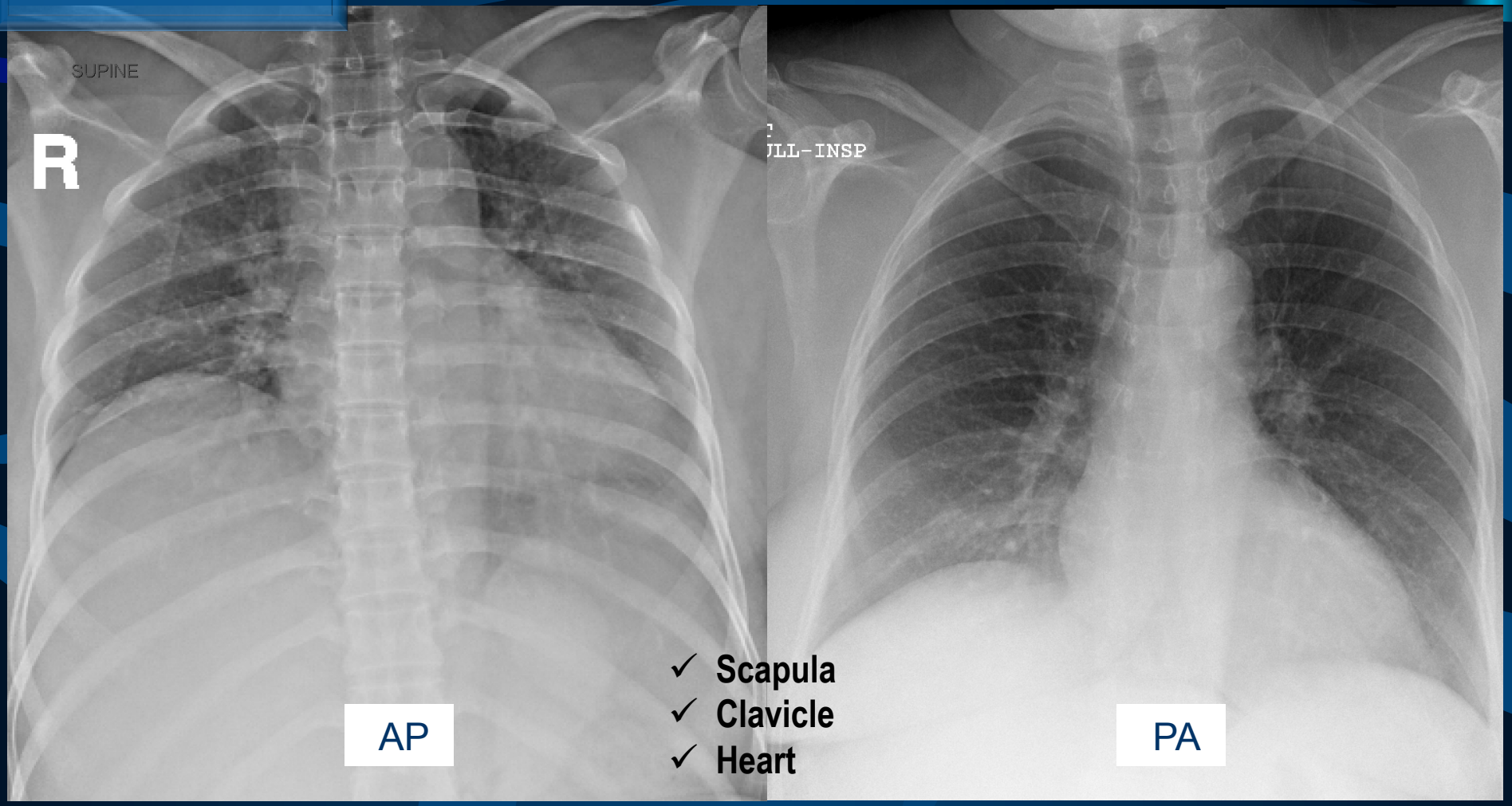
TECHNICAL FACTORS

WHAT IS DUAL ENERGY TECHNIQUE?



TECHNICAL FACTORS

AP VS PA TECHNIQUE?



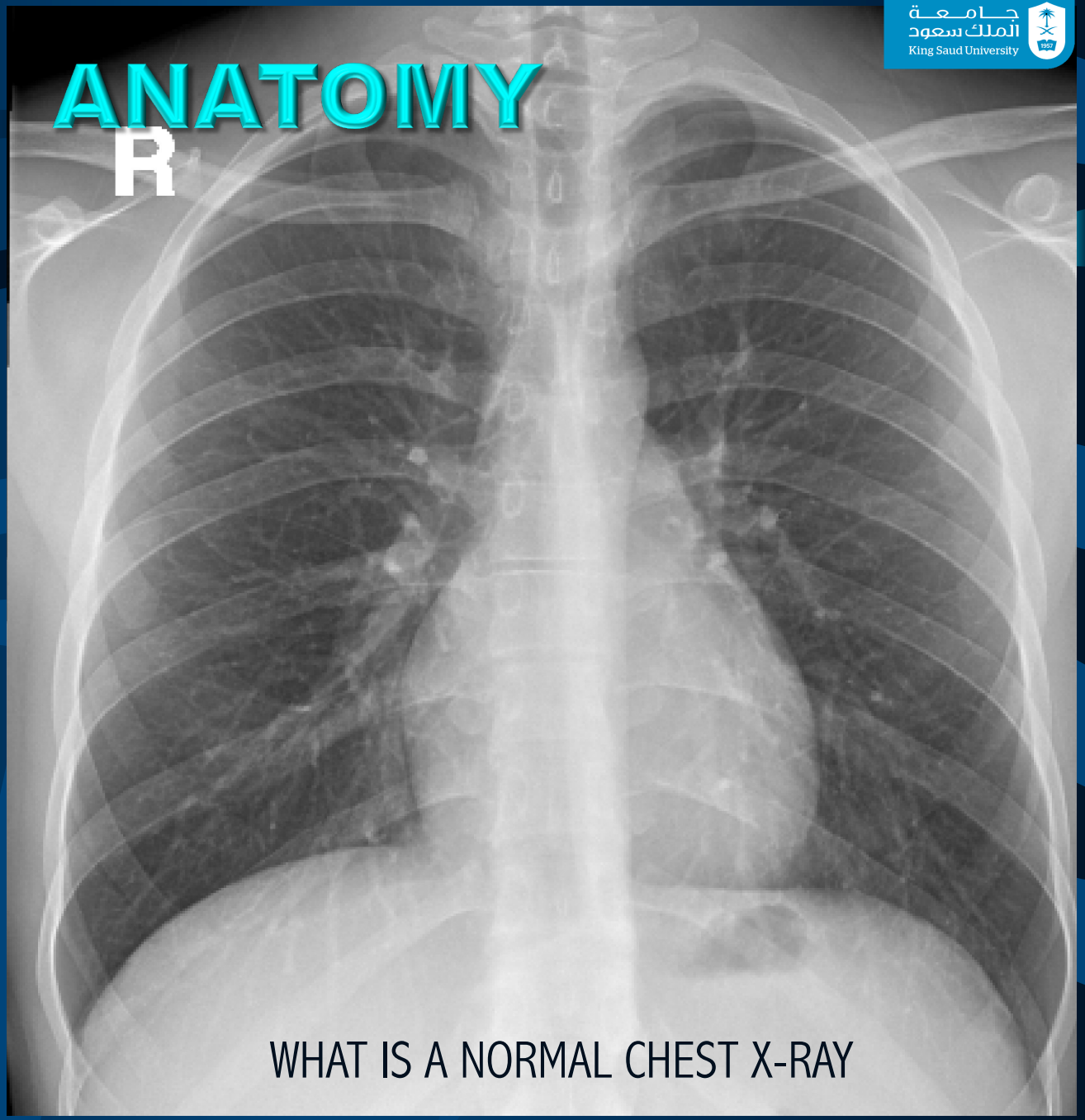
AP

- ✓ Scapula
- ✓ Clavicle
- ✓ Heart

PA

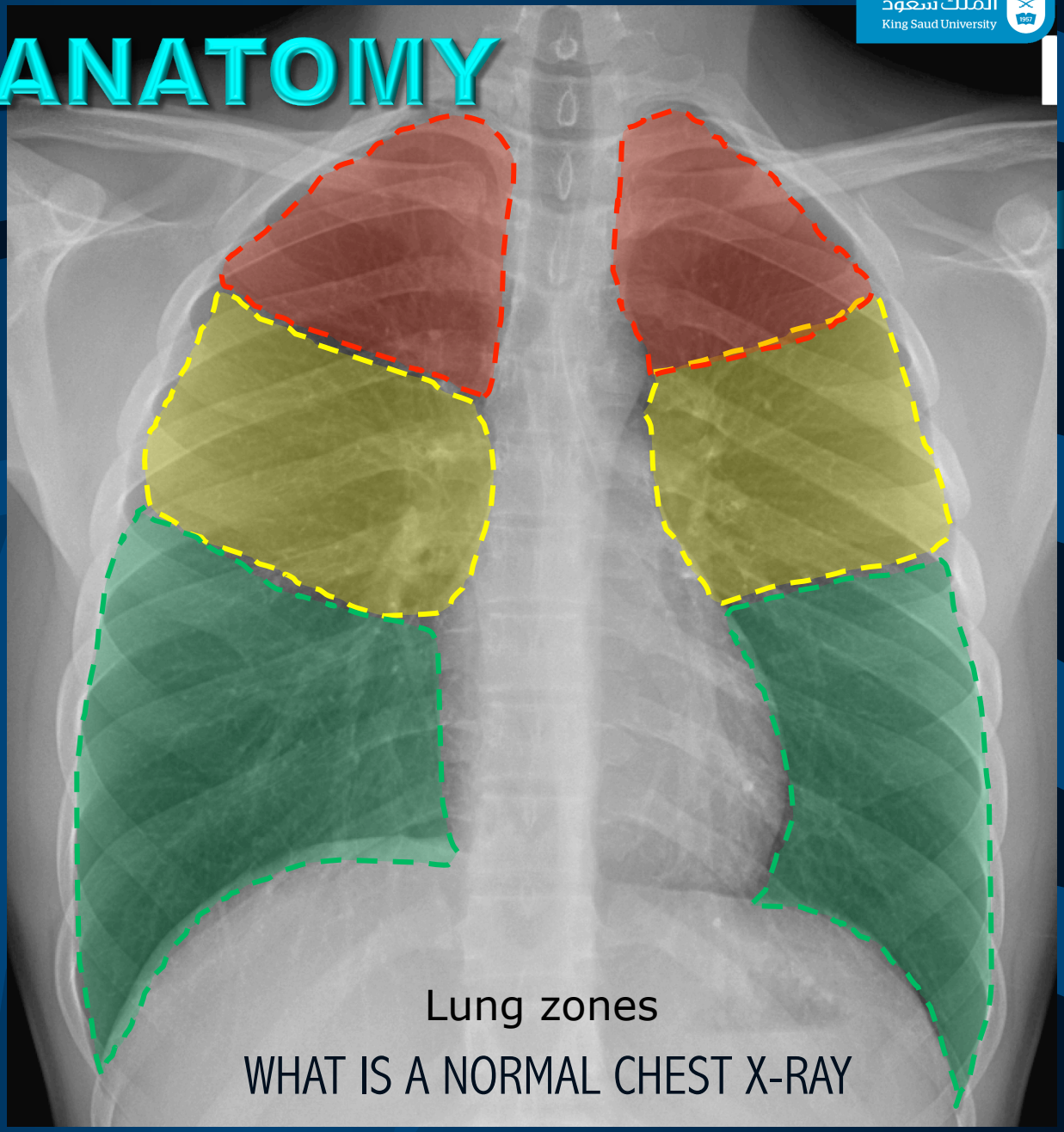
CHEST X-RAY

- LUNGS
- MEDIASTINUM
- BONY CAGE
- SOFT TISSUE COMPONENT

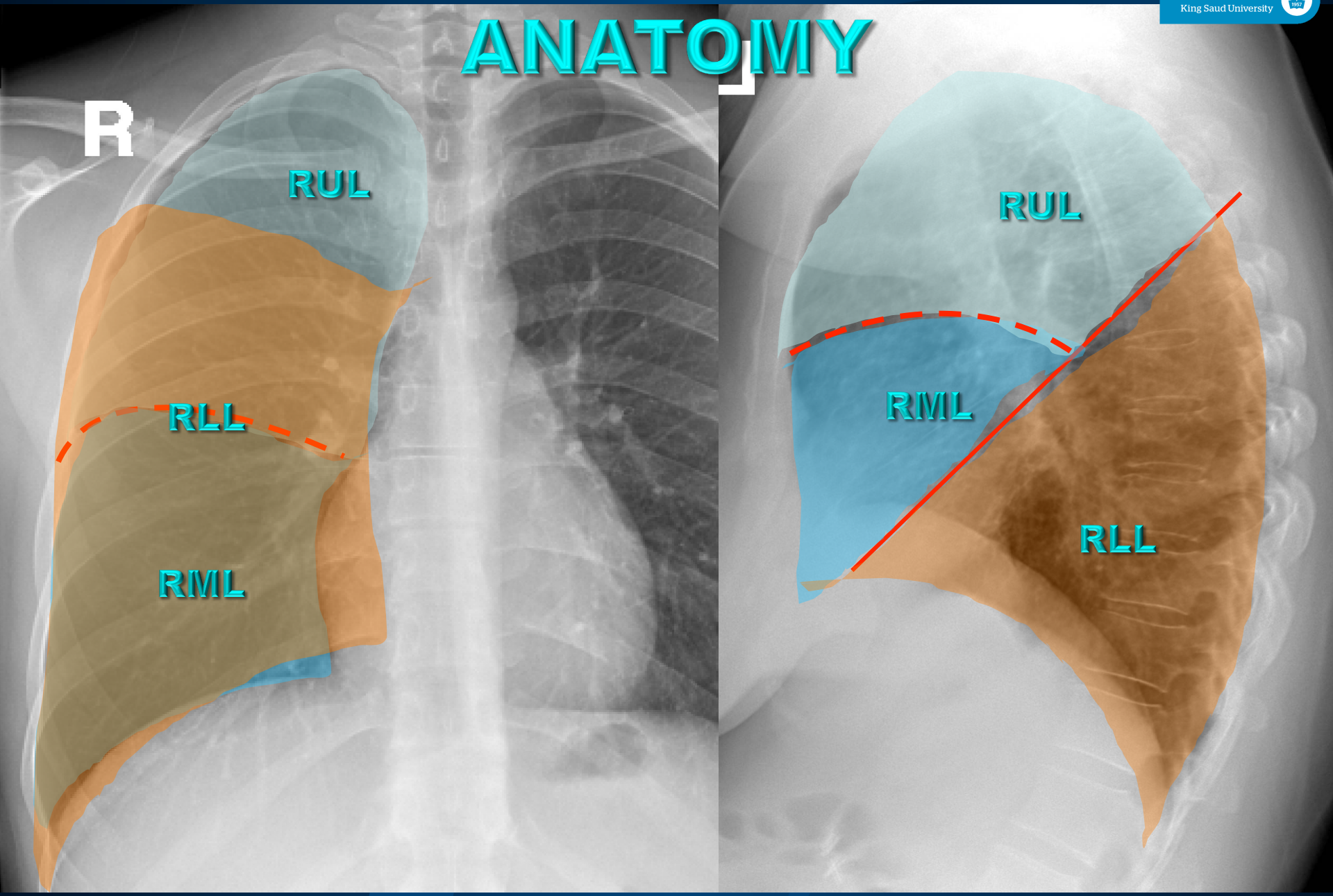


ANATOMY

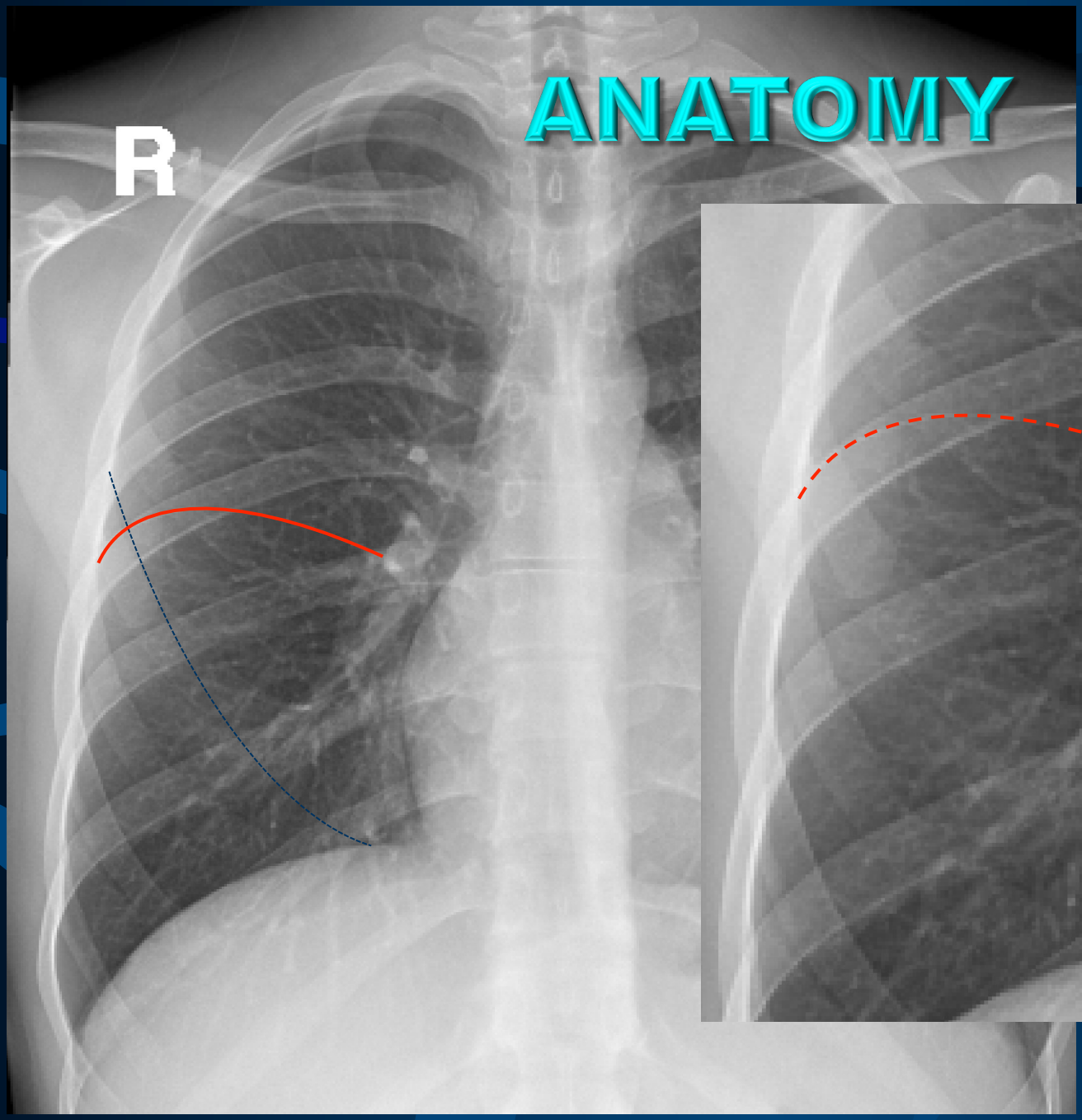
- LUNGS
  - Well-aerated
  - Symmetrical translucency
  - Clear apices & costophrenic angles
  - Normal vascular distribution

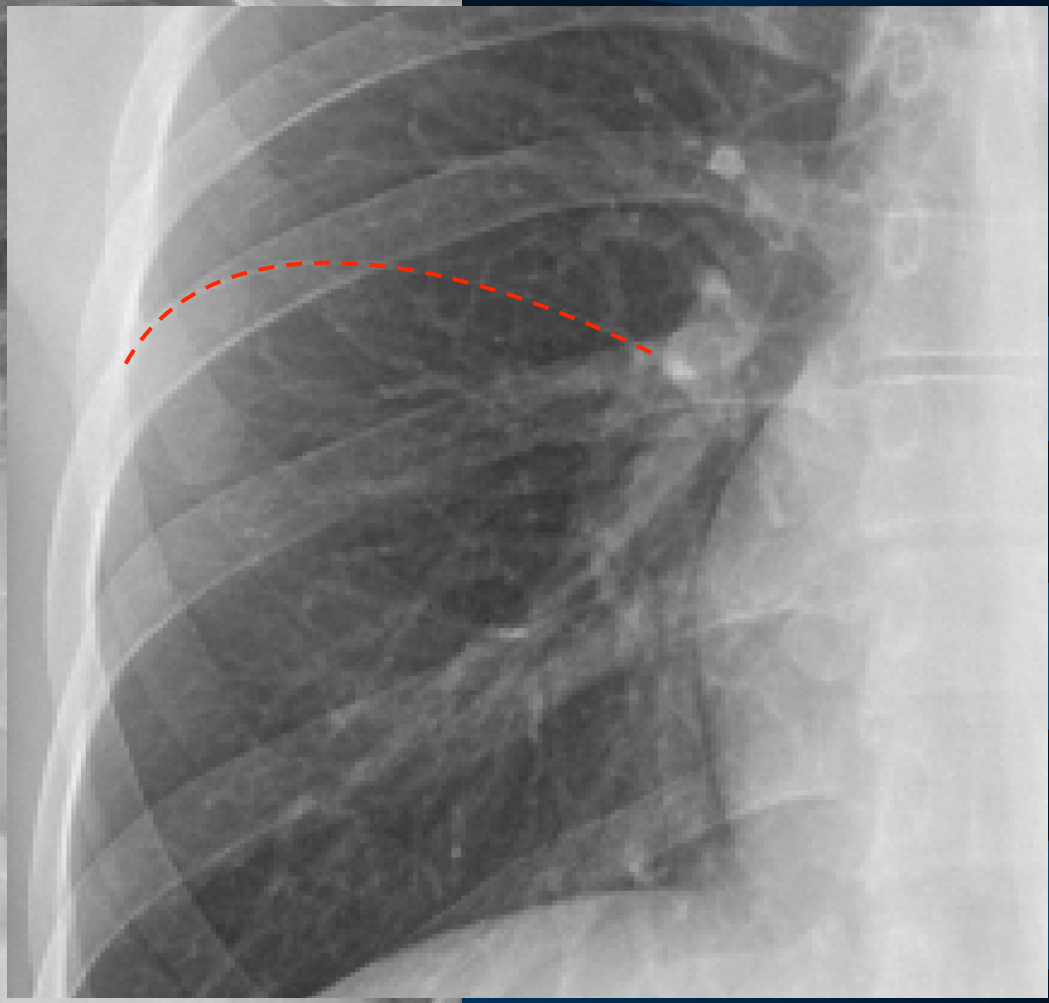


ANATOMY



ANATOMY





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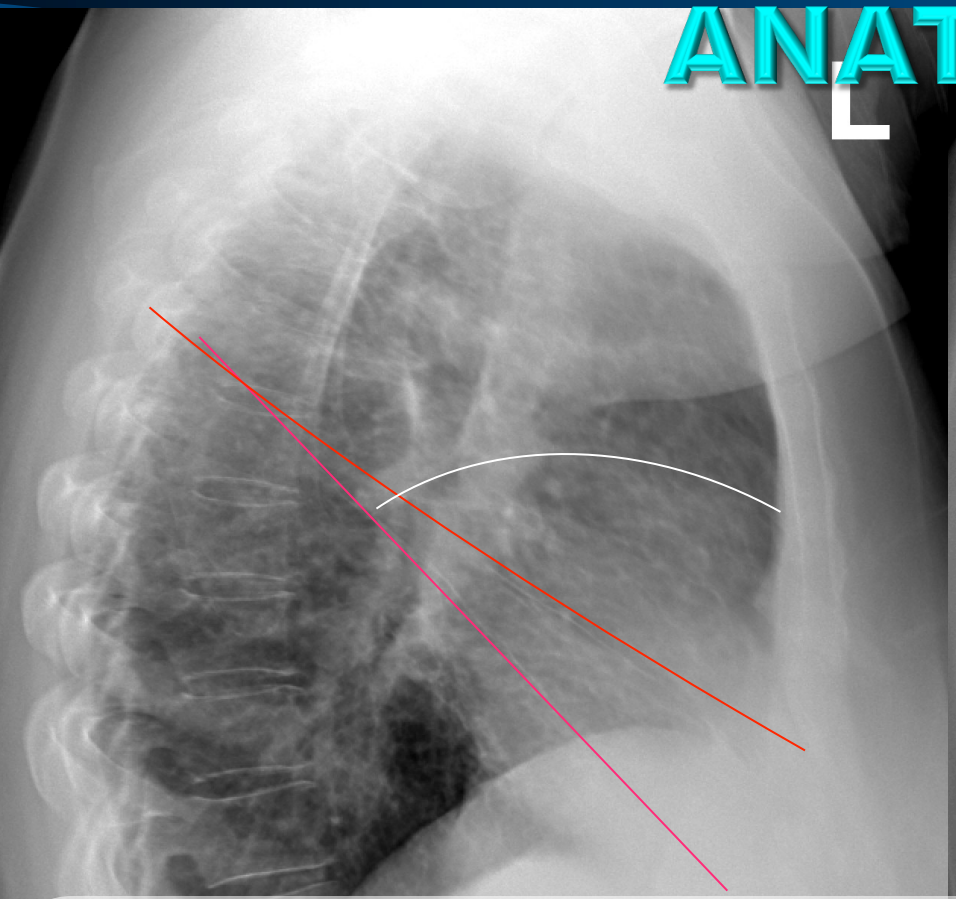
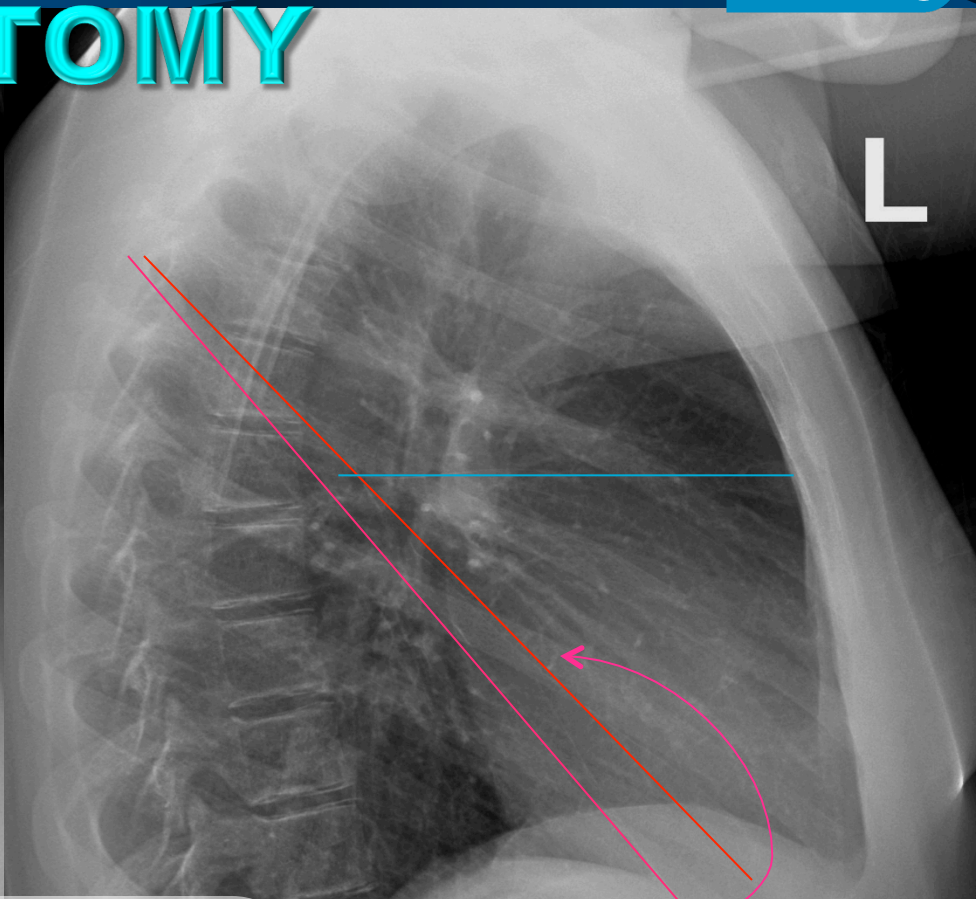




Fissures:

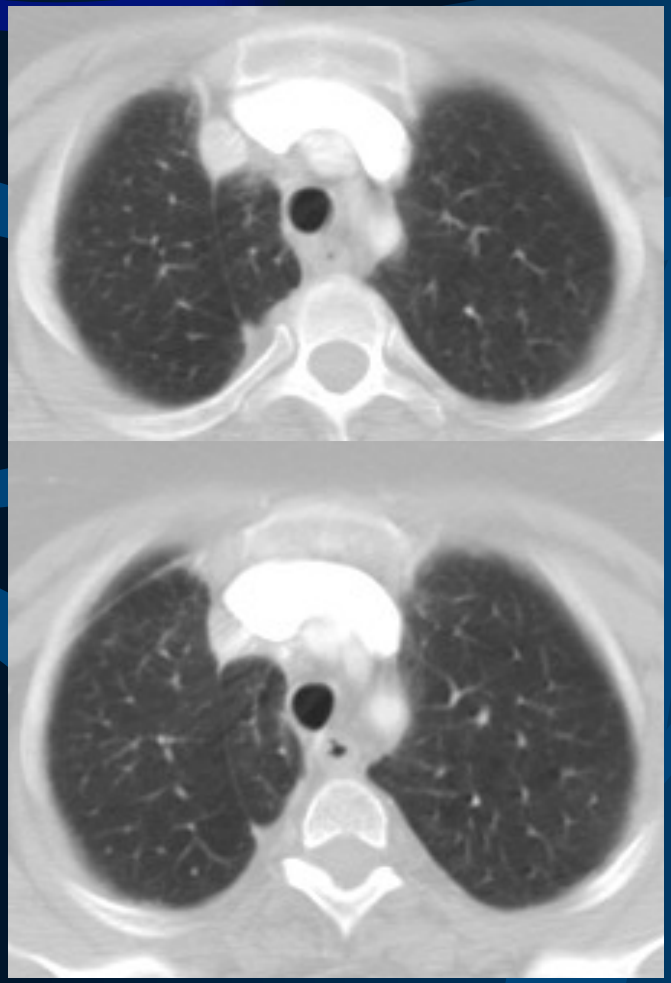
•Oblique (major): is seen best in lateral view (occasionally seen in PA view –not always)
right is more anterior than left

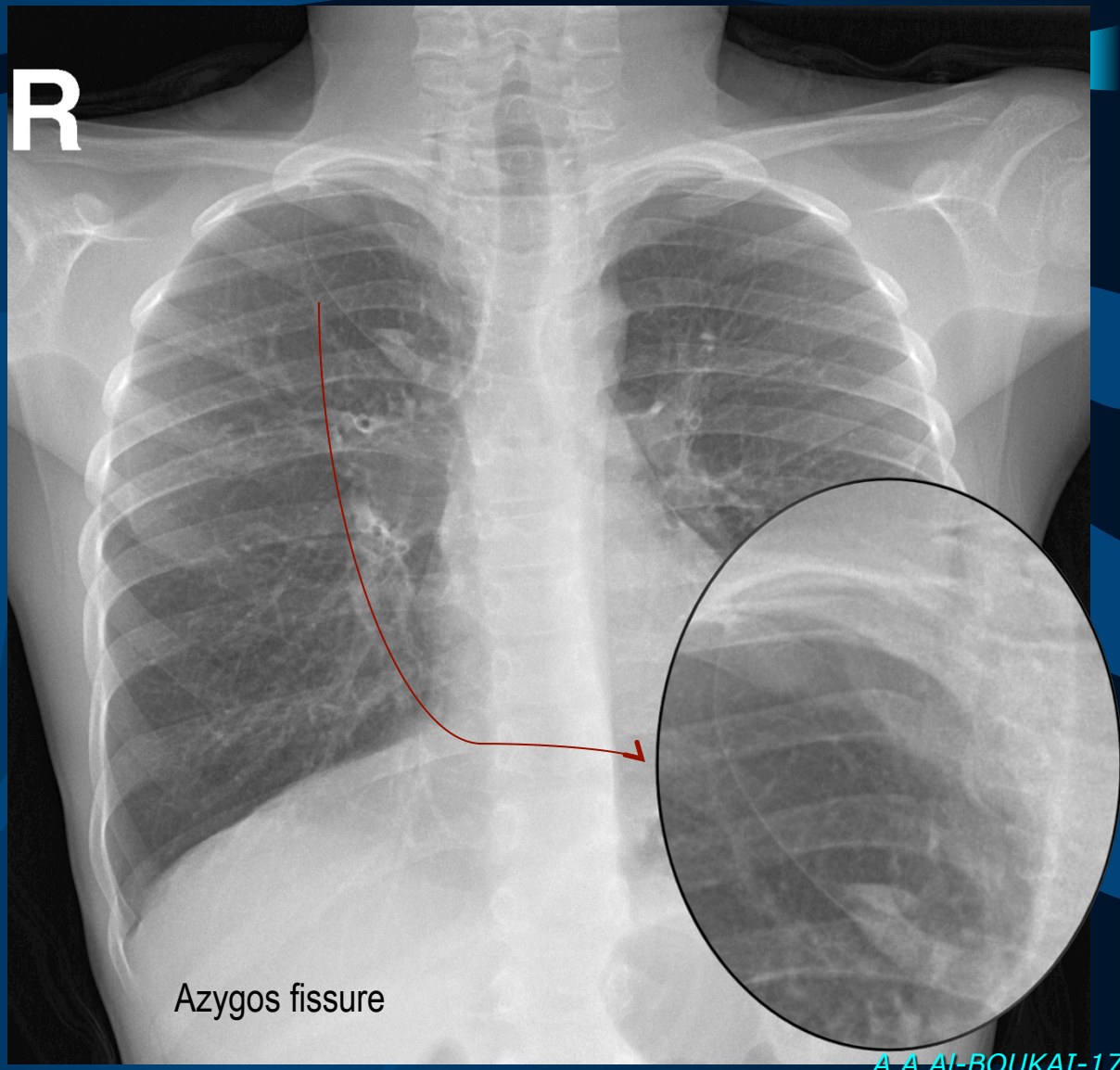
•Horizontal (minor): is seen in both PA and lateral view

Both are formed from 2 layers

Accessory fissure has 4 layers example is Azygos fissure

ANATOMY

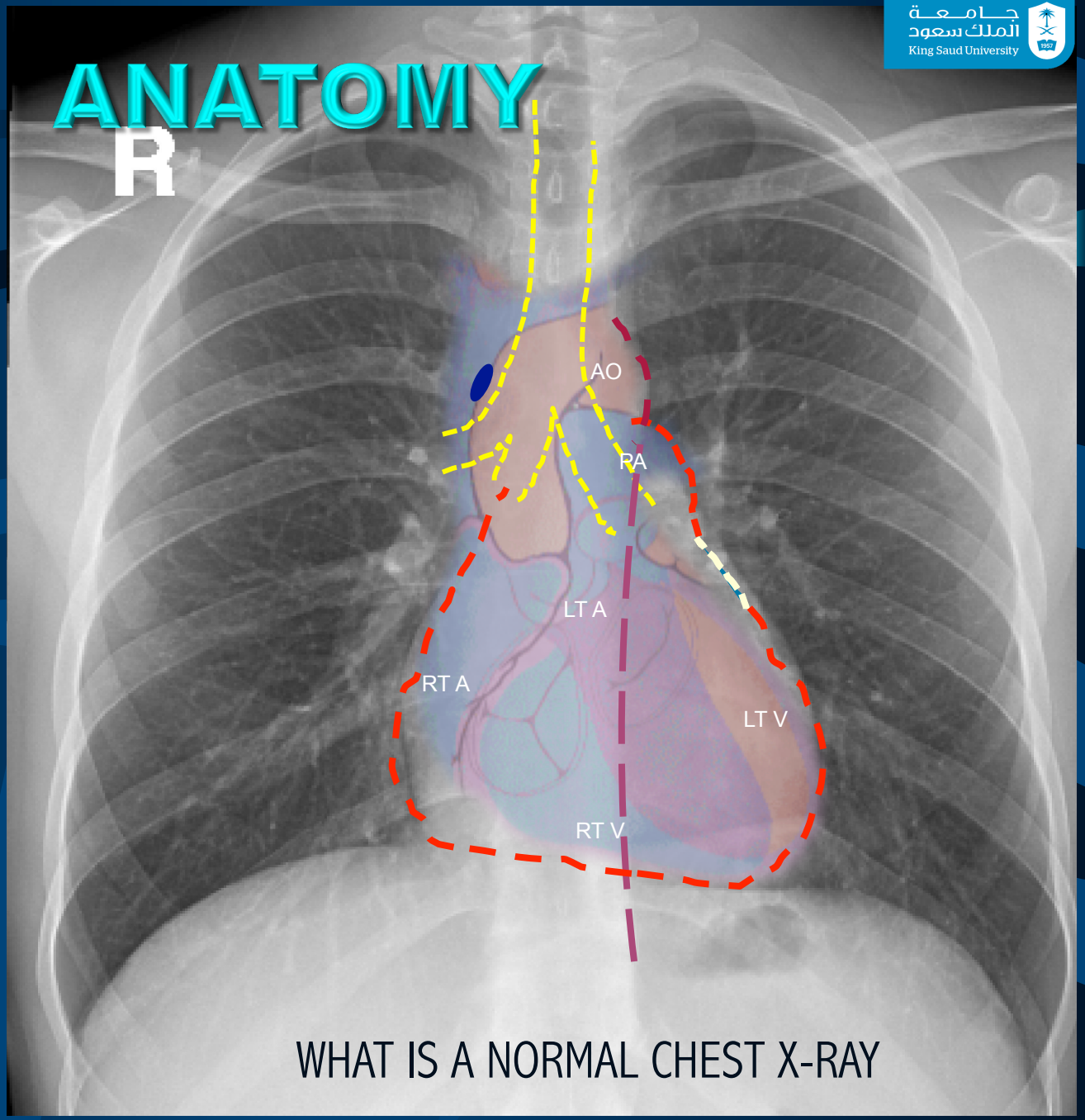




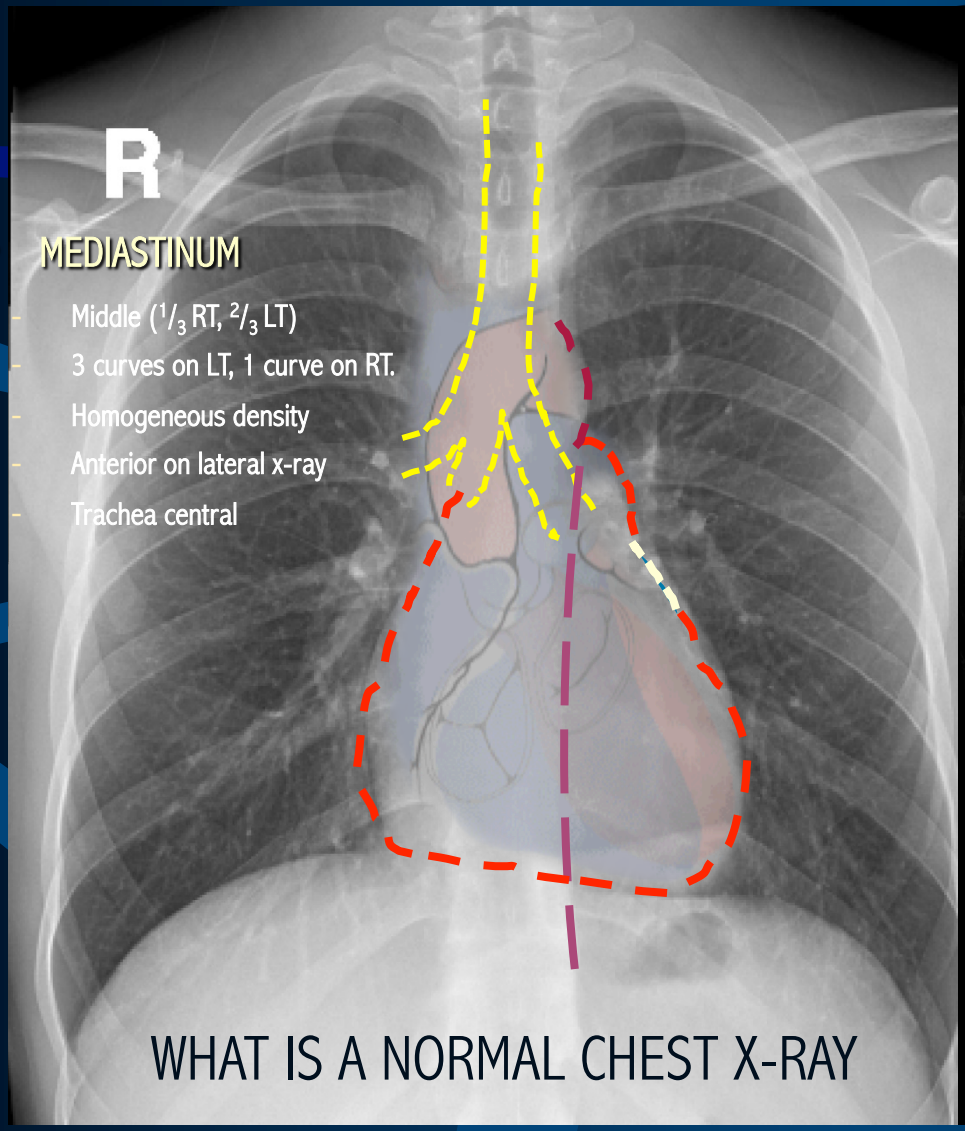
ANATOMY

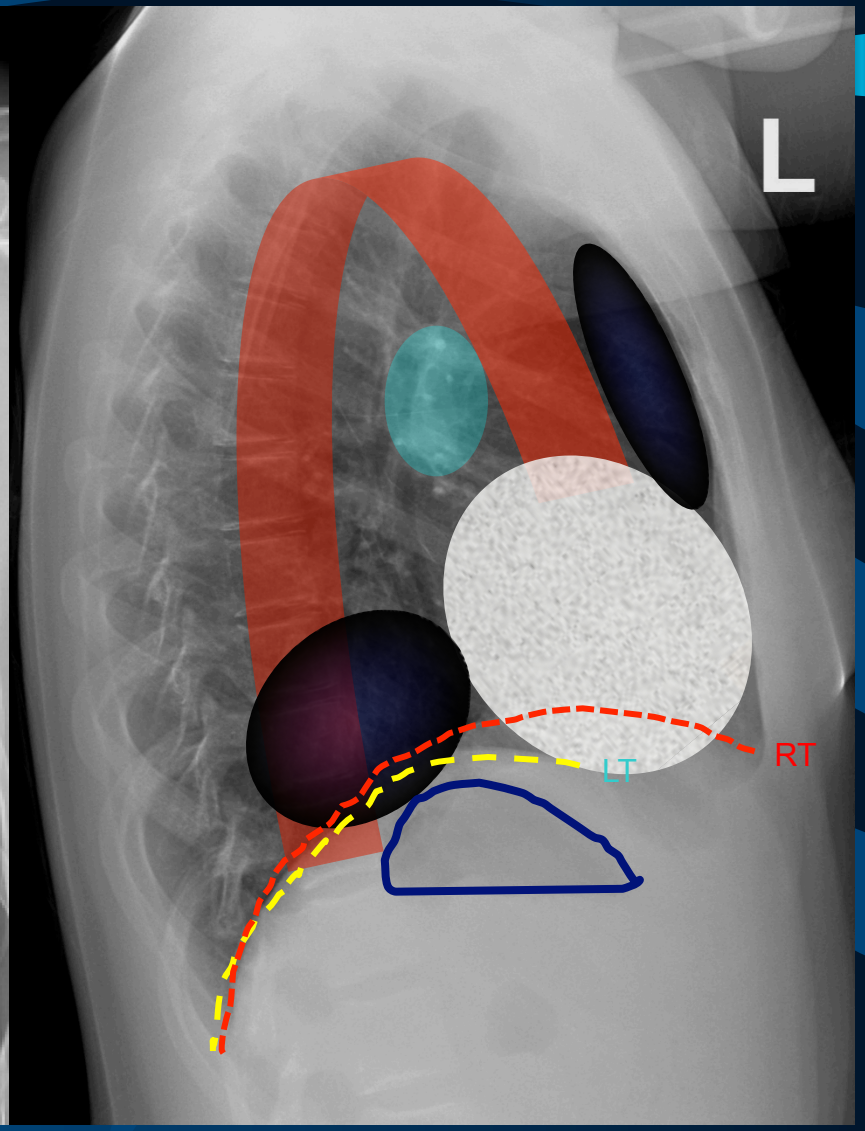
R

- MEDIASTINUM
  - Middle ($^1/_3$ RT, $^2/_3$ LT)
  - 3 curves on LT, 1 curve on RT.
  - Homogeneous density
  - Anterior on lateral x-ray
  - Trachea central



ANATOMY


R
MEDIASTINUM
Middle (1/3 RT, 2/3 LT)
3 curves on LT, 1 curve on RT.
Homogeneous density
Anterior on lateral x-ray
Trachea central
WHAT IS A NORMAL CHEST X-RAY


L
LT
RT

ANATOMY

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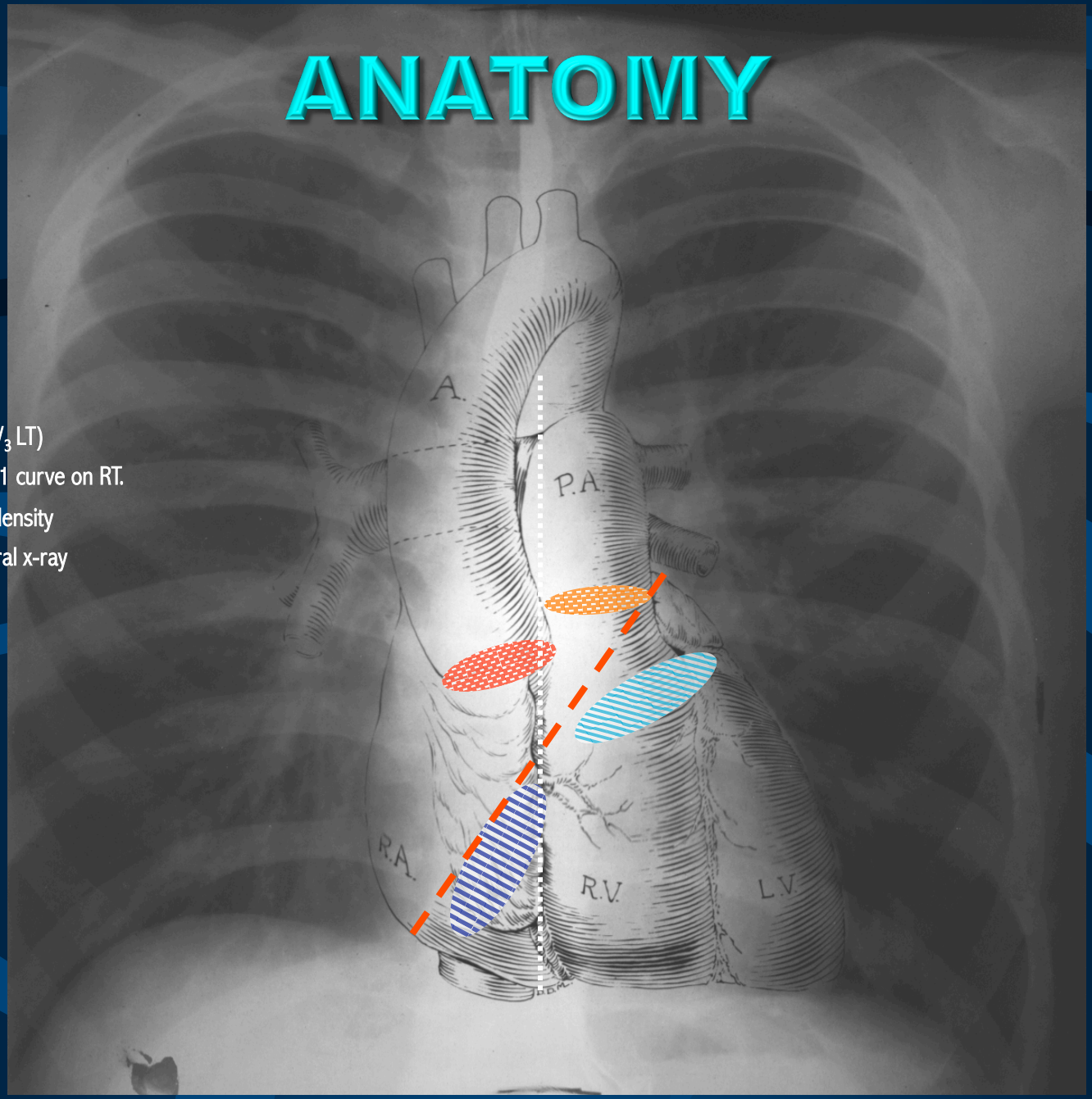

ANATOMY

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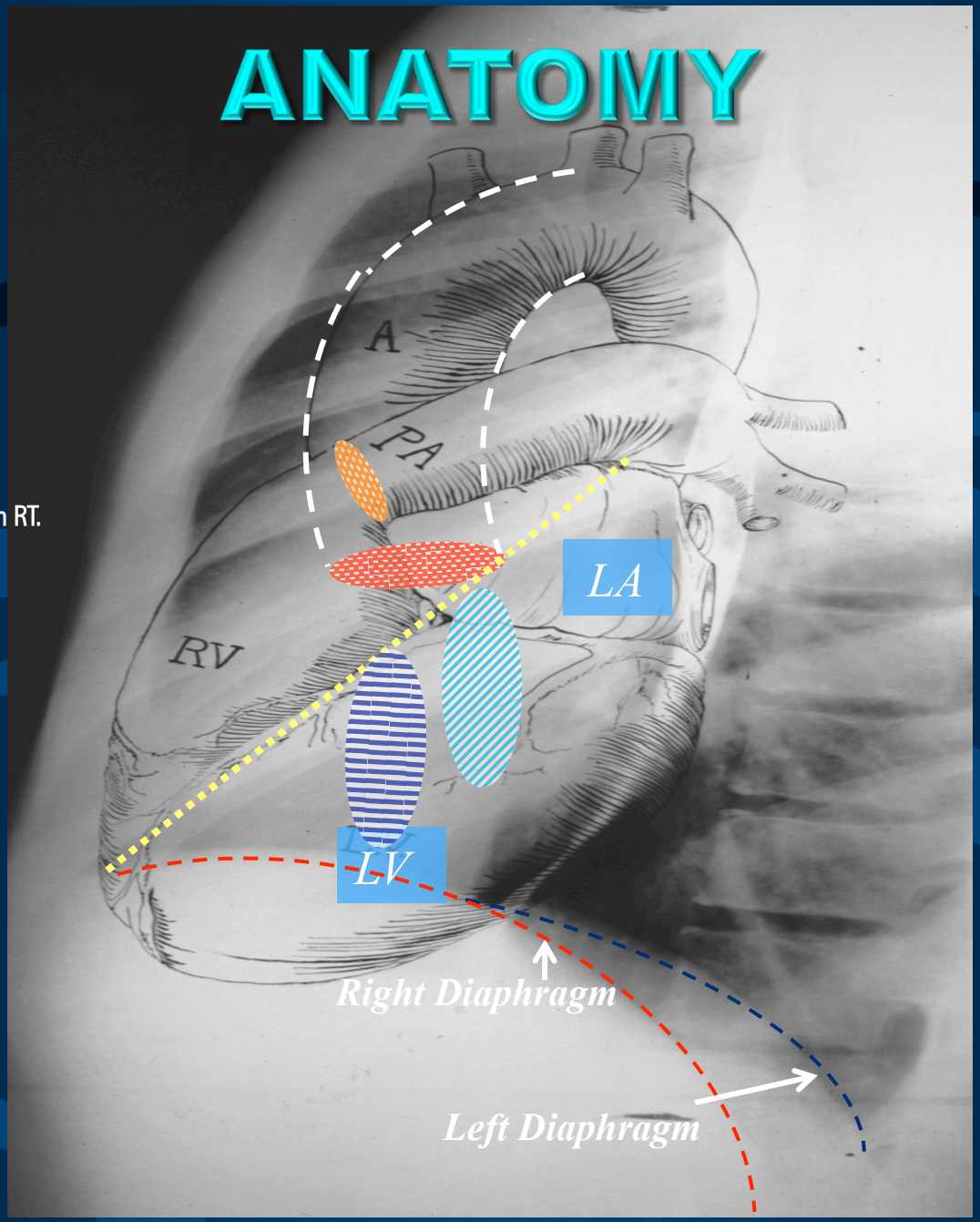
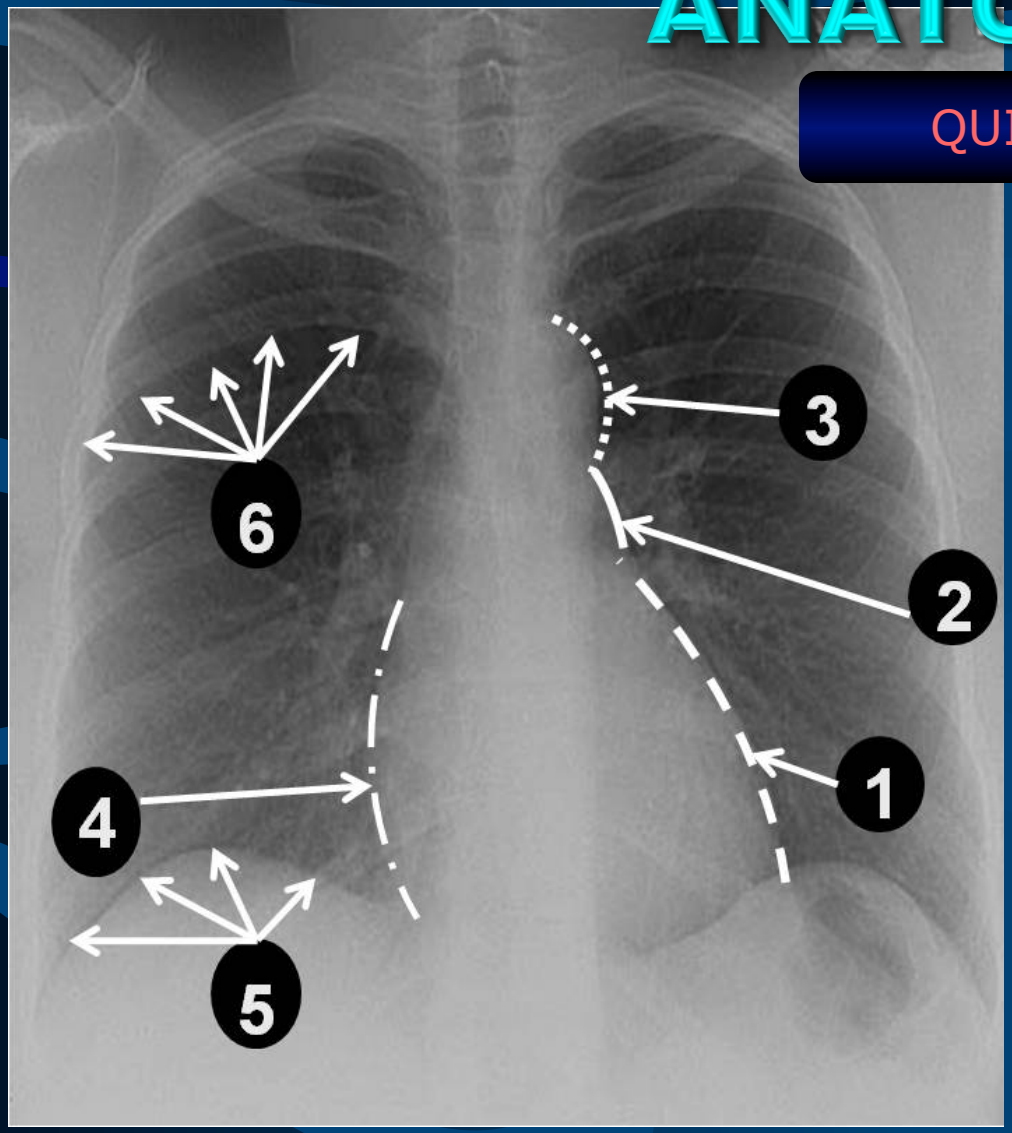
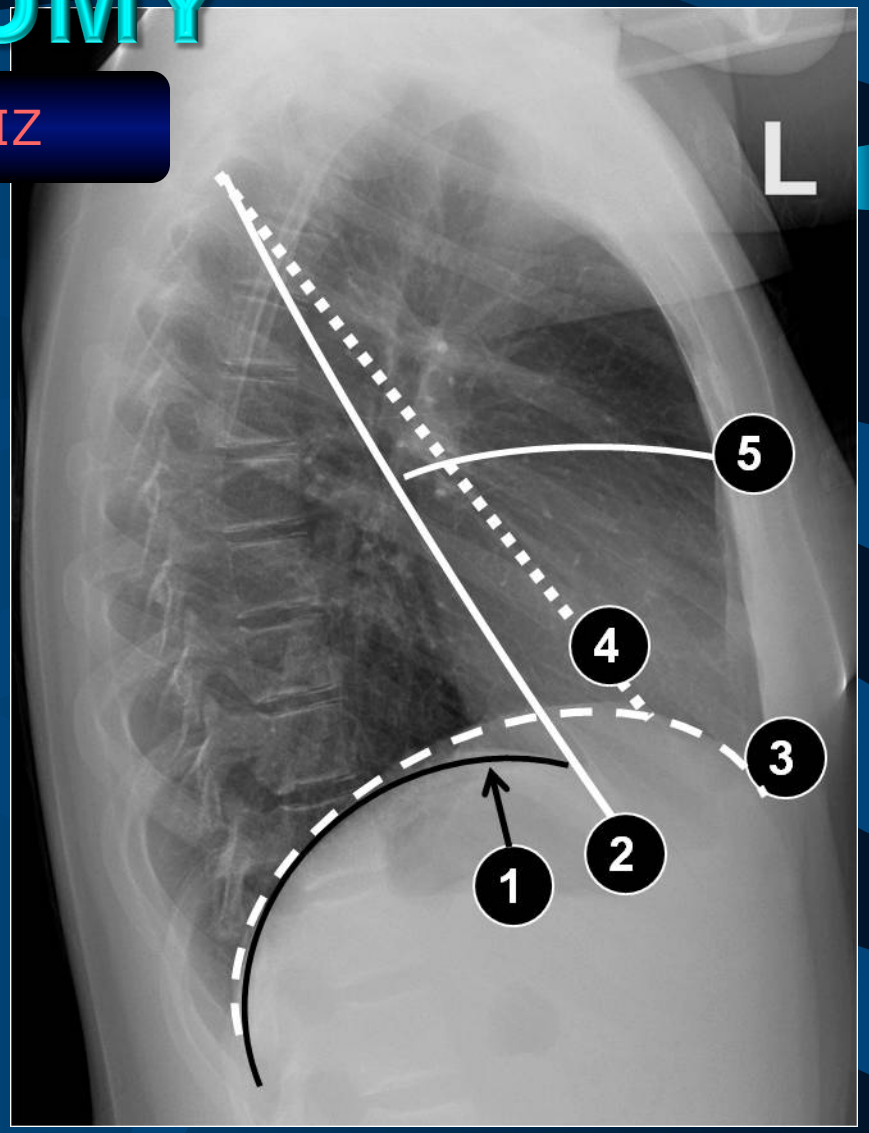


ANATOMY

QUIZ

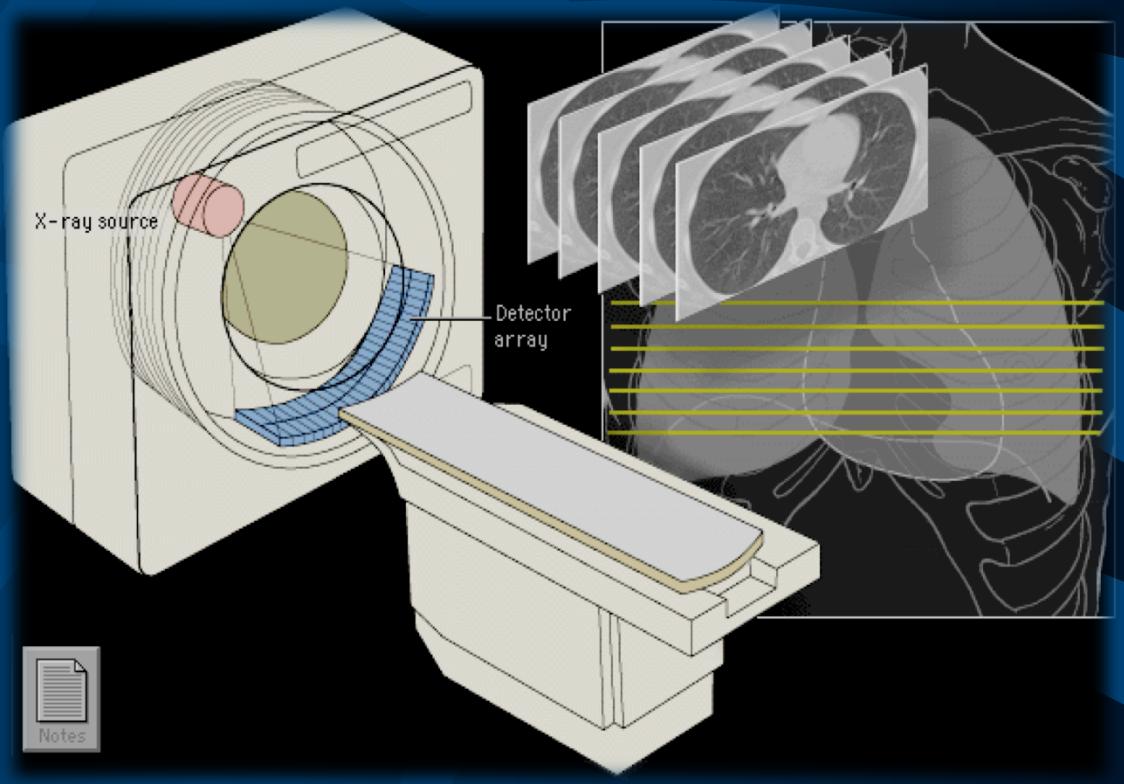




MODALITIES UTILIZED

MODALITIES UTILIZED

- Computed Tomography (CT)



MODALITIES UTILIZED

✧ Computed Tomography (CT)

CT Scan:

•Relies on x-rays transmitted through the body. It differs from conventional radiography in that a more sensitive x-ray detection system is used, the images consist of sections (slices) through the body, and the data are manipulated by a computer.

•Has very small differences in x-ray absorption values compared with conventional radiography; the range of densities recorded is increased approximately 10-fold.

•So gradations of density within soft tissues can be recognized, e.g. brain substance from cerebrospinal fluid, or tumor from surrounding normal tissues.

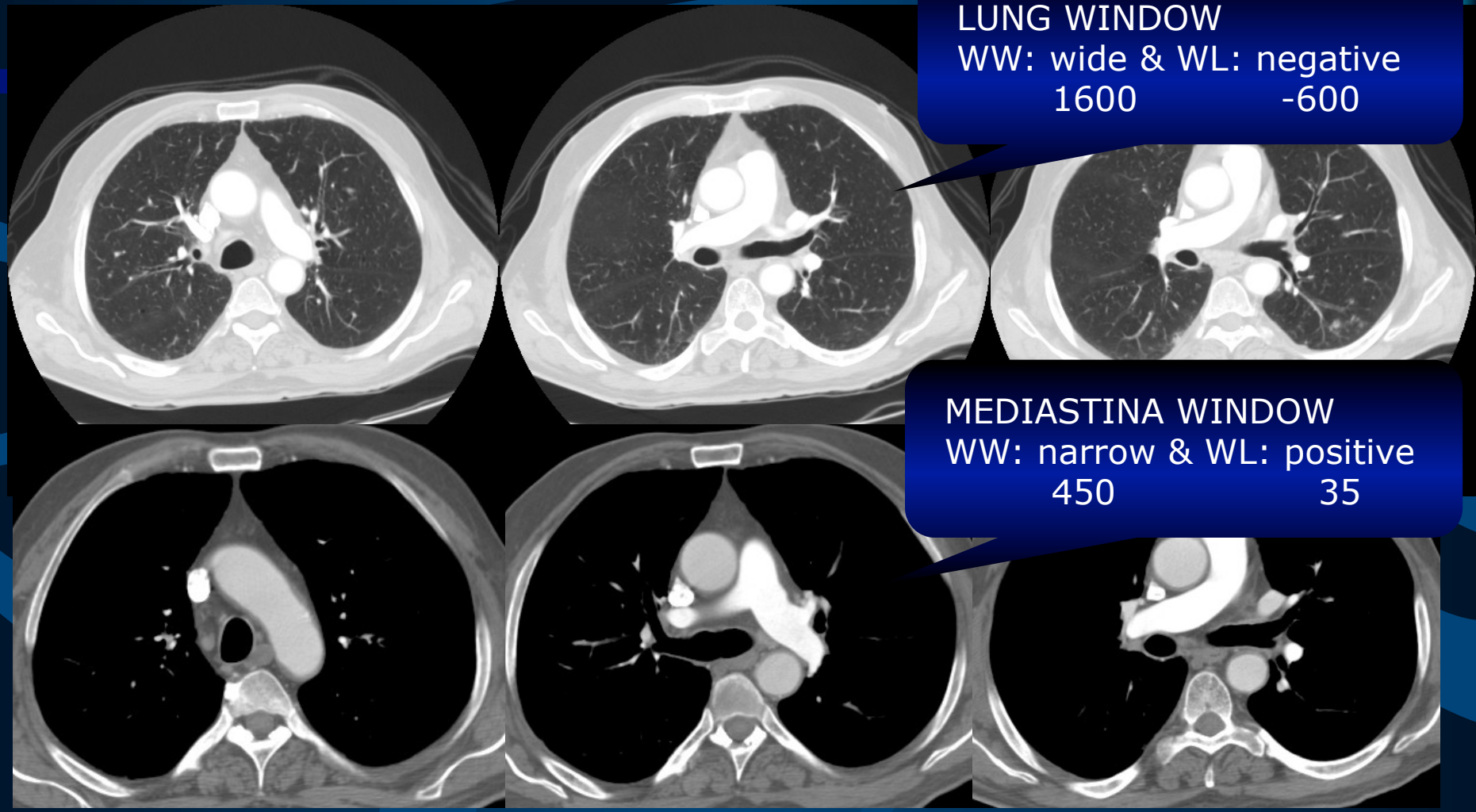
•There is major risk behind CT scan, 1barin CT scan radiation = 200 x-ray radiation , pelvic CT radiation = 400 x-ray radiation which means don't request a CT scan unless it is needed and We can't use it for a pregnant women unless it is necessary

•*Lung window* is wide window to visualize lung parenchymal structures including bronchi, vessels and alveoli

•*Mediastinal window* is narrow window to visualize mediastinal structures including major vessels, heart….

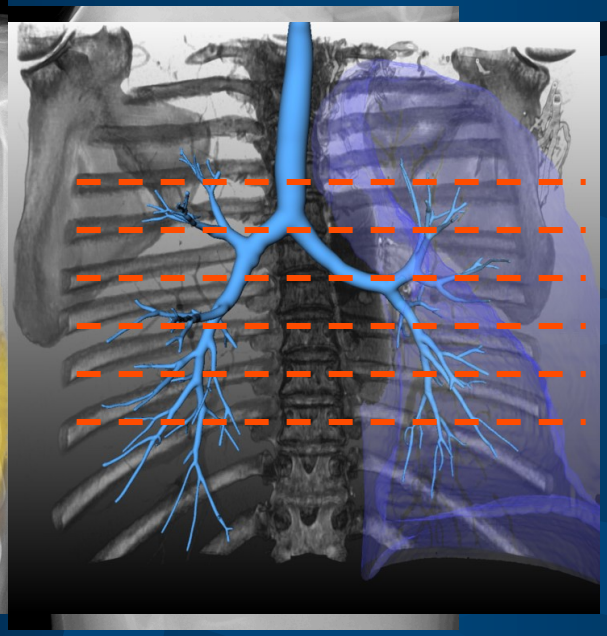
MODALITIES UTILIZED

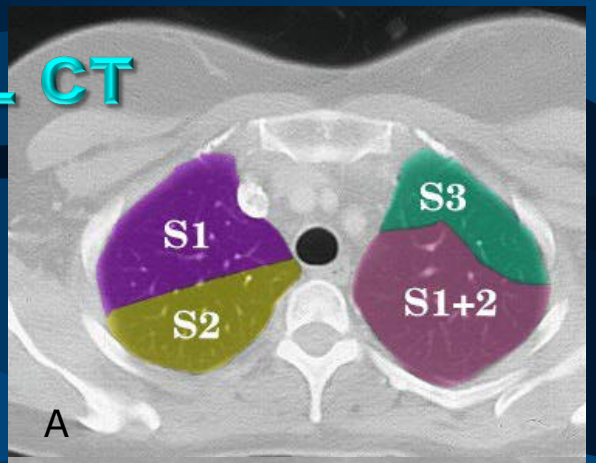
- Computed Tomography (CT)

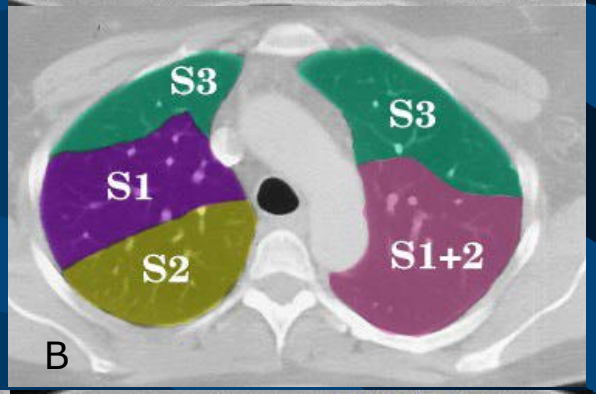


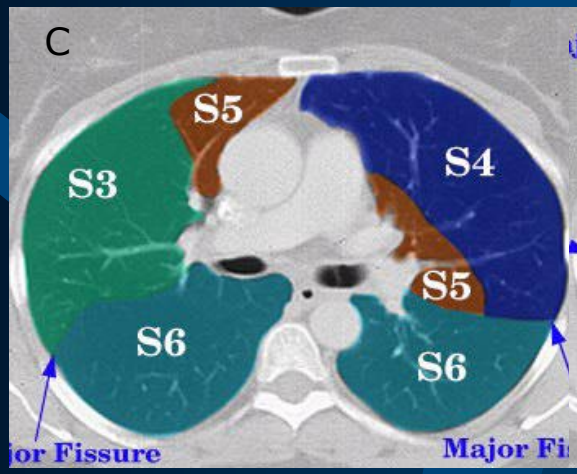
MODALITIES UTILIZED

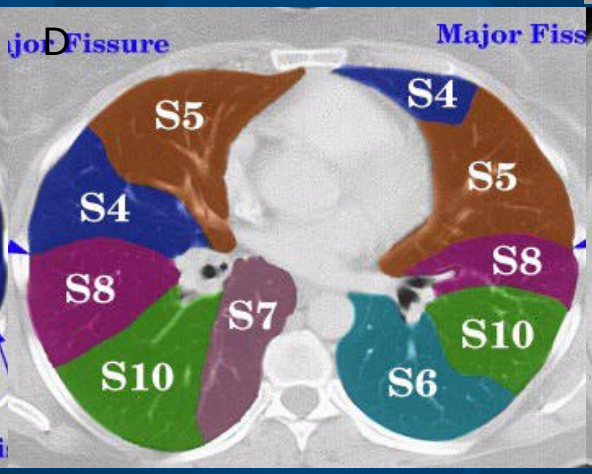
CROSS SECTIONAL CT

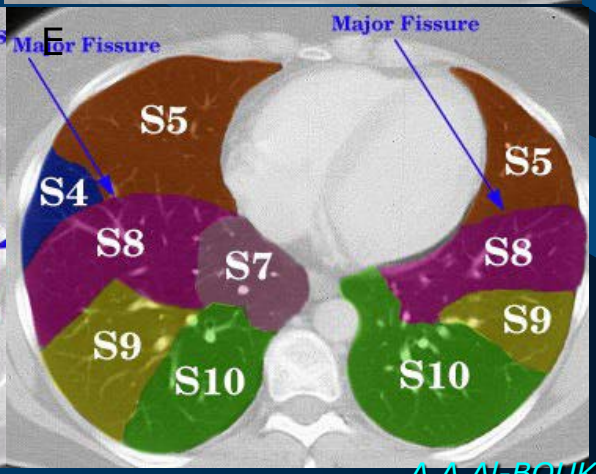








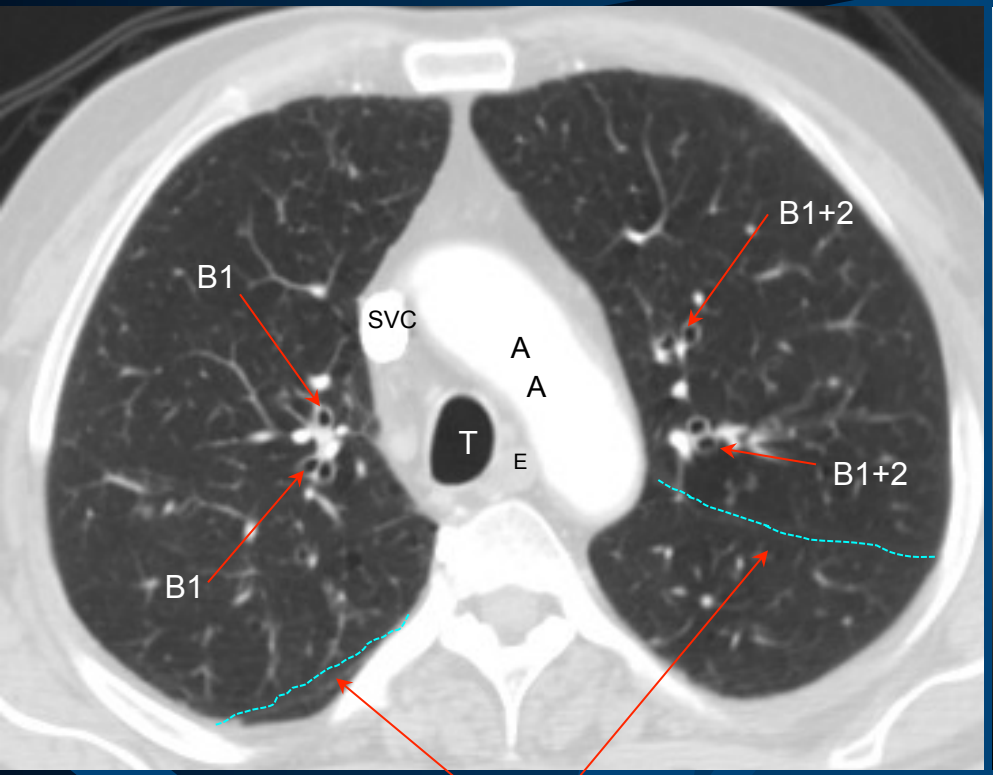


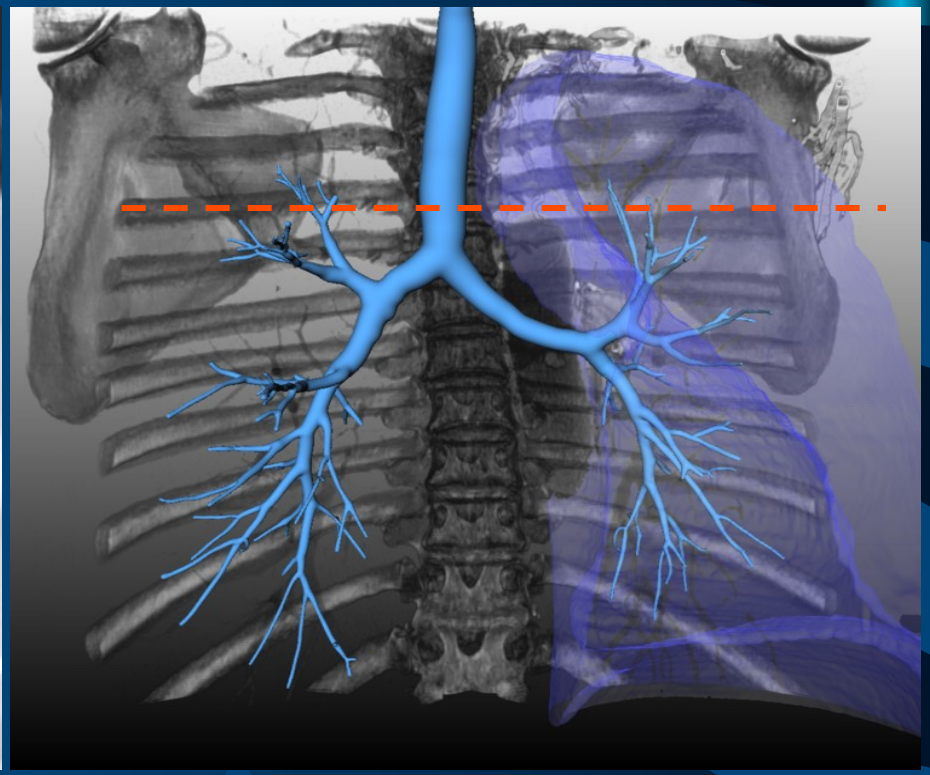


NORMAL ANATOMY CHEST

CROSS SECTIONAL CT

B1= APICAL UPPER LOBE B
B2=POSTERIOR UPPER LOBE B
B1+2= APICPOSTERIOR UPPER LOBE B



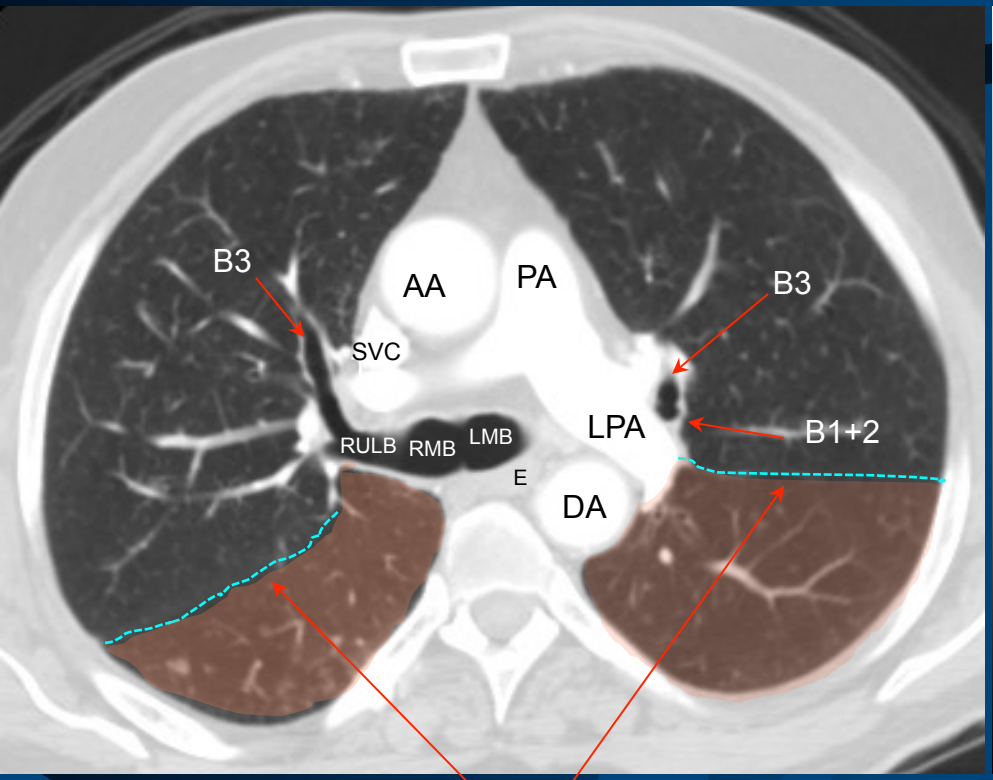


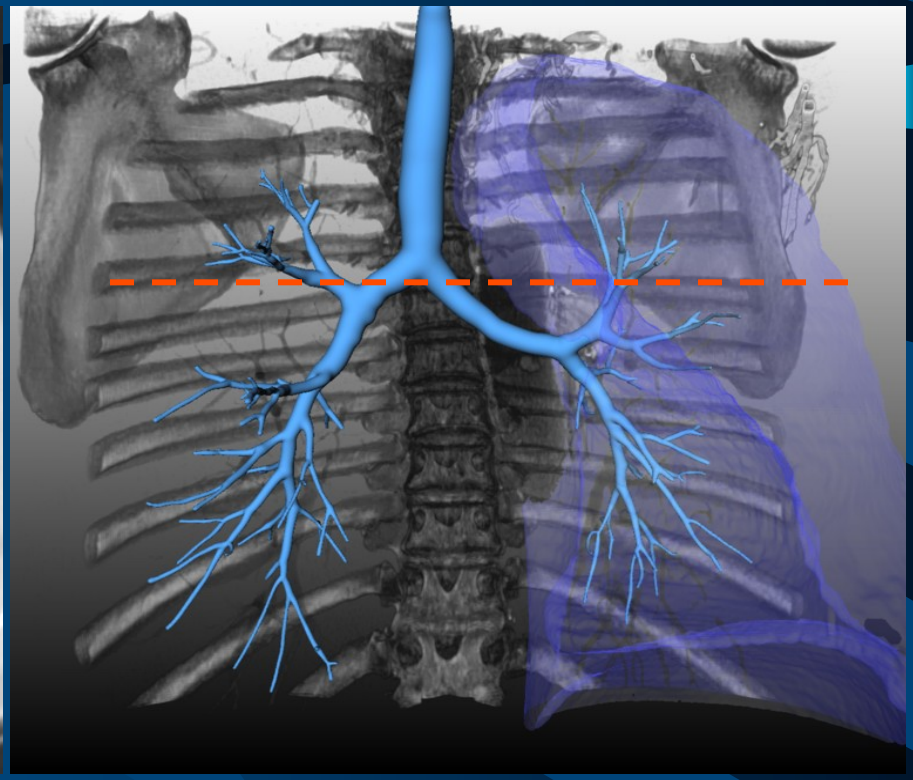
MAJOR FISSURE Appears as White hairline
Lucent band
White band

NORMAL ANATOMY CHEST

B1+2= APICPOSTERIOR UPPER LOBE B
B3 = ANTERIOR UPPER LOBE B

CROSS SECTIONAL CT

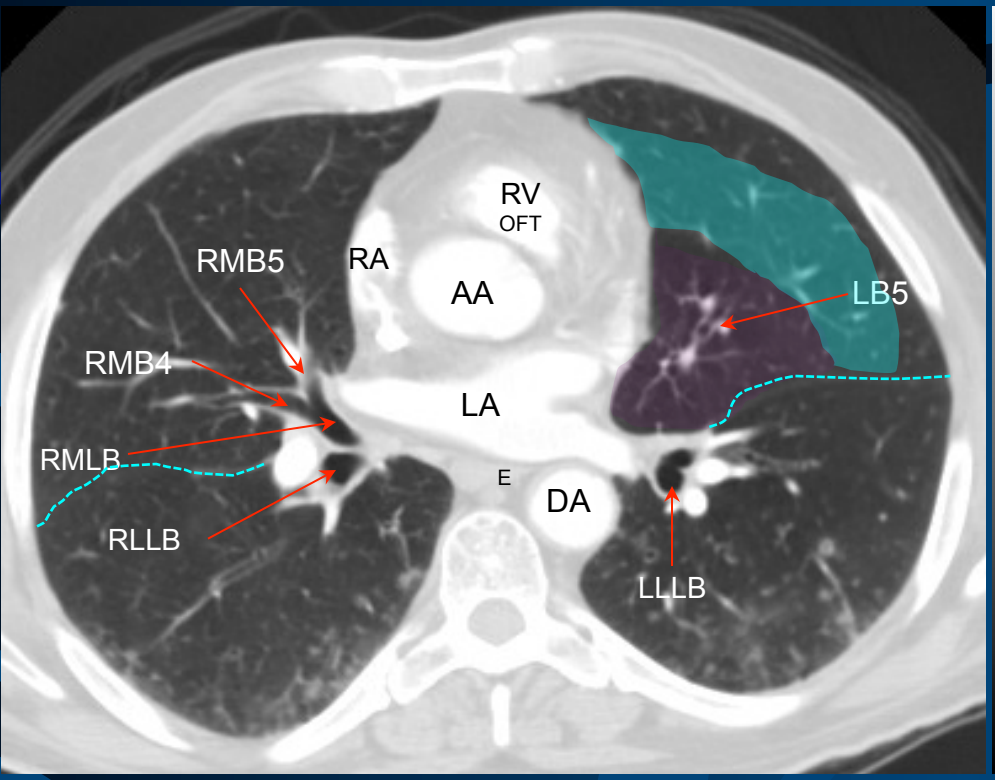


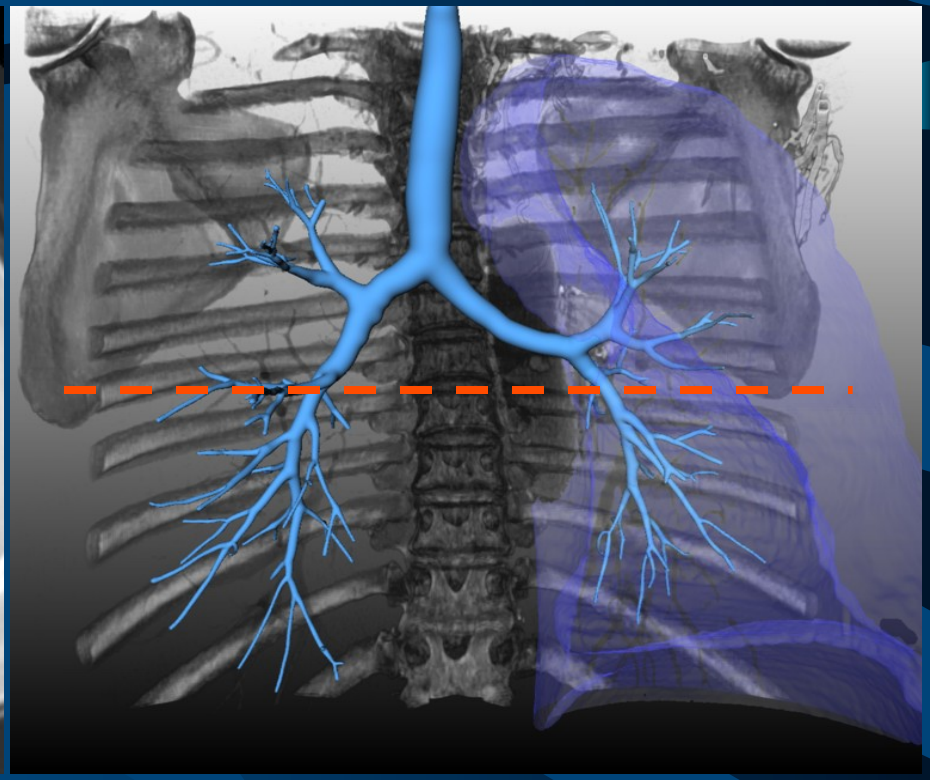


MAJOR FISSURE

NORMAL ANATOMY CHEST

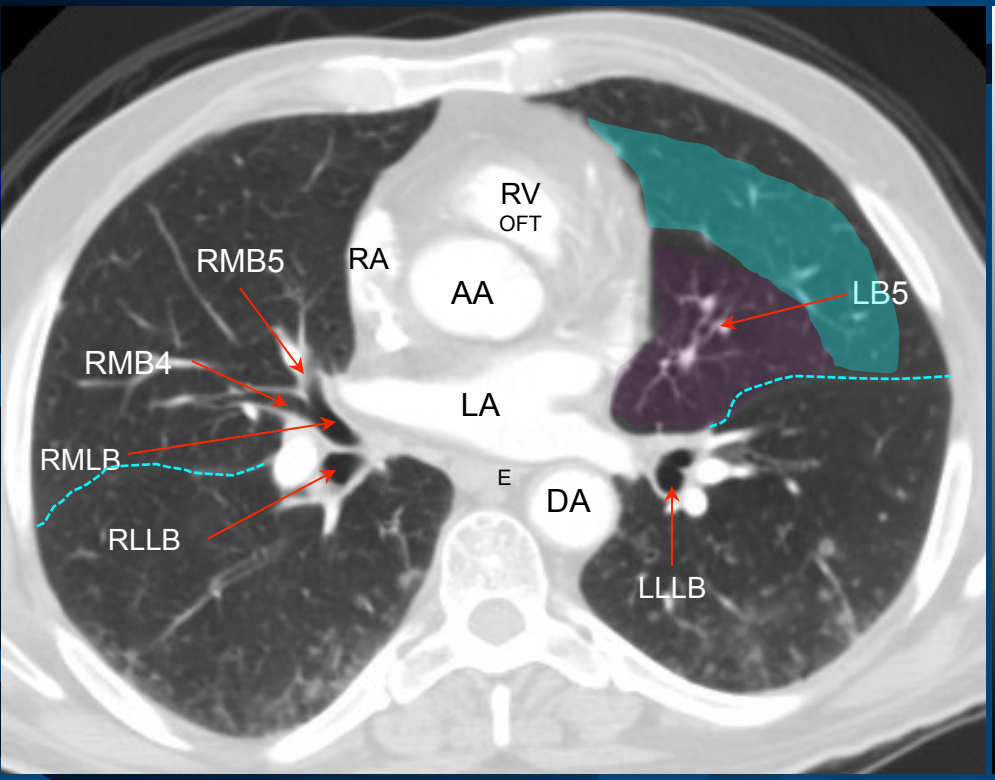
CROSS SECTIONAL CT

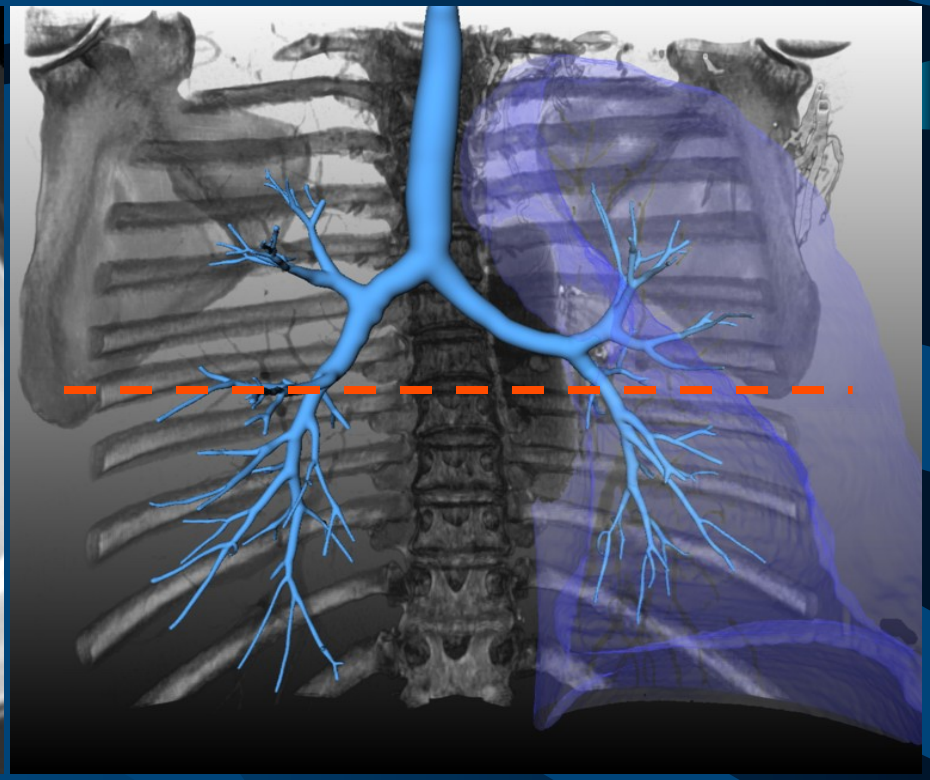




NORMAL ANATOMY CHEST

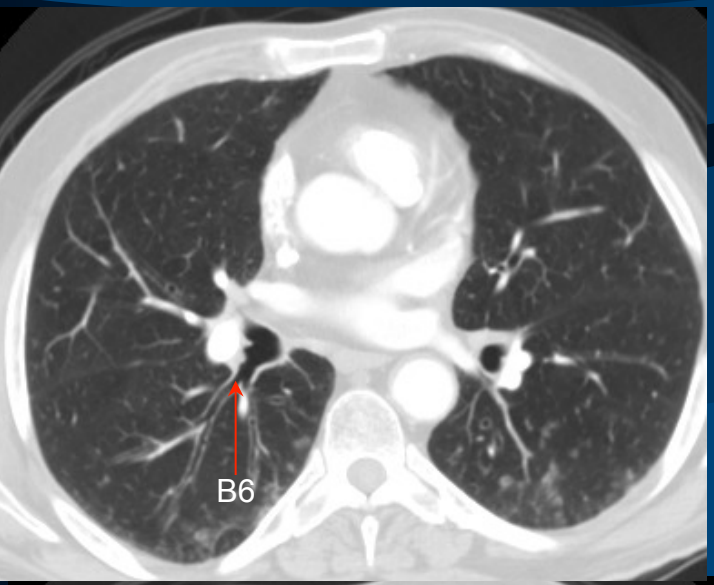
CROSS SECTIONAL CT

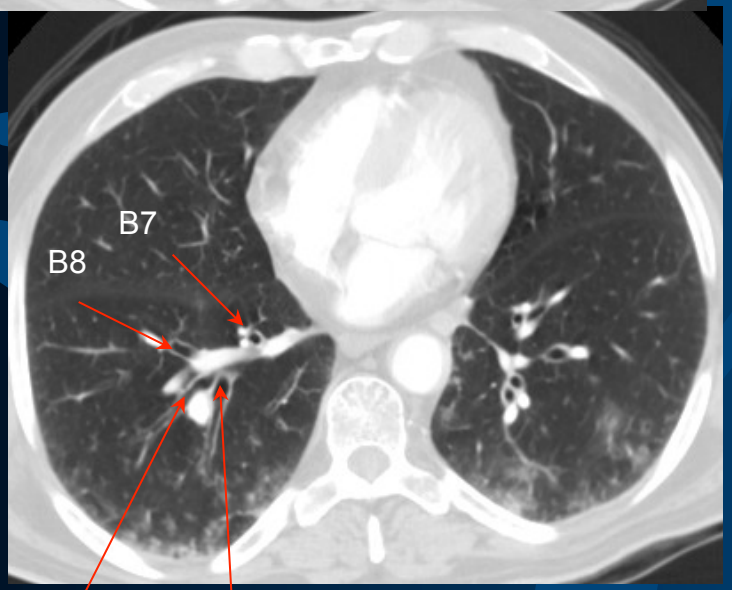




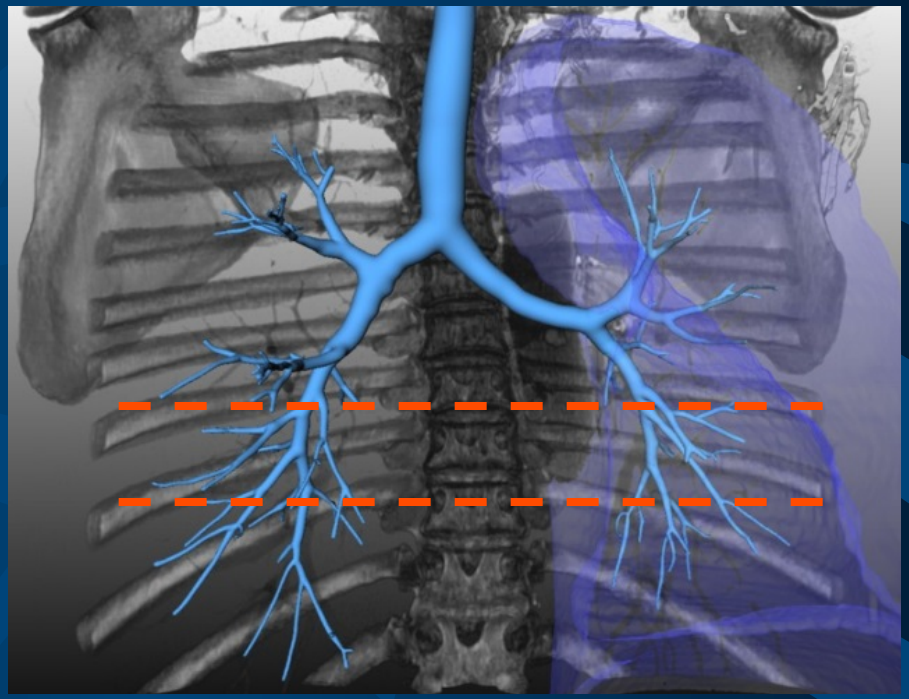
NORMAL ANATOMY CHEST

CROSS SECTIONAL CT





LOWER LOBE



B6= SUPERIOR LOWER LOBE B
B7= MEDIAL BASAL B
B8= ANTERIOR BASAL B

B9 = LATERAL BASAL B
B10= POSTERIOR BASAL B

A A AI-BOUKAI-32

NORMAL ANATOMY CHEST

CROSS SECTIONAL CT

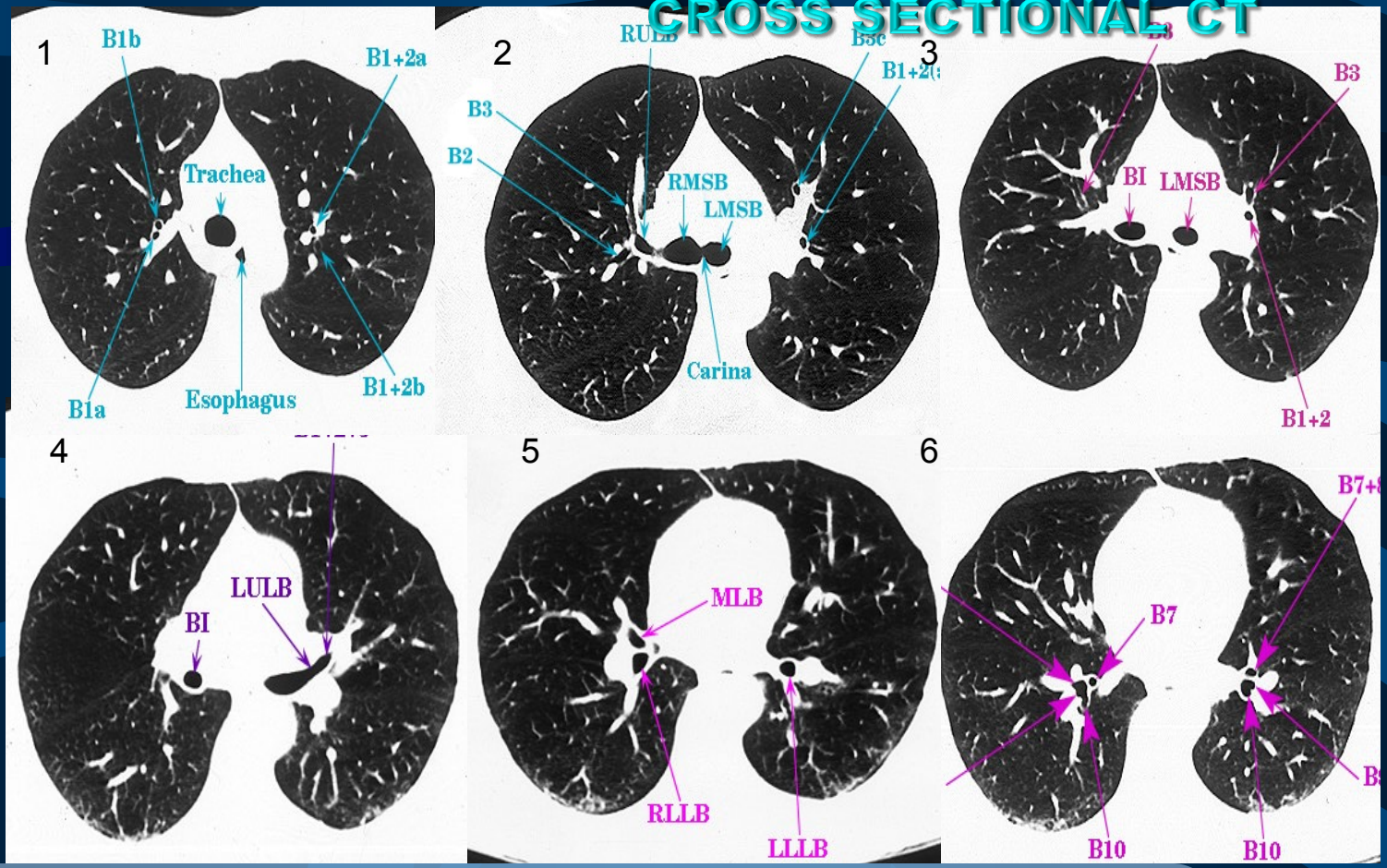


Image1: Level of trachea we could see upper lobe segmental bronchi

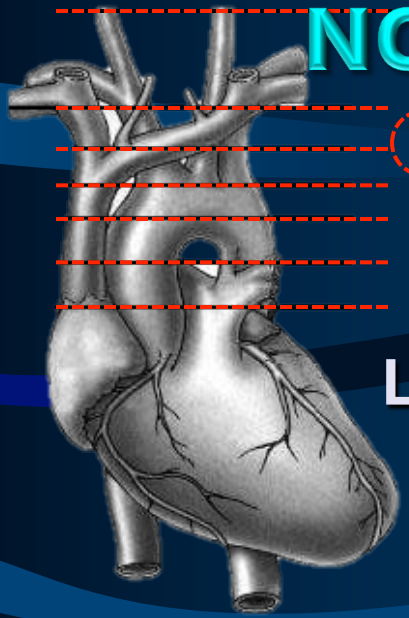
Image 2: Level of bifurcation and right upper lobe bronchus

Image 3: Lower cut at right bronchus intermedius level (BI)

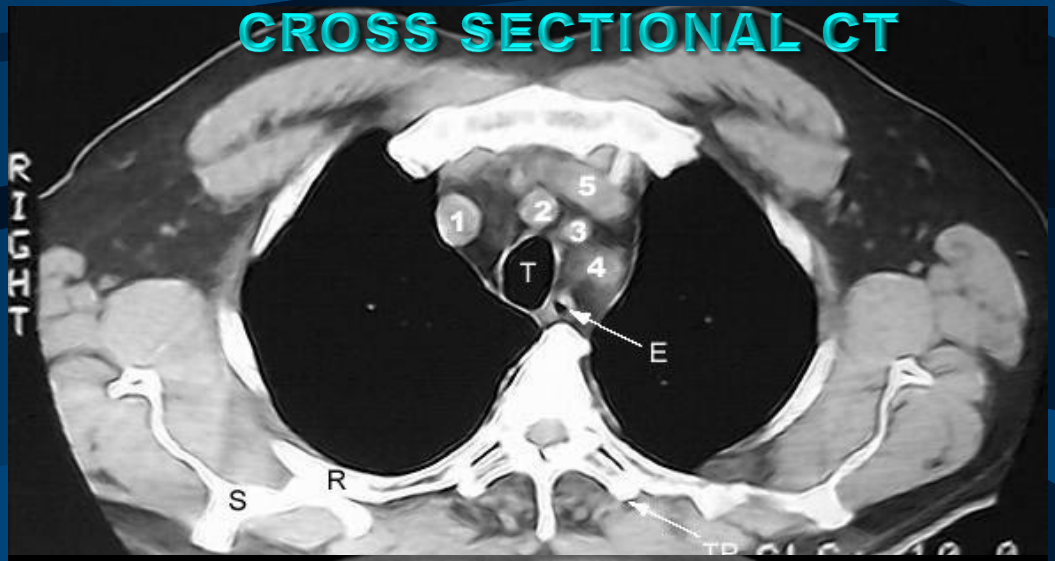
Note : segments of the lung follow distribution of segmental bronchi

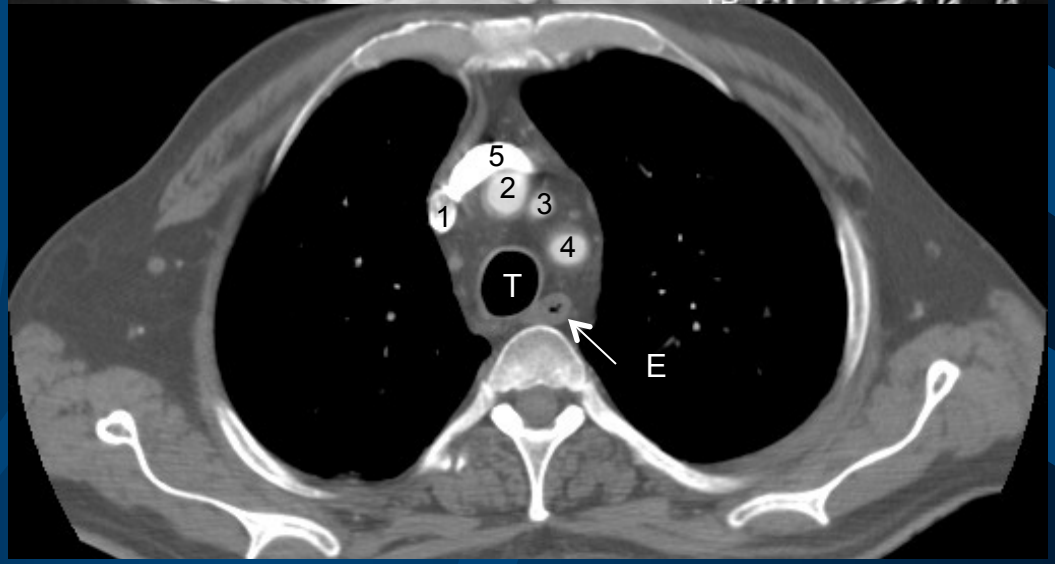
Fissure could be seen as either thin hairline structure or as lucent (black) density band

NORMAL ANATOMY CHEST



LEVEL 1

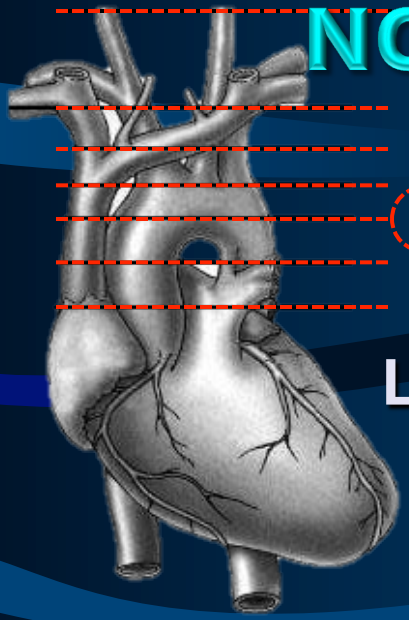




E ESOPHAGUS
R RIB
S SCAPULA
T TRACHEA
1 Right Brachiocephalic vein
2 Brachiocephalic artery
3 Left common carotid artery
4 Left subclavian artery
5 Right Brachiocephalic vein

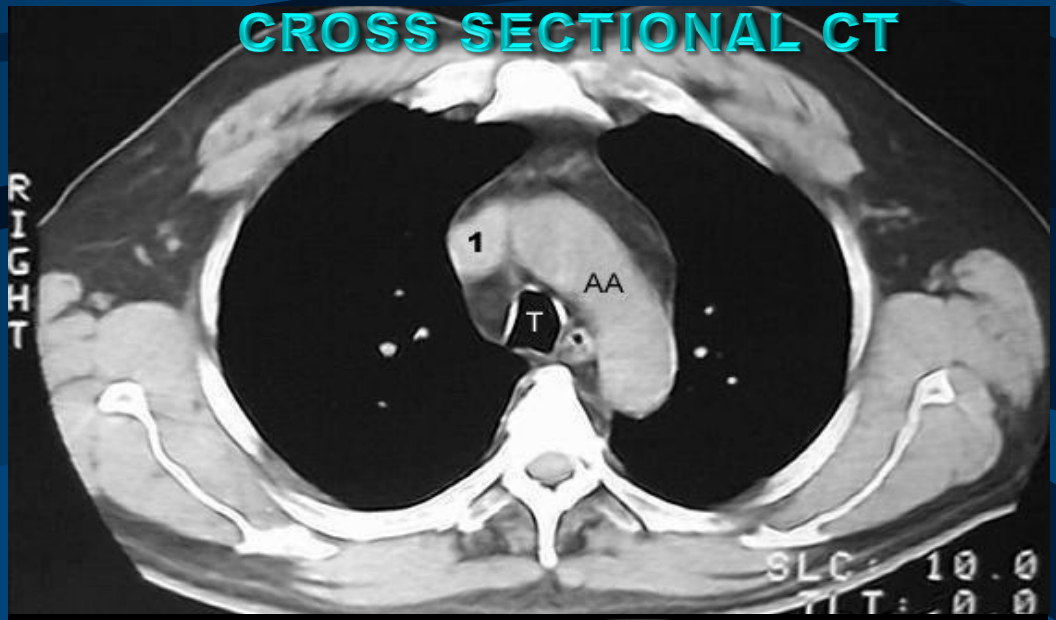
A A Al-BOUKAI-34

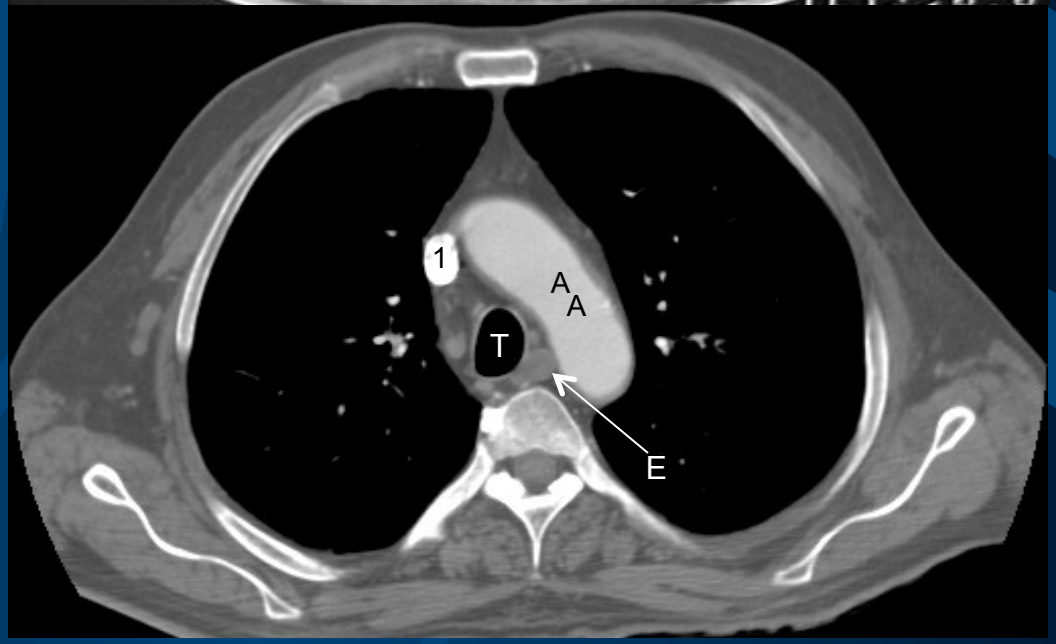
NORMAL ANATOMY CHEST



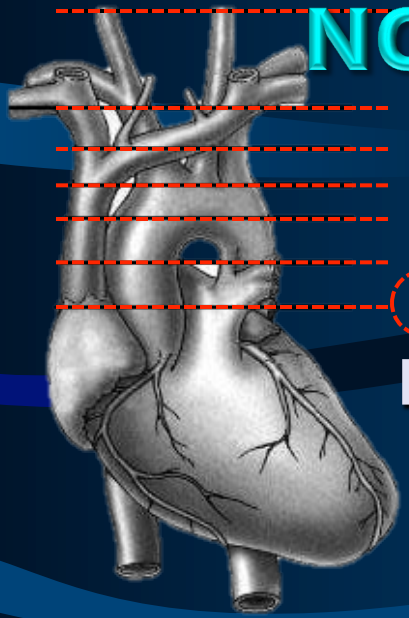
LEVEL 2

AA Aortic Arch
T TRACHEA
1 Superior vena cava





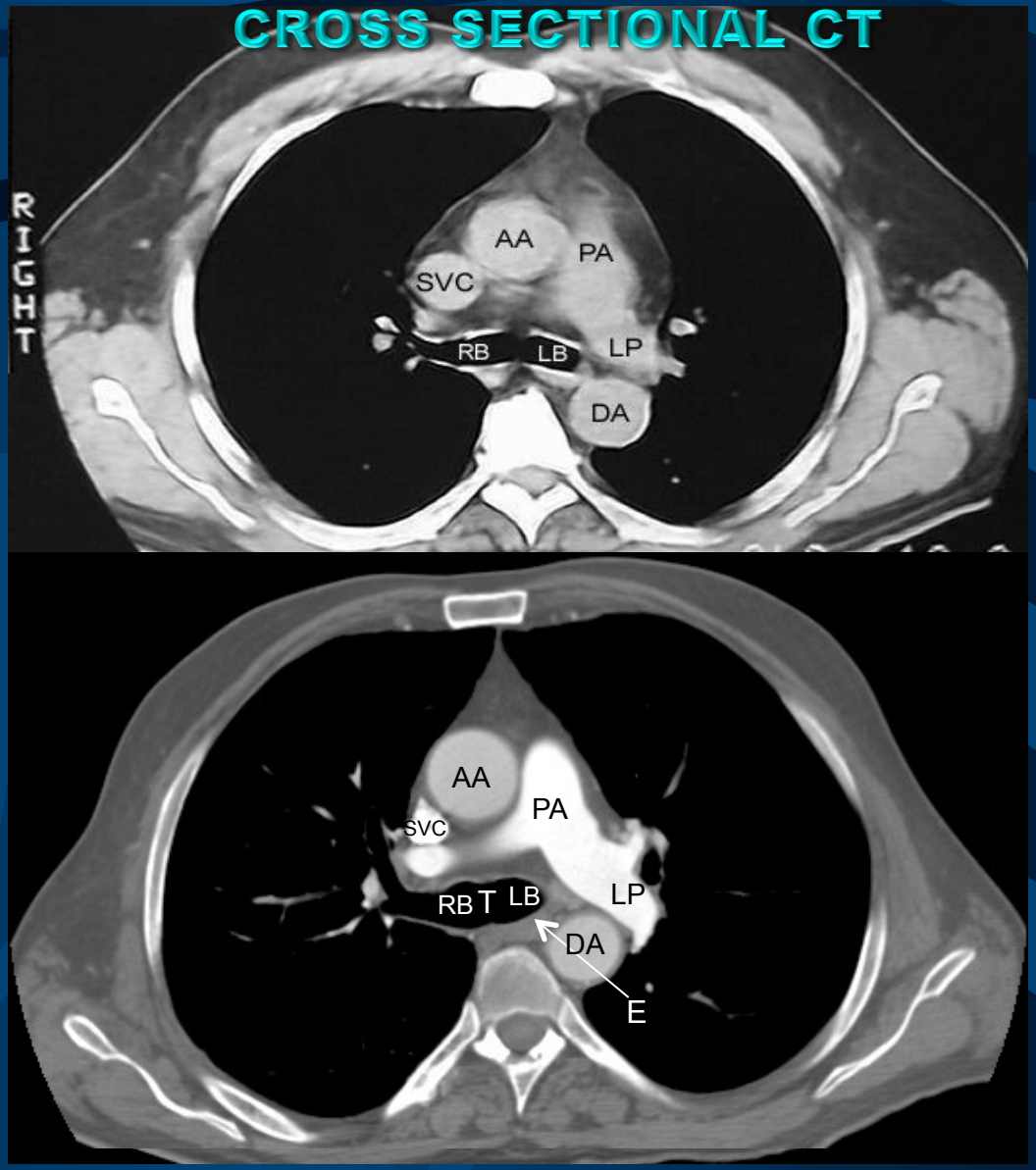
NORMAL ANATOMY CHEST



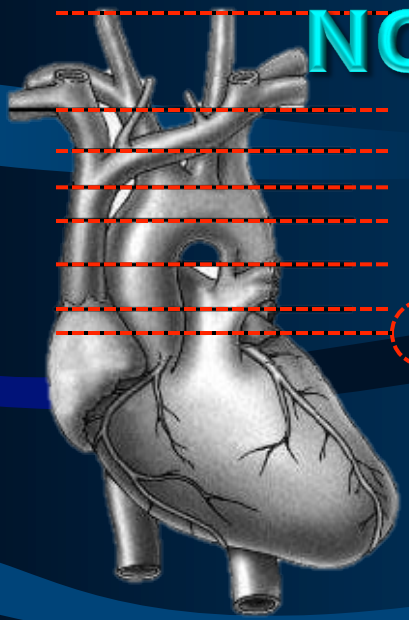
LEVEL 3

AA Ascending Aorta
DA Descending Aorta
LB Left main bronchus
LP Left pulmonary artery
PA Pulmonary trunk
RB Right main bronchus
SVC Superior vena cava

CROSS SECTIONAL CT



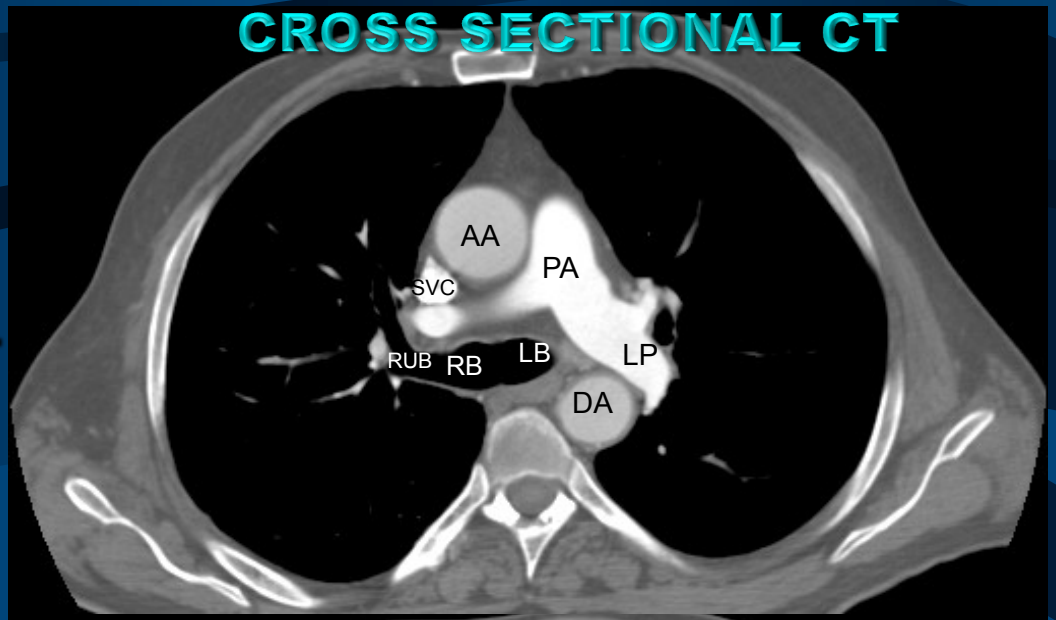
NORMAL ANATOMY CHEST

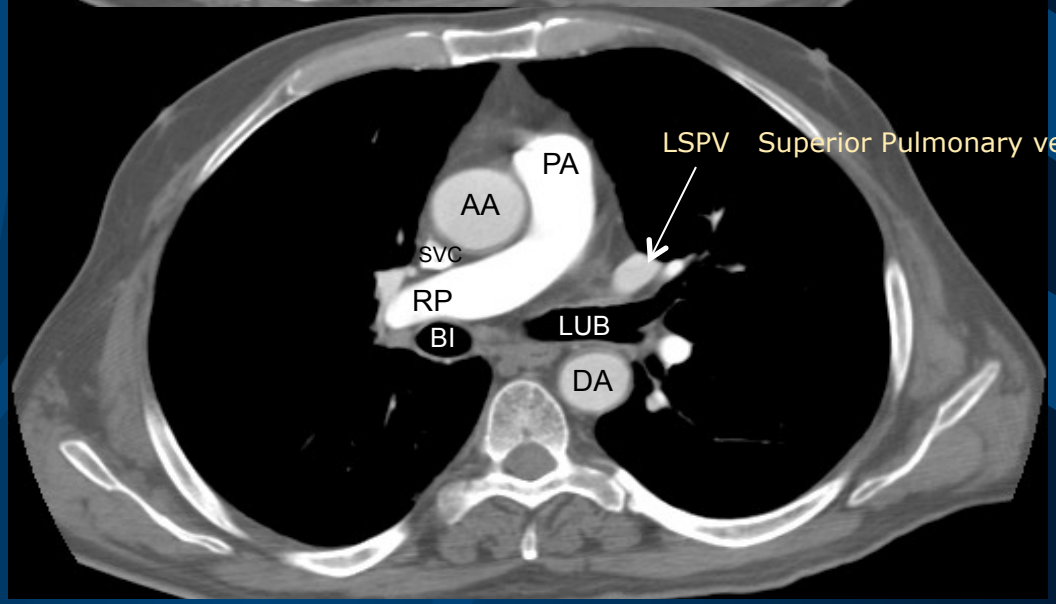


LEVEL 4

AA Ascending Aorta
DA Descending Aorta
LUB Left upper bronchus
BI Bronchus intermedius
LP Left pulmonary artery
RP Right pulmonary artery
PA Pulmonary trunk
RB Right main bronchus
SVC Superior vena cava

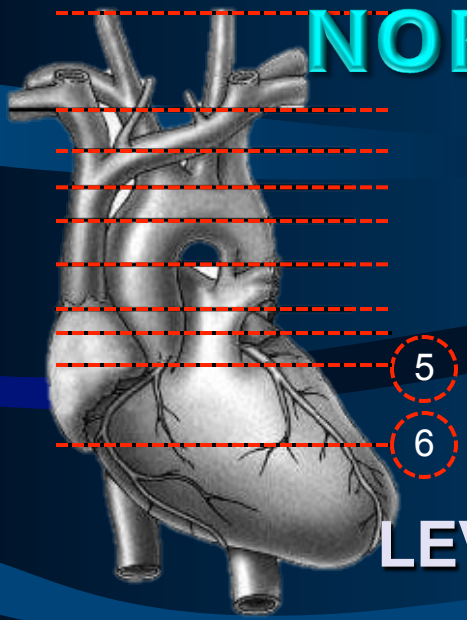
CROSS SECTIONAL CT





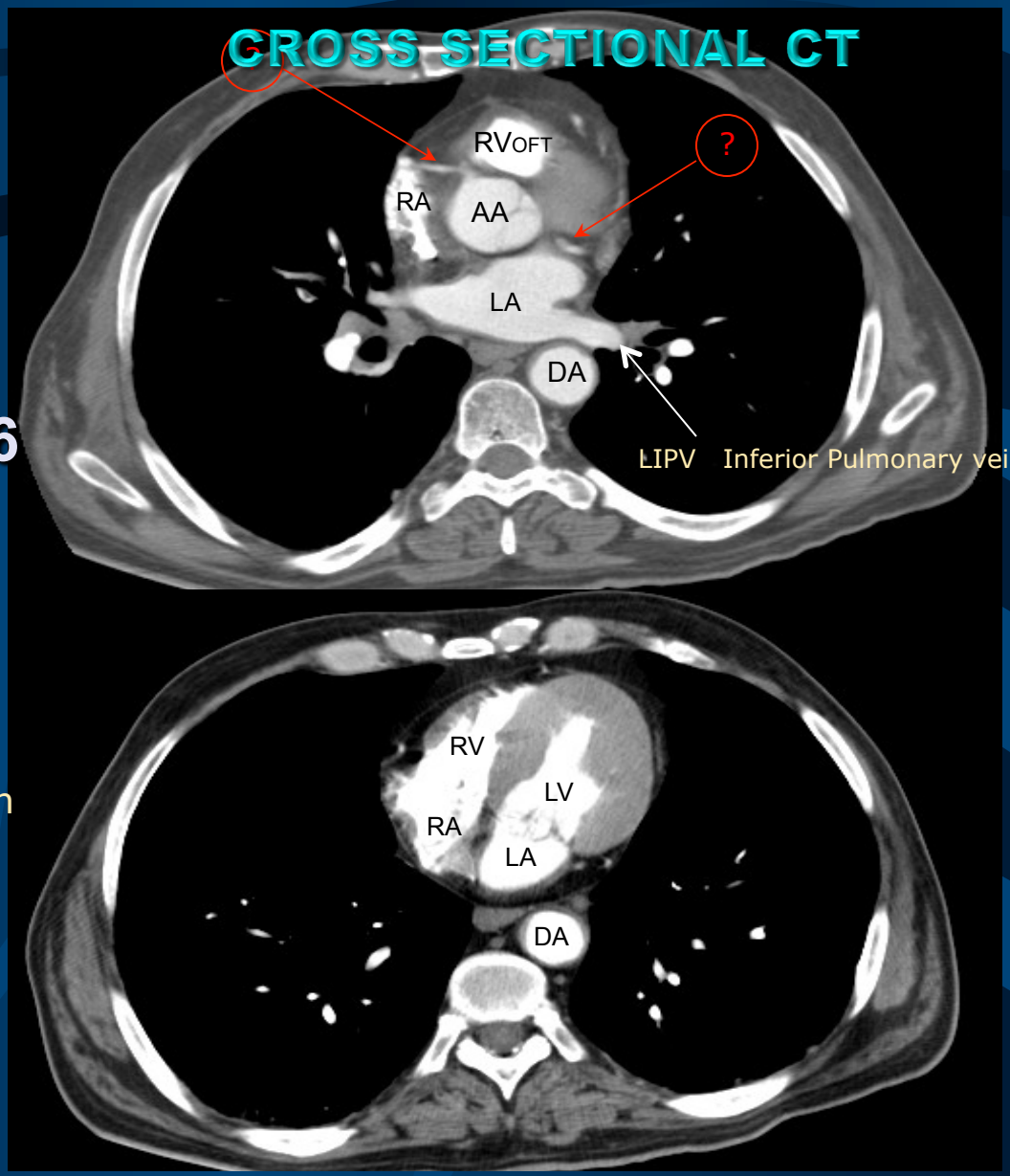
A A AI-BOUKAI-37

NORMAL ANATOMY CHEST



LEVEL 5-6

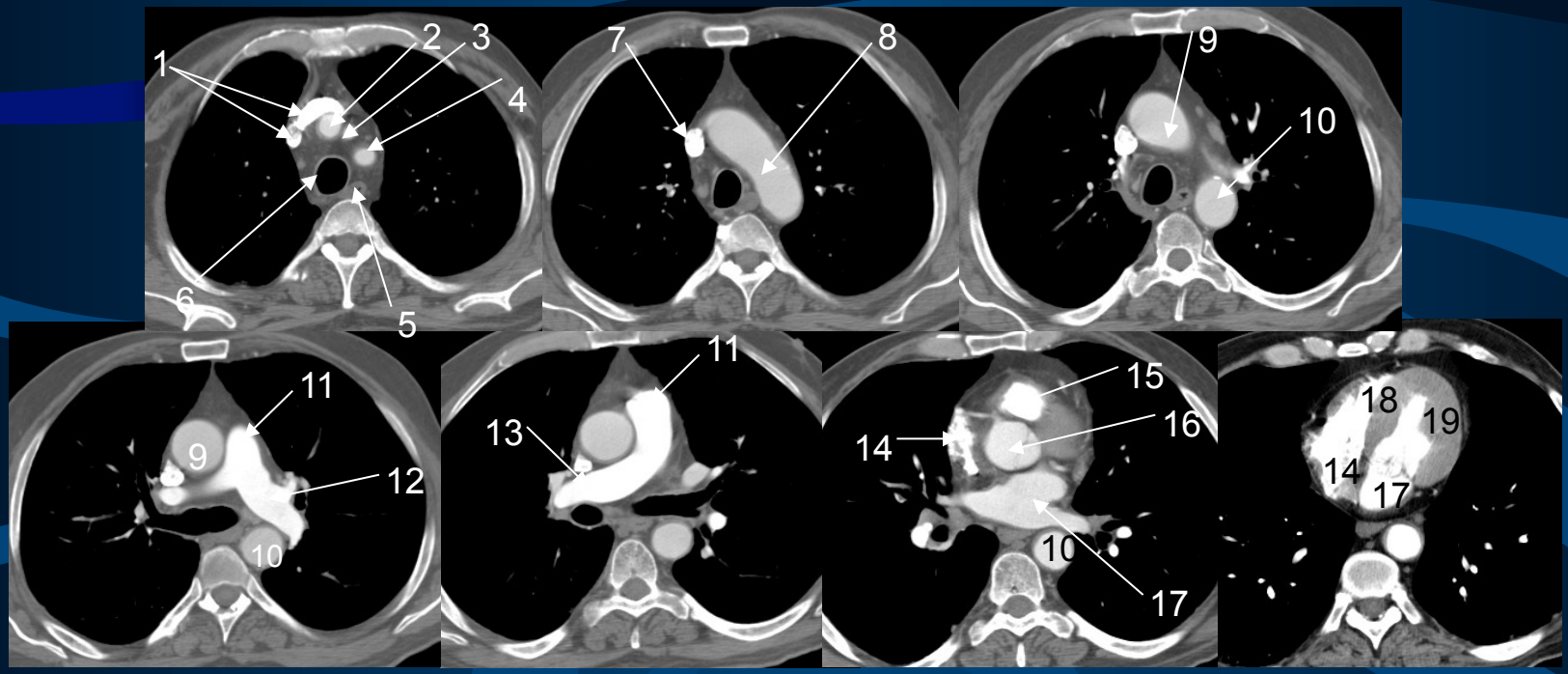
AA Ascending Aorta (root)
DA Descending Aorta
LA Left atrium
LV Left ventricle
RA Right atrium (auricle)
RV Right ventricle (outflow)
LIPV Left inferior pulmonary vein



A A Al-BOUKAI-38

NORMAL ANATOMY CHEST

CROSS SECTIONAL CT

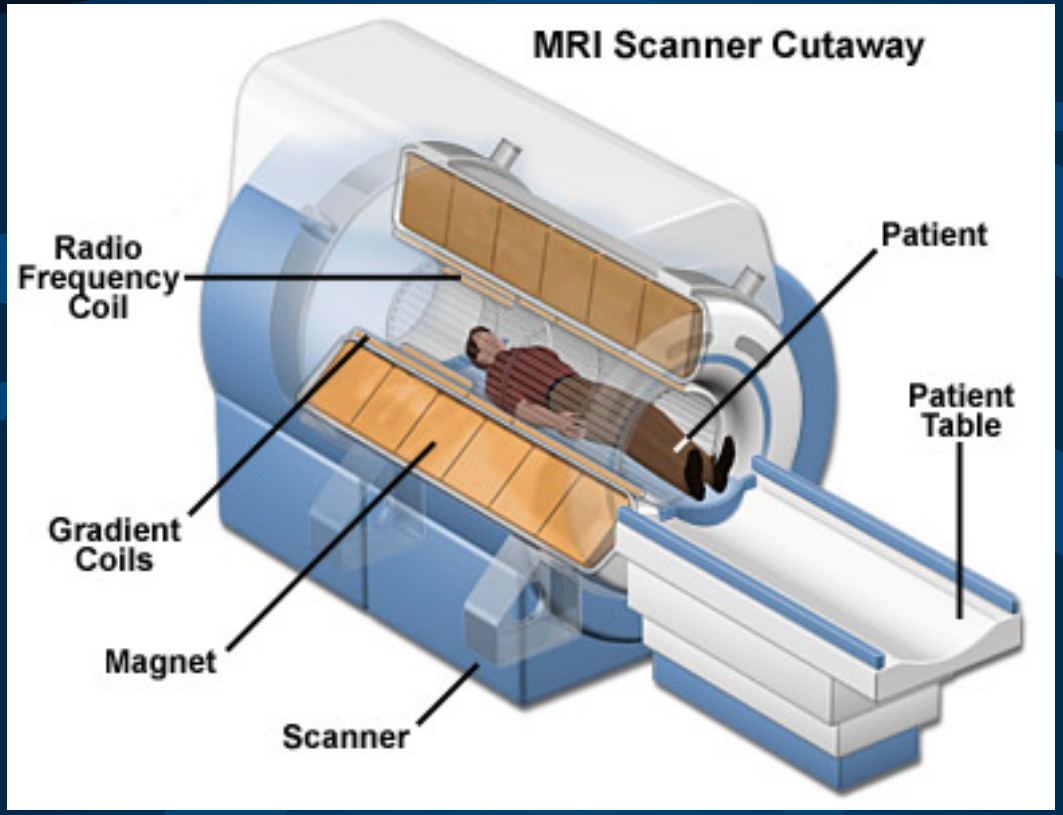


1: Rt & Lt innominate veins (brachiocephalic veins) 2: RT brachiocephalic artery 3: LT common carotid
4: LT subclavian artery 5: esophagus 6: Trachea 7: Superior vena cava 8: Aortic arch 9: Ascending Aorta
10: Descending Aorta 11: Pulmonary trunk (artery) 12: LT Pulm artery 13: RT Pulm artery 14: RT atrium
15: Pulm artery 16: Aortic root 17: Lt atrium 18: RT ventricle 19: LT ventrivle

Note : LT Pulmonary artery is seen before RT artery therefore it is higher than the right artery.
LT atrium is the most posterior chamber; RT ventricle is most anterior chamber.

MODALITIES UTILIZED

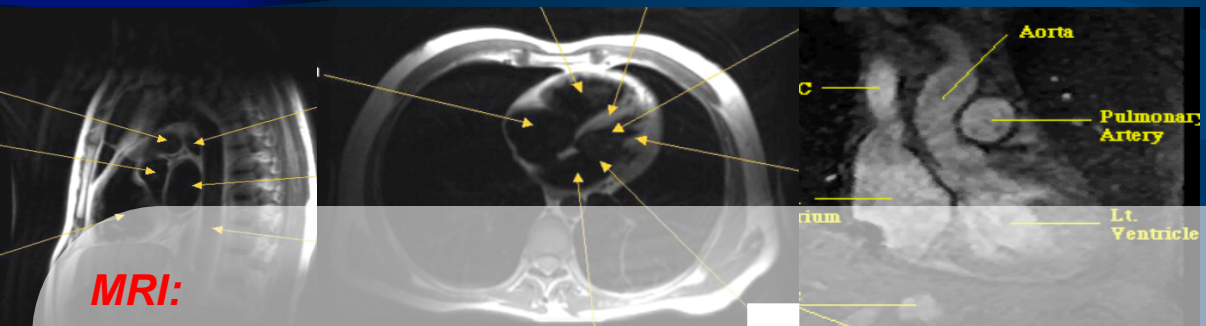
- Magnetic Resonance Imaging (MRI)

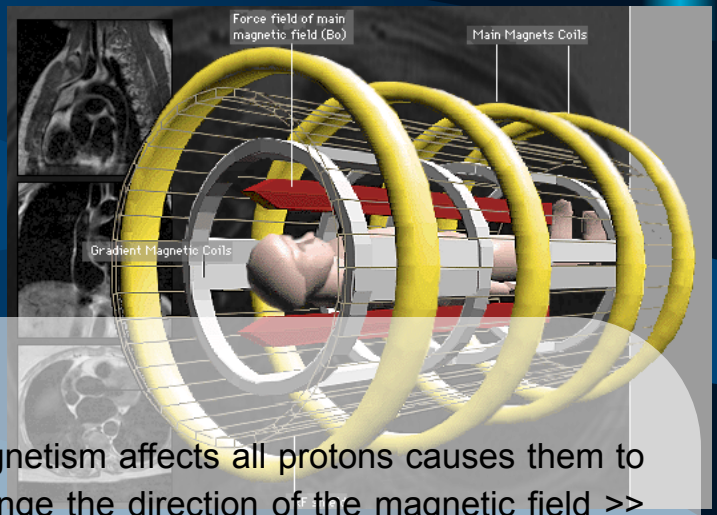


MODALITIES UTILIZED

Magnetic Resonance Imaging (MRI)

Sagittal | Axial | Coronal





MRI:

Simply, hydrogen atoms (protons) in water molecules and lipids >> magnetism affects all protons causes them to line up in one direction >> magnets can be switched on and off to change the direction of the magnetic field >> whenever the water molecule spin around they give a light radio wave >> MRI machine can detect it >> show it as images

So gradations of density within soft tissues can be recognized, e.g. brain substance from cerebrospinal fluid, or tumor from surrounding normal tissues.

MRI advantages

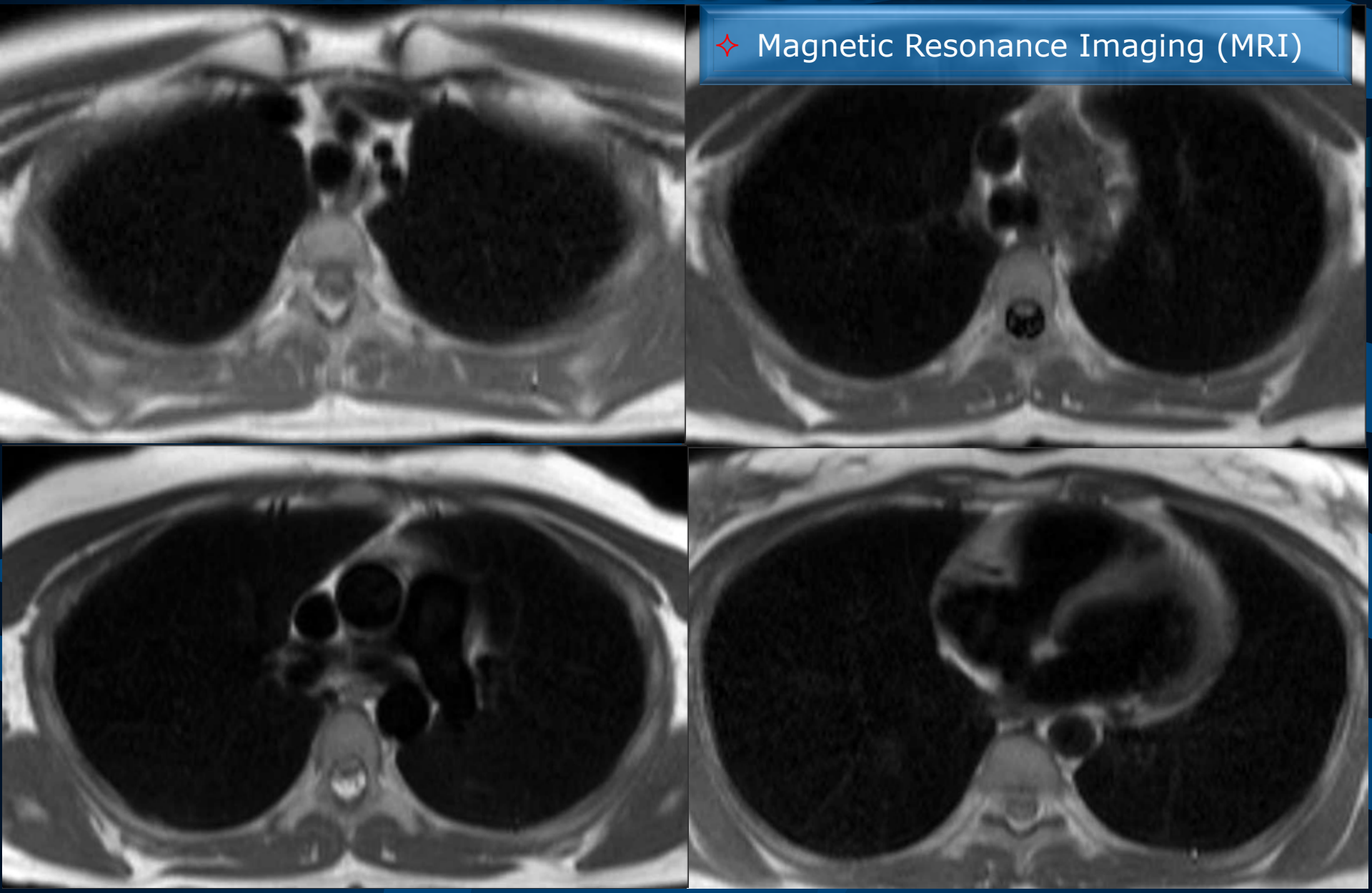
Best for soft tissue imaging
There is no ionization
It can be done for pregnant women with caution
Images can be directly in any plane

MRI disadvantages

expensive
Time consuming
patients fear it and dislike it because it is a narrow place
Since it is magnetic no metals can be allowed
Patient has to keep still during scanning procedure

MODALITIES UTILIZED

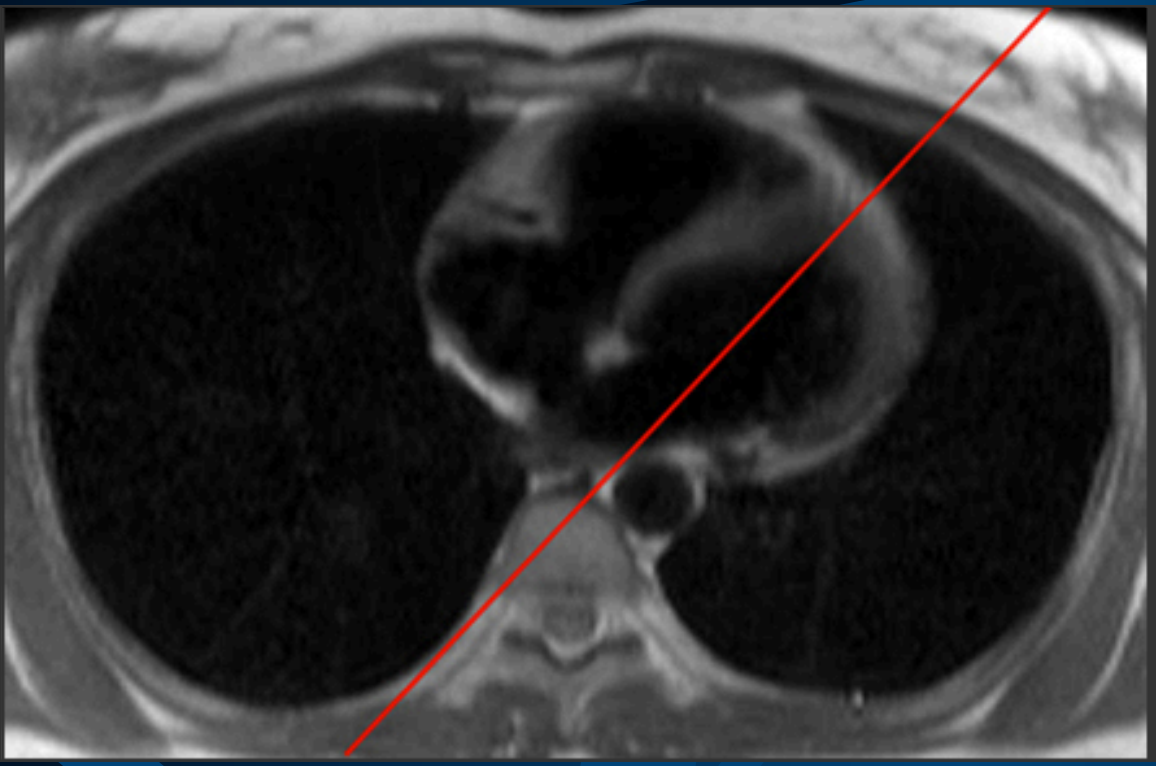
- Magnetic Resonance Imaging (MRI)

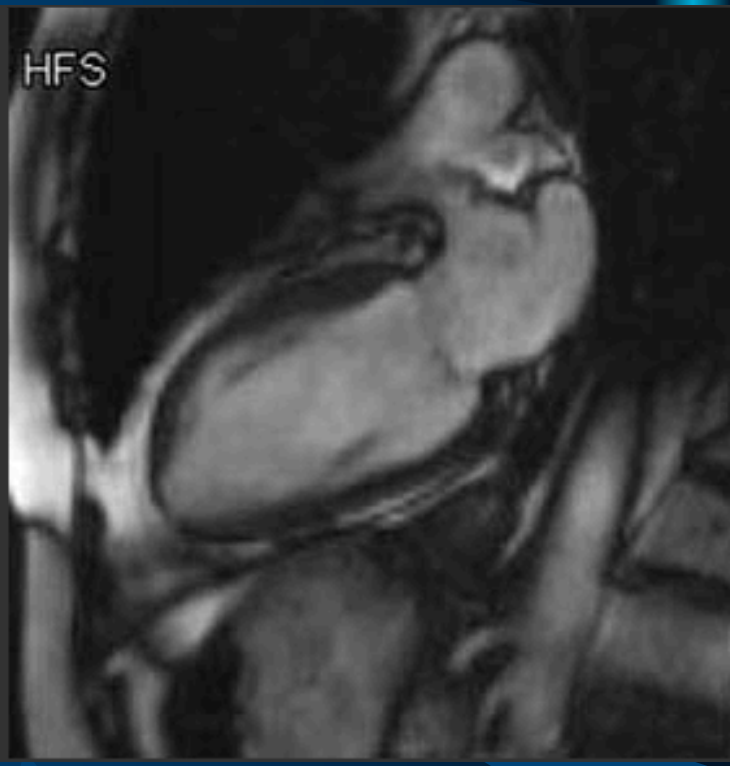


MODALITIES UTILIZED

- Magnetic Resonance Imaging (MRI)

VERTICAL LONG AXIS VIEW



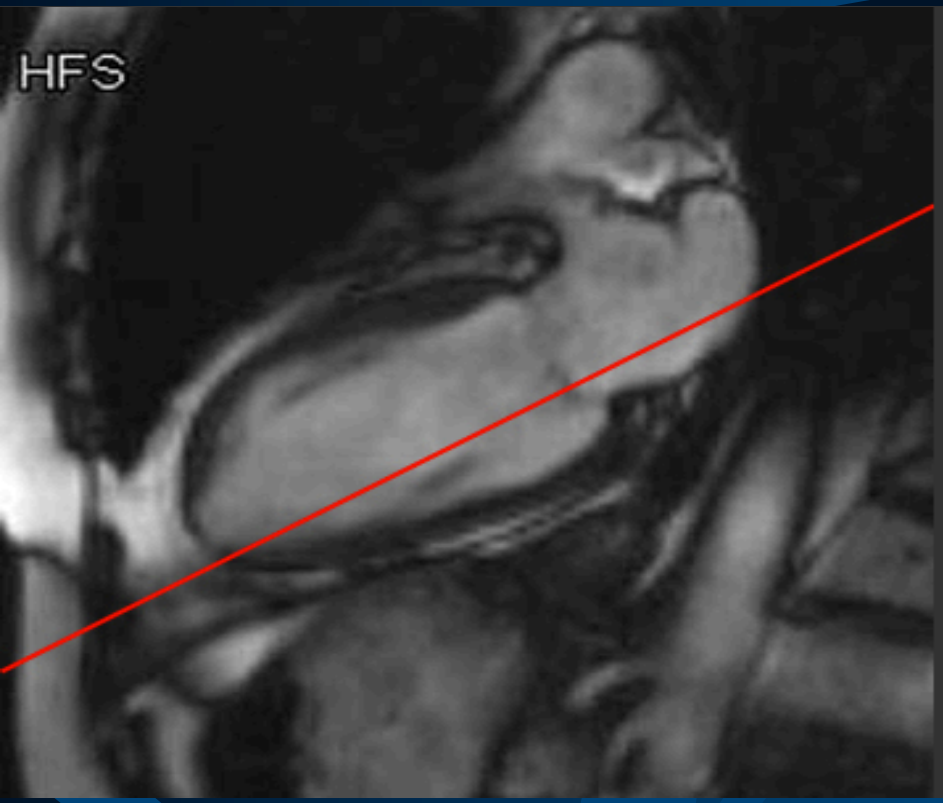


The vertical long axis is for evaluating the anterior and inferior walls and apex of the left ventricle. An axial image through the LV and LA is chosen from the transverse localizer images and a parasagittal plane that is perpendicular to the chosen image is prescribed that bisects the mitral valve and intersects the LV apex.

MODALITIES UTILIZED

- Magnetic Resonance Imaging (MRI)

HORIZONTAL LONG AXIS VIEW

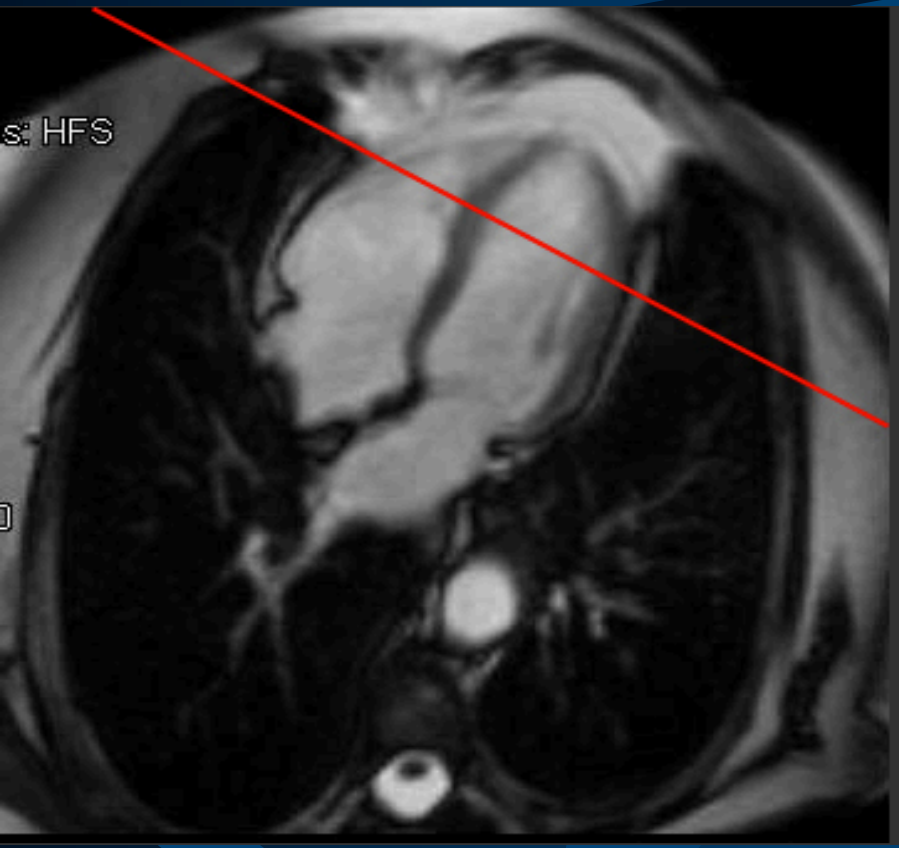


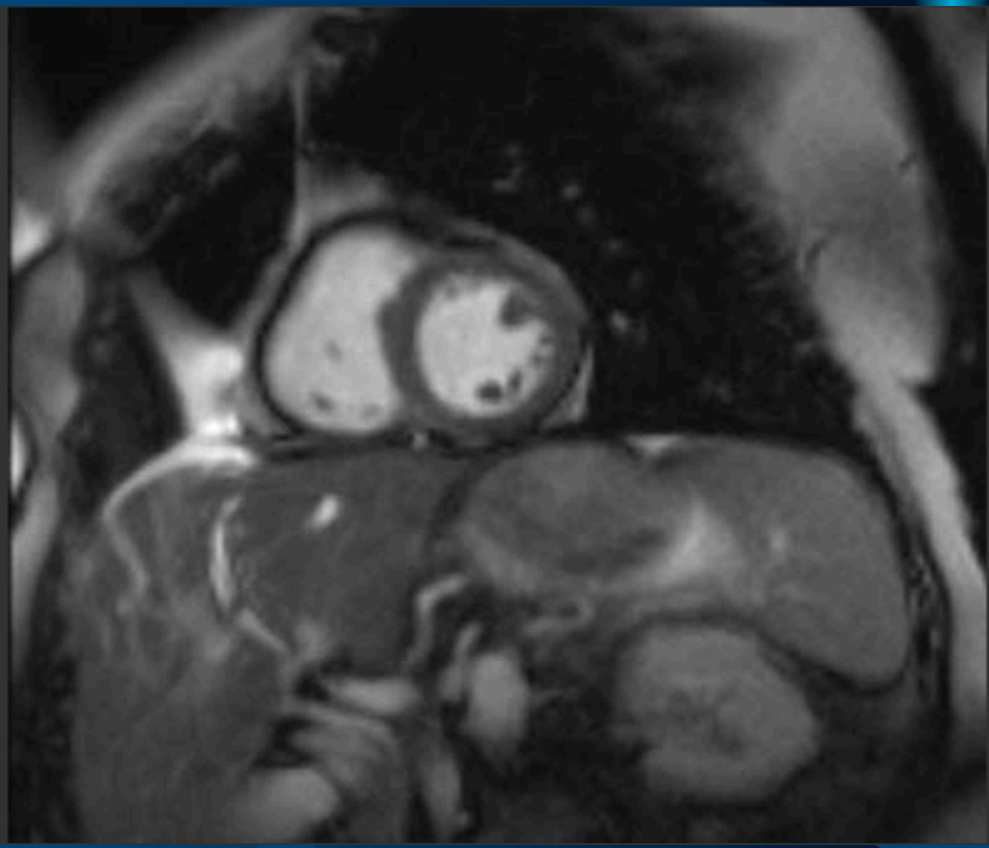
The horizontal long axis (four chamber view) is best for evaluating the septal and lateral walls and apex of the left ventricle, the right ventricular free wall, and chamber size. The mitral and tricuspid valves are also well visualized in this plane. A perpendicular plane to the vertical long axis image is chosen which intersects the lower third of the mitral valve and the LV apex.

MODALITIES UTILIZED

- Magnetic Resonance Imaging (MRI)

SHORT AXIS VIEW



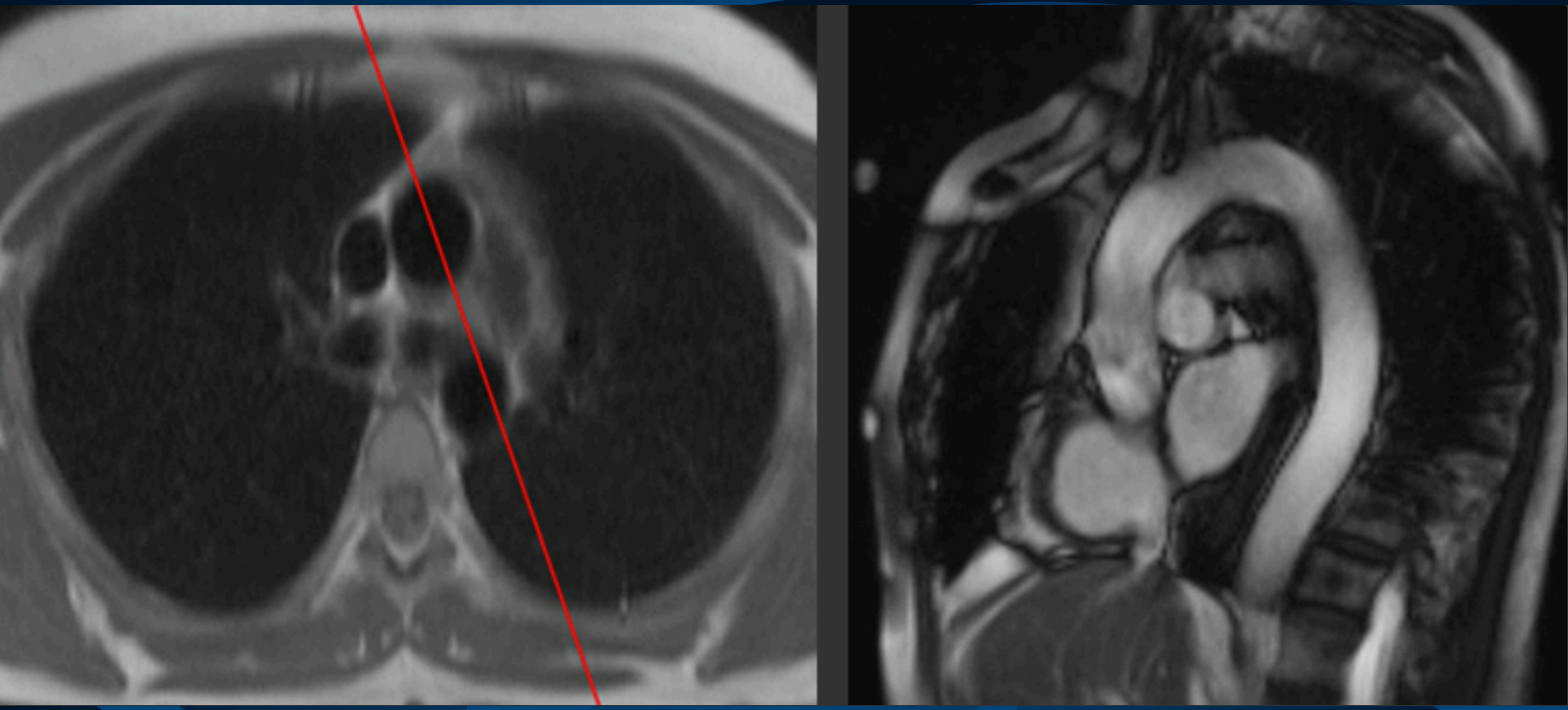


The short axis view shows cross-sections of the left and right ventricle that are useful for volumetric measurements using Simpson's rule. The short axis view is chosen perpendicular to long axis of LT ventricle in serial cuts.

MODALITIES UTILIZED

- Magnetic Resonance Imaging (MRI)

AORTIC VIEW

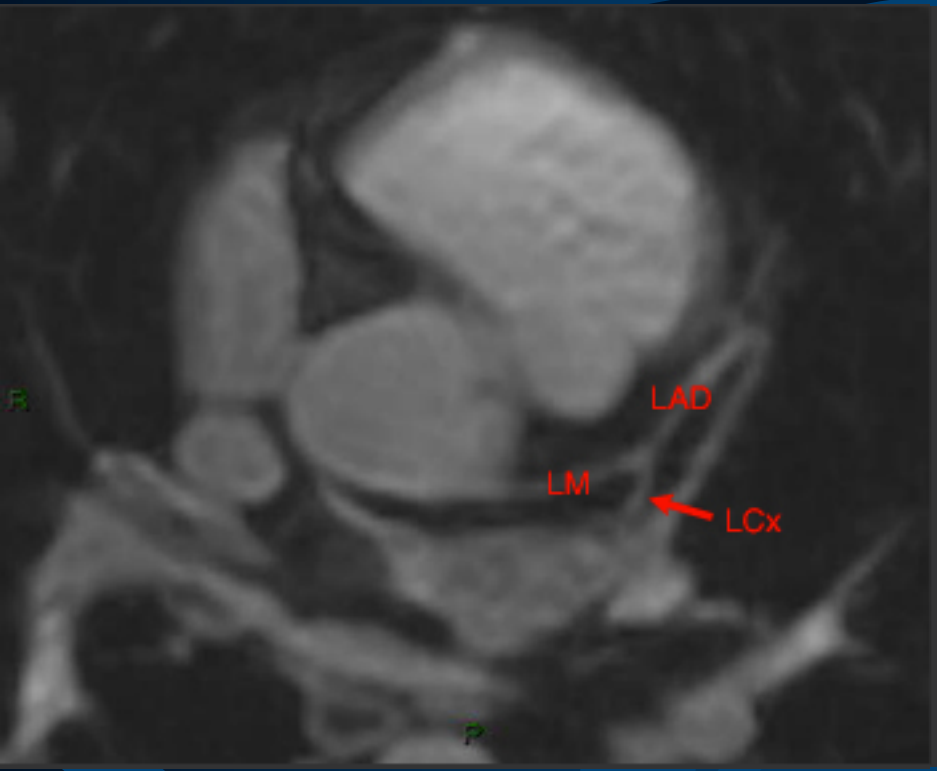


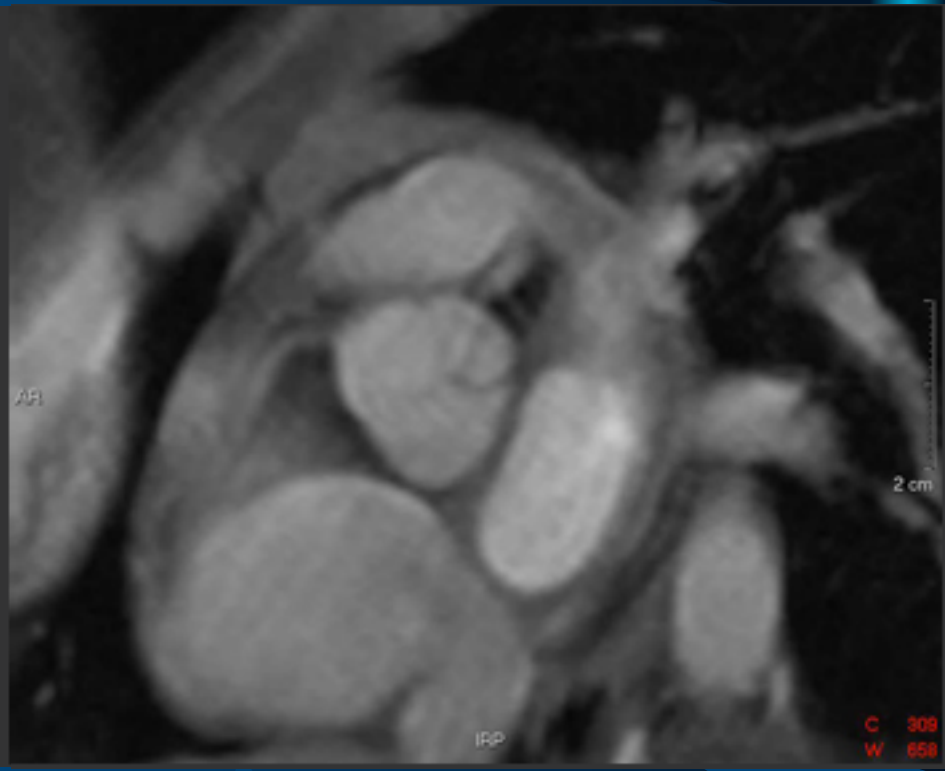
The Aortic view ("Candy Cane" view) shows the aorta along its entire thoracic course along with some of its branches off the aortic arch. An axial image is selected and a plane is chosen that bisects both the ascending and descending aorta.

MODALITIES UTILIZED

- Magnetic Resonance Imaging (MRI)

CORONARY ARTERIES VIEW

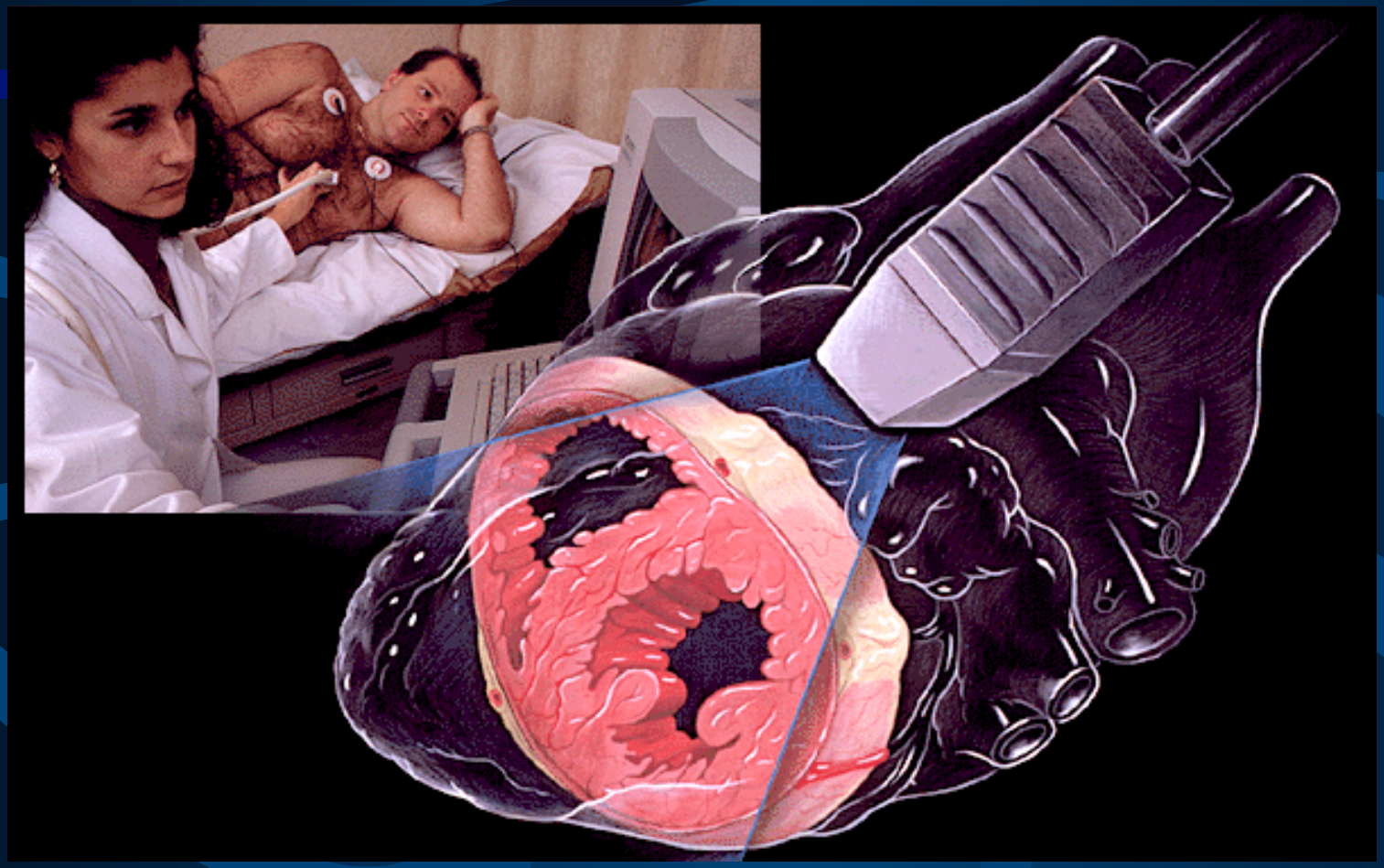




The coronary arteries originate from the proximal portion of the ascending aorta from the Sinuses of Valsalva. The two coronary arteries arising from the aorta are the right coronary artery (RCA) and the left main coronary artery (LM). The LM branches into the left anterior descending (LAD) and left circumflex (LCx) arteries.

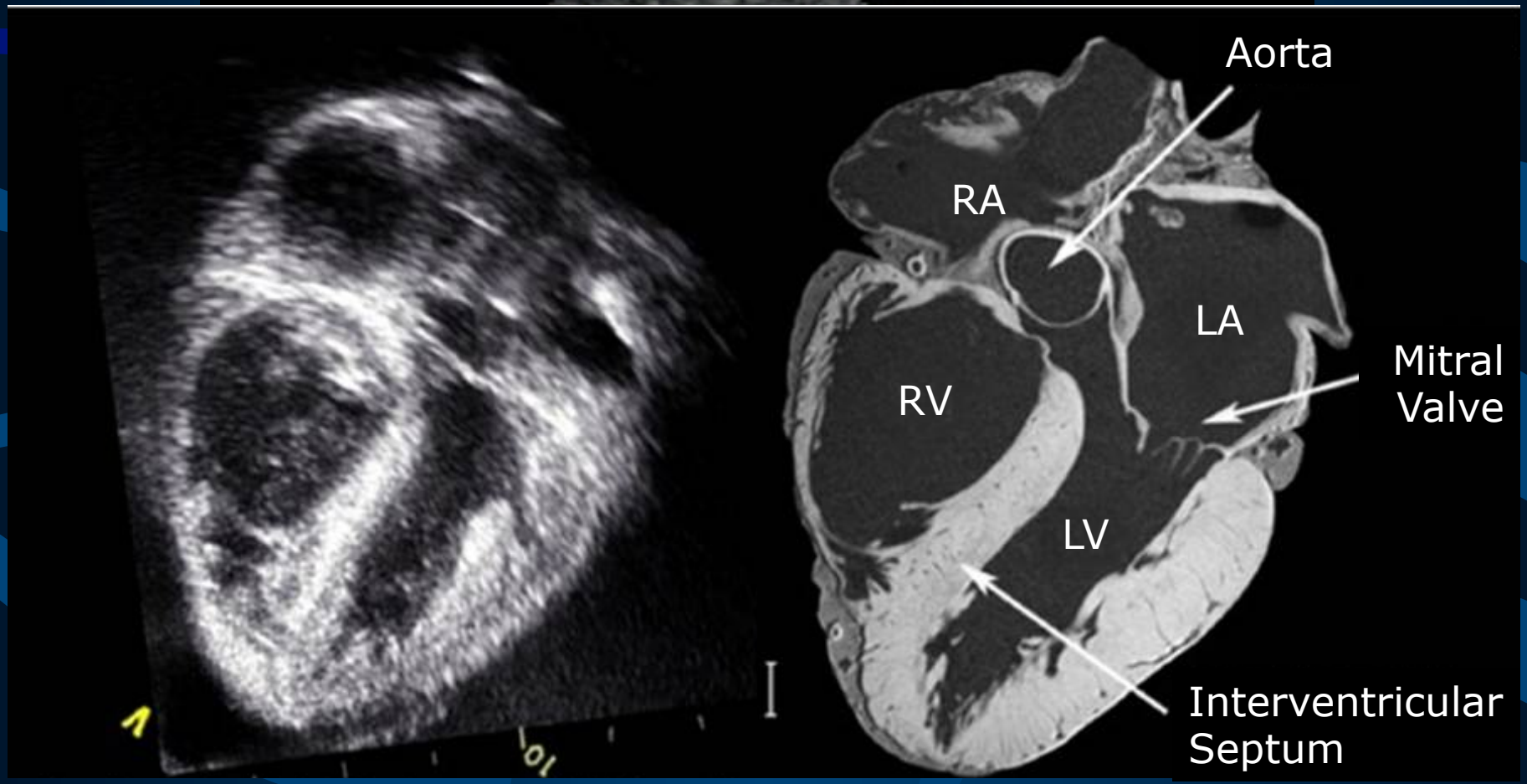
MODALITIES UTILIZED

- Ultrasound



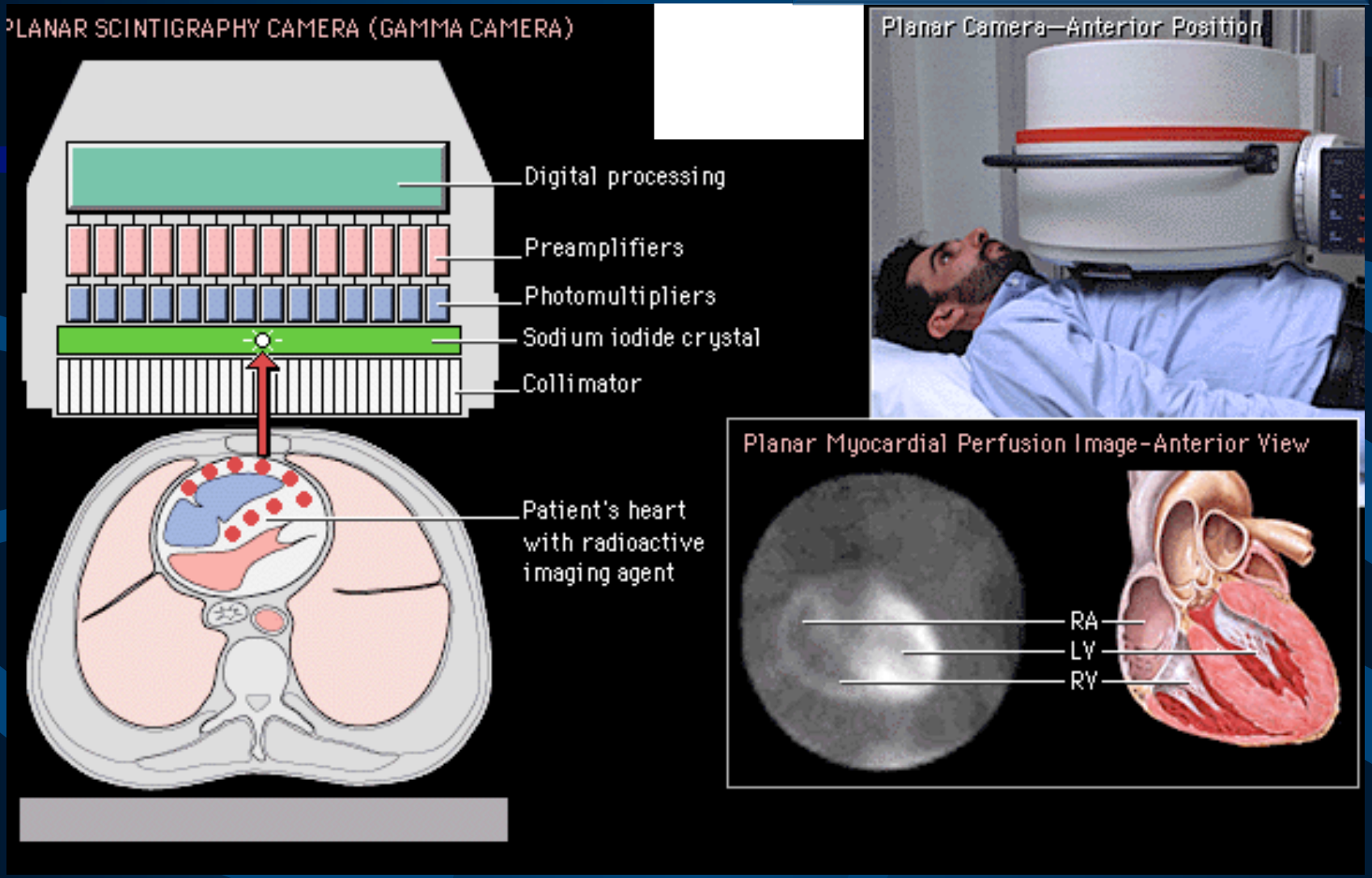
MODALITIES UTILIZED

- Ultrasound



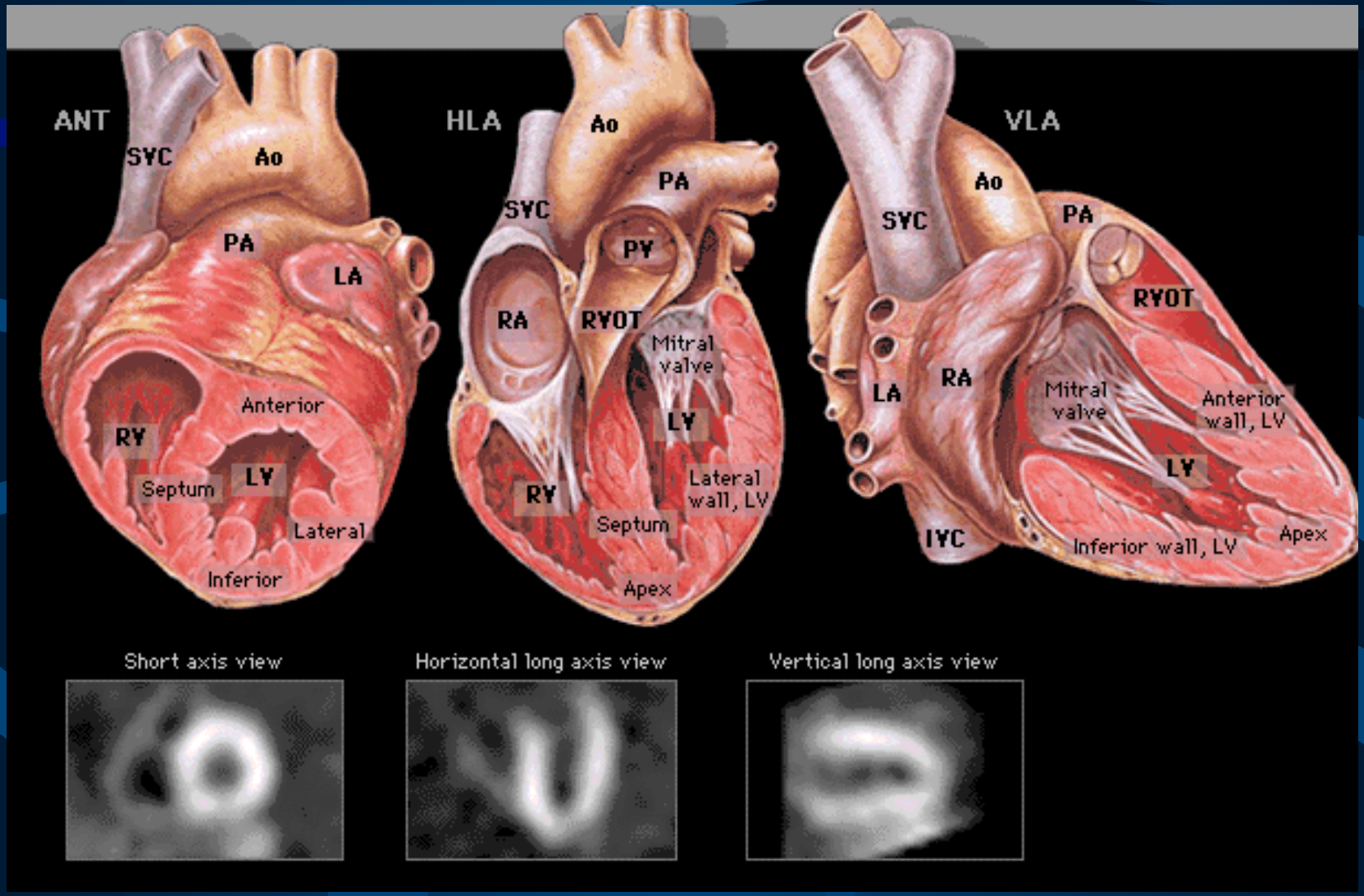
MODALITIES UTILIZED

- Nuclear Medicine



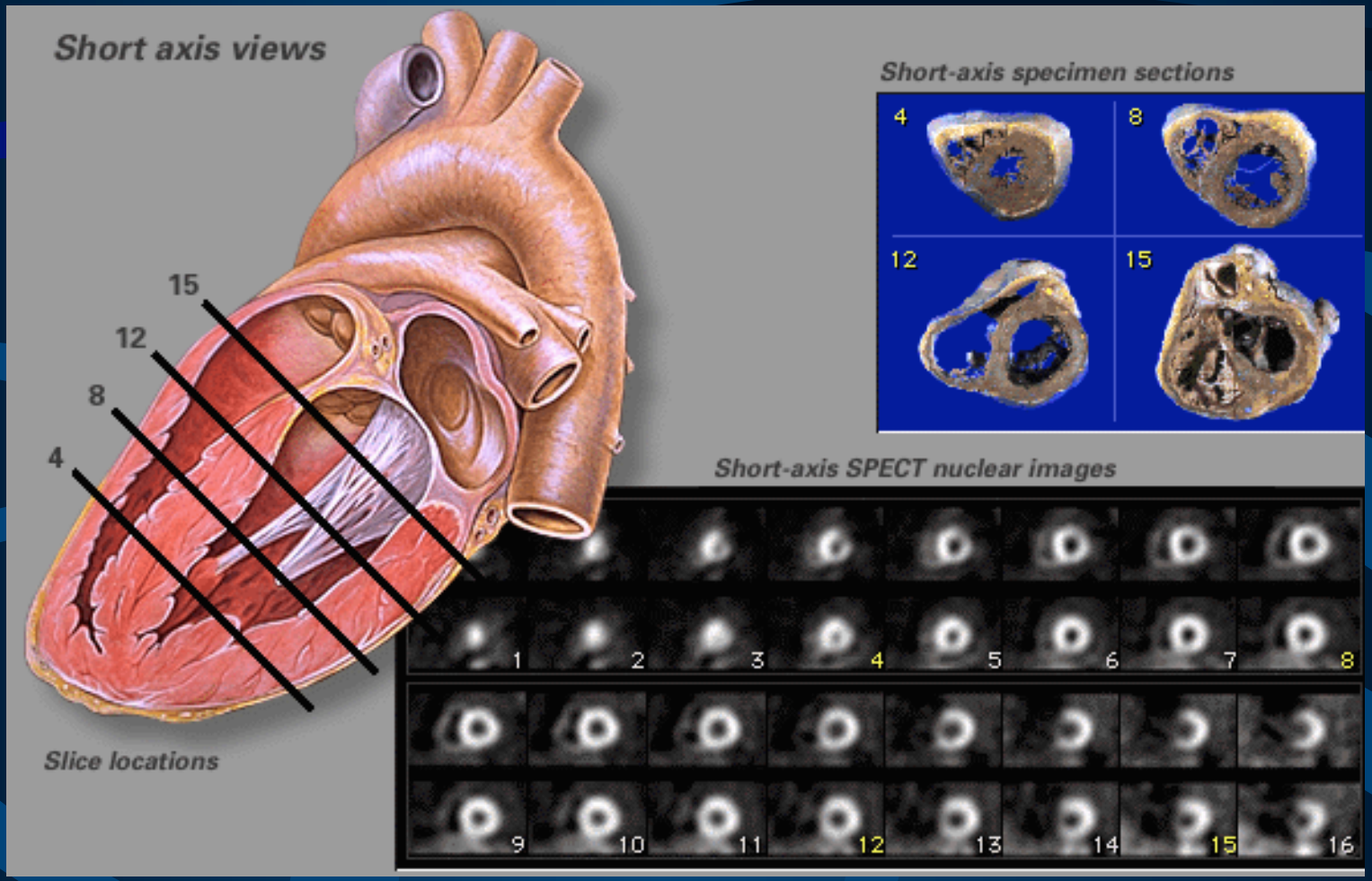
MODALITIES UTILIZED

- Nuclear Medicine



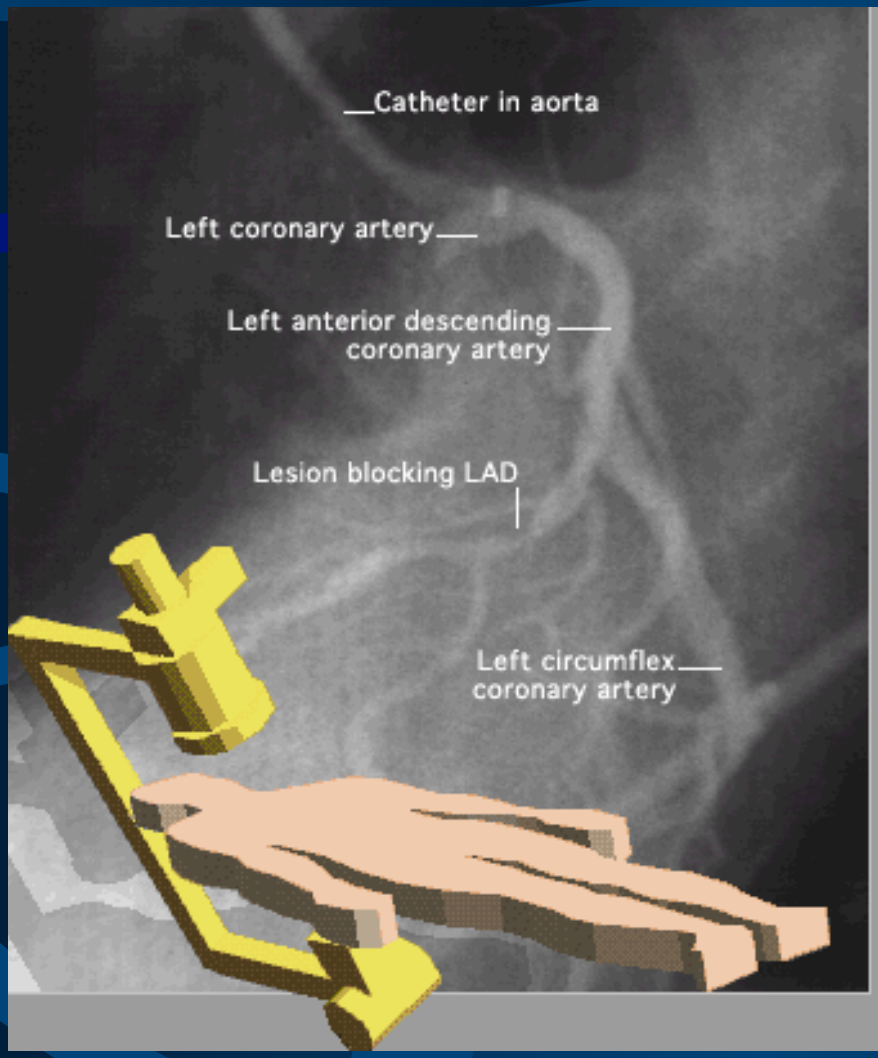
MODALITIES UTILIZED

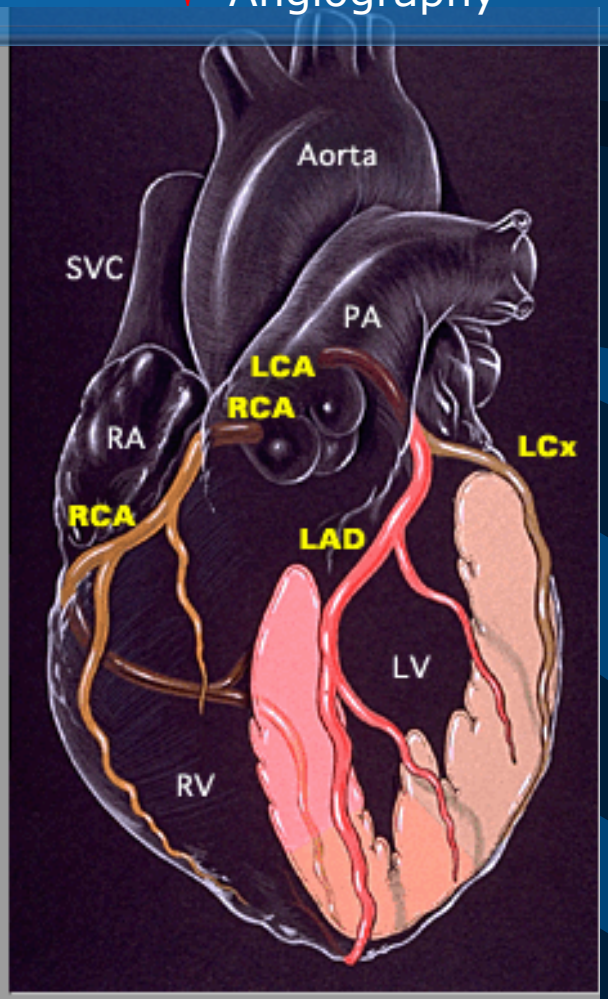
- Nuclear Medicine



MODALITIES UTILIZED

- Angiography





Imaging of Chest & CVS

Anatomy Review