436 Teams

Radiology Teams 436

Radiology of cardiac diseases

Objectives

- To list radiological exams used to image to the heart and mediastinal vessels.
- To list advantages and disadvantages of each exam in relation to heart and mediastinal vessels imaging.
- To Identify normal appearance of the heart and mediastinal vessels on each modality.

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Color Coding

Important | Notes | Extra

Editing File

What radiological exams are used in imaging heart and mediastinal vessels?

- Xray
- Angiogram
- Echocardiology
- CT scan
- MRI
- Nuclear scan

All are used

Chest X ray

There are other names of x ray which is (Radiograph & Plain film)

Advantages :

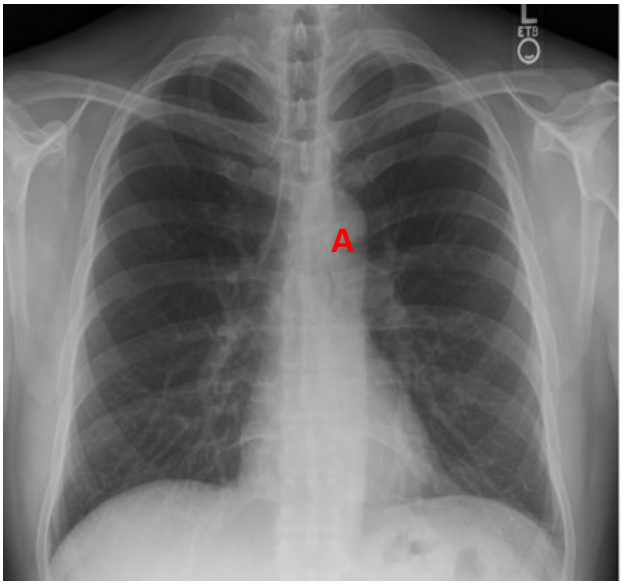
- Widely available, portable, cheap, easy to read.
- Proper in assessing heart size.
- Proper in assessing heart position (e.g. dextrocardia).
- Proper in assessing lung changes secondary to cardiac diseases (e.g. pulmonary edema).

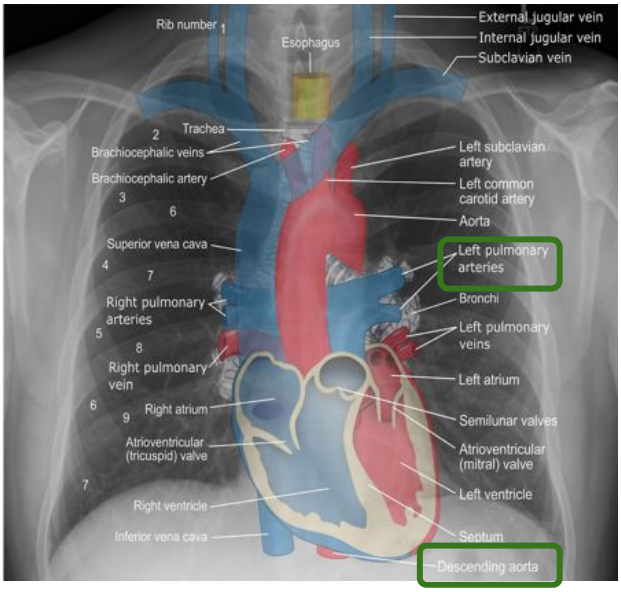
Disadvantages:

- Use Ionizing radiation. (so it puts pregnant women and children under risk)
- Limited assessment of heart chambers and myocardium. (you cant see the heart from inside)
- Limited assessment of heart valves (only when calcified).
- Limited assessment of pericardium. (to see if there is any fluids or lesions)
- Limited assessment of mediastinal vessels. (mostly carotid and pulmonary trunk)

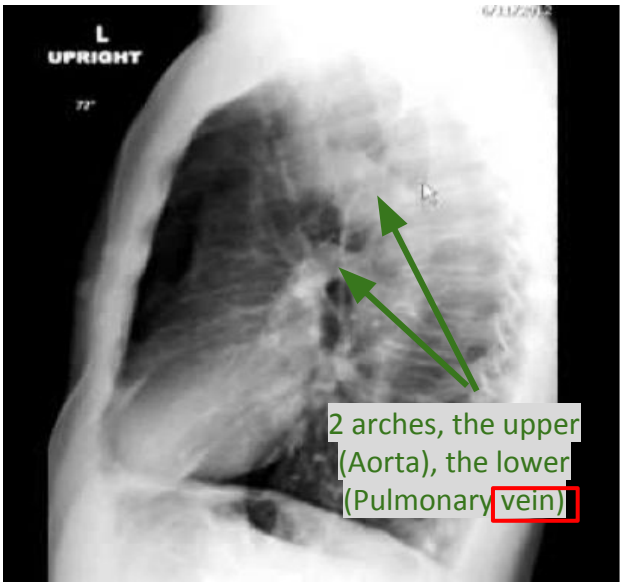
Normal chest x-ray (PA view)

Direction of the rays (from back/ posterior to front/ anterior)

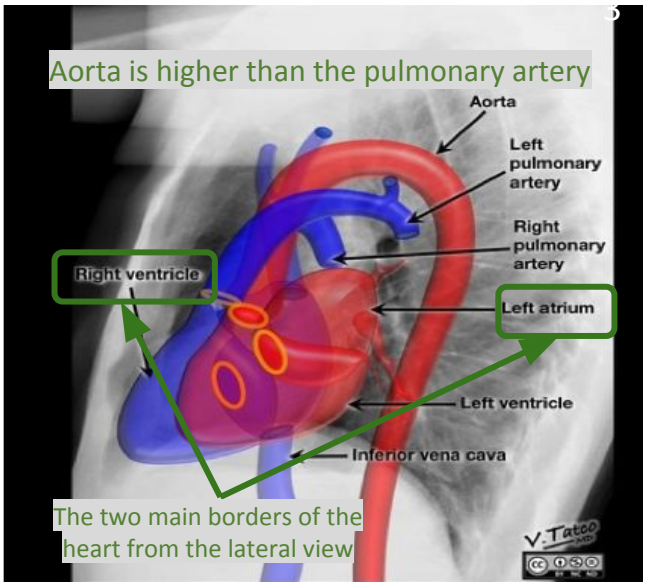




A: aortic knuckle

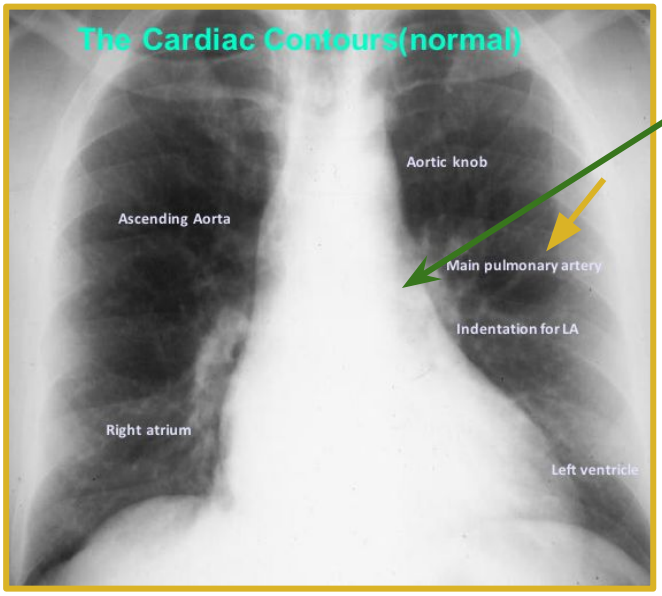


Normal chest x-ray (lateral view)



Left atrium border can be seen only in lateral view

More explanation slide 14



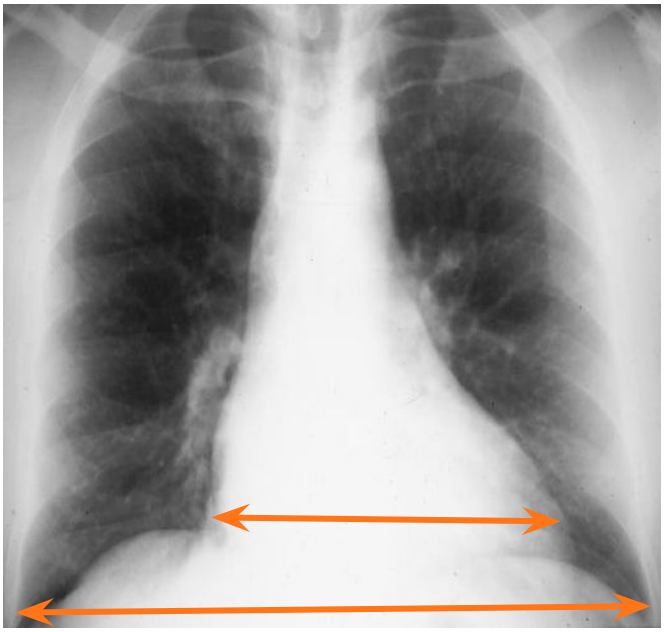
Indentation for LA = the left atrial appendage

- The left ventricle forms the left border of the heart. While the right ventricle forms the inferior border of the heart, and the right atrium forms the right border of the heart.

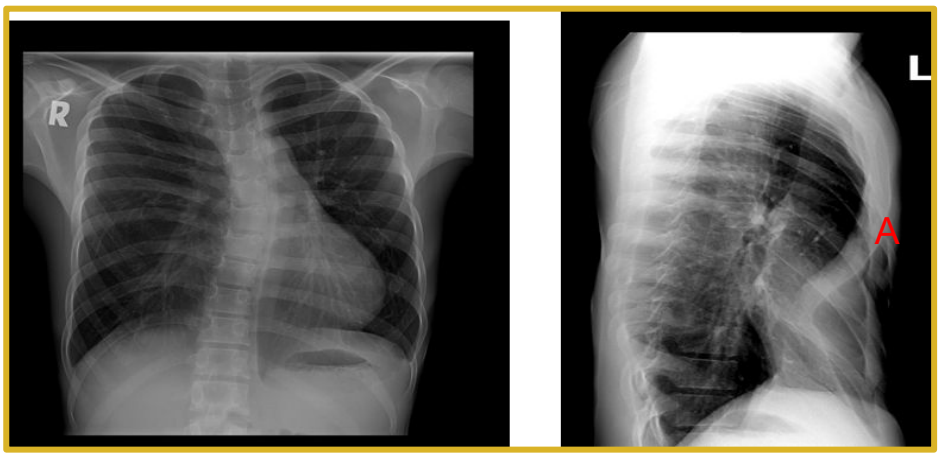
Cardio-thoracic Ratio

One of the easiest observations to make is something you already know: the cardio-thoracic ratio which is the widest diameter of the heart compared to the widest internal diameter of the rib cage and it must be <50%.
(the X-ray must be posterior-anterior view)

1. To determine the heart size: the x-ray should be PA (to avoid false enlargement of the heart).
2. Then compare the widest diameter of the heart shadow with the widest diameter of the thoracic cage (do not include the ribs). It must be <1/2 of the diameter of the chest.



Cardiac displacement (Pectus Excavatum)

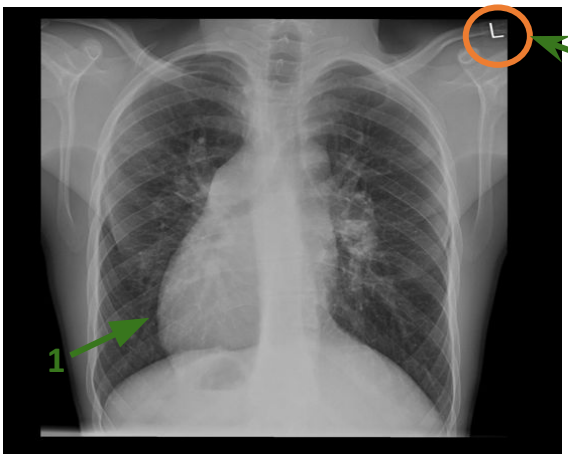


A: the sternum is pushed inside

The right border of the heart isn't visible due to: (Differential diagnosis In previous AP view)
1. pneumothorax (Air in the right lung pushes the heart toward the left lung).
2. lung mass (Pushes the heart toward the other side, or silhouette its borders).
3. pectus excavatum (sternal depression) (The movement of bones moves the heart seconderly).
A further imaging in lateral view will determine the specific cause which is pectus excavatum.

Dextrocardia

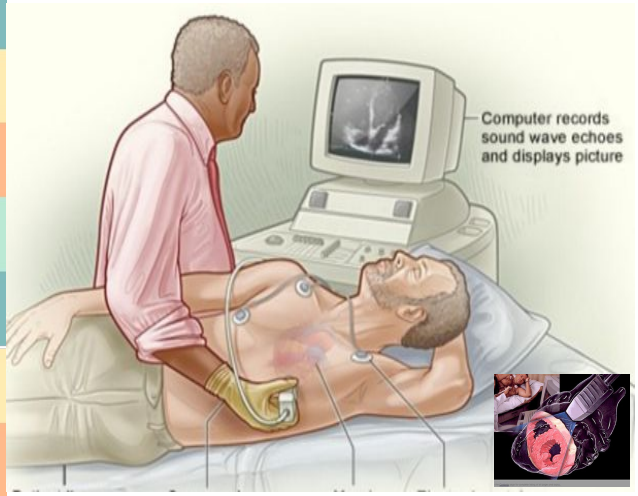
More explanation slide 14



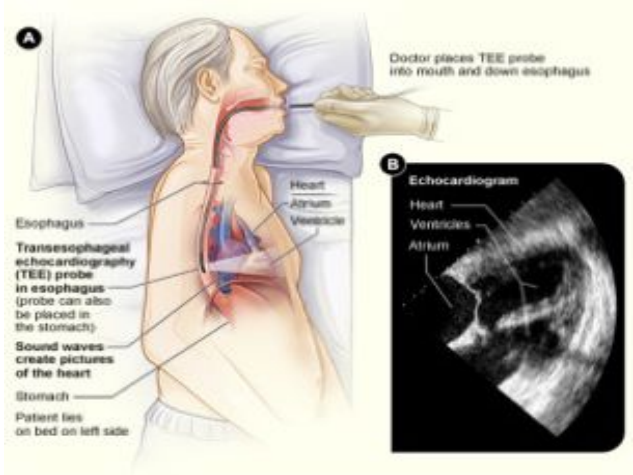
Look at the label to know which is left and which is right and you can see that this person has dextrocardia (heart turned to the other side.

(1) The apex is pointing to the other side.

Echocardiogram (is an ultrasound done by the cardiologist)



Transthoracic (probe is in the area of the heart on the skin)
First line echo assessment



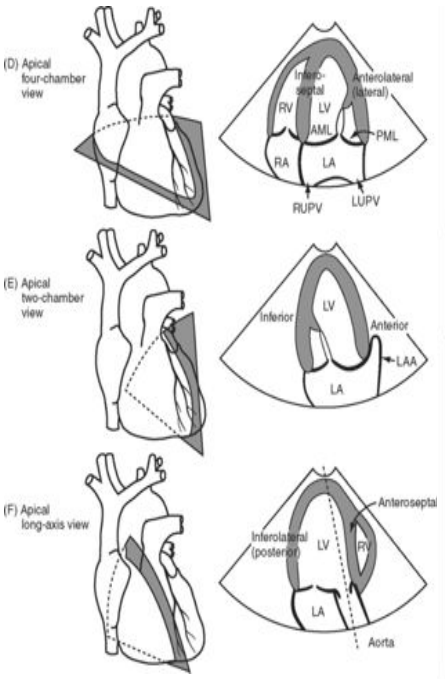
Transesophageal (the probe will be swallowed by the patient to look posteriorly)

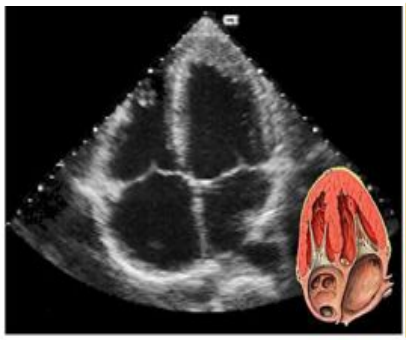
Advantages: Like general US

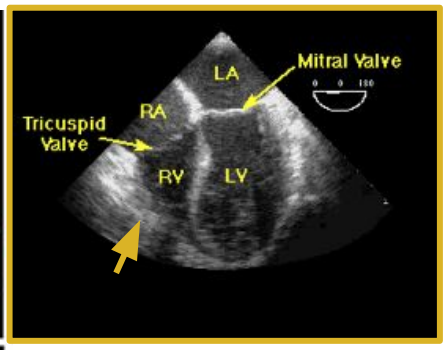
- No Ionizing radiation
- Widely available, portable.
- Proper in assessing heart morphology (anatomy: cardiac chambers, myocardium and valves).
- Proper in assessing heart function (ejection fraction) . By using doppler effect
- Proper in assessing pericardial effusion.

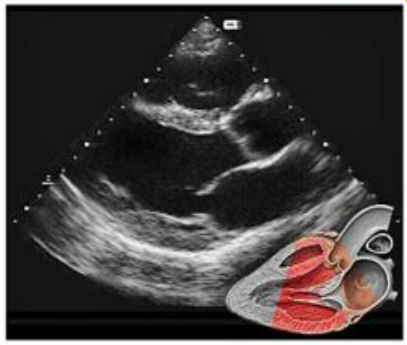
Disadvantages:

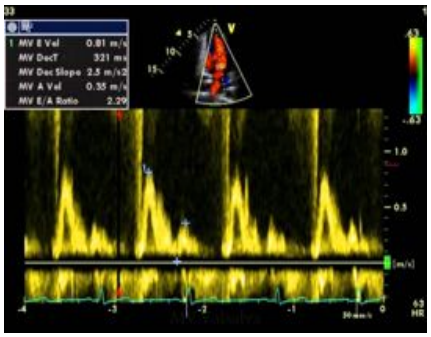
- Operator dependent. (requires experience)
- Not proper to assess coronary arteries. (because coronaries are super small)











Normal Echocardiogram

More explanation slide 14

Doppler effect (Real time assessment) We can assess the velocity of blood flow via doppler. For example, in cases of valvular stenosis we have higher velocity of blood movement.

Angiogram

- Angiogram = X-ray + I.V contrast
- Cardiac catheterization: assessment of coronary arteries and left ventricle.
- Aortogram :assessment of aorta and main branches.
- Pulmonary angiogram: assessment of pulmonary arteries.

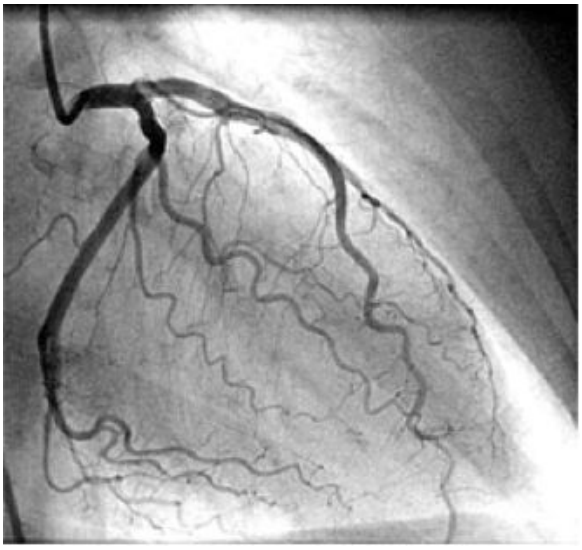
Advantages:

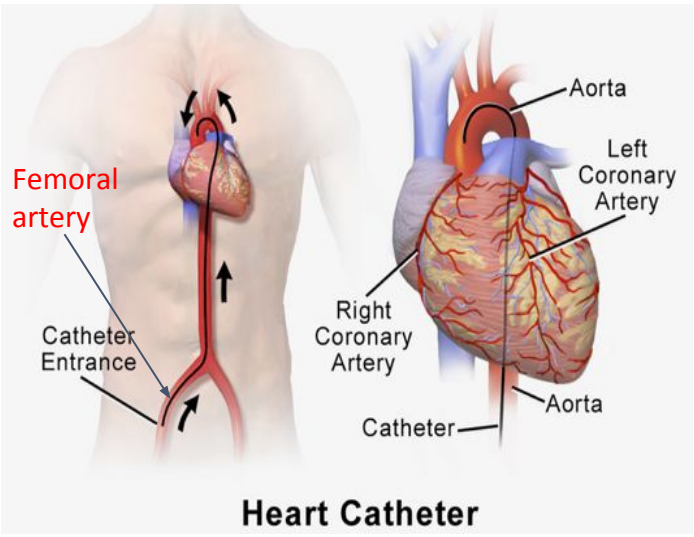
- Minimal invasive procedure and can replace surgery.
- Proper in assessing and **treating** coronary stenosis.
- Proper in assessing left ventricle.
- Proper in assessing and treating aortic dissection or aneurysm.
- A treatment option in extensive pulmonary embolism. No blood to lung> No gas exchange!

Disadvantages:

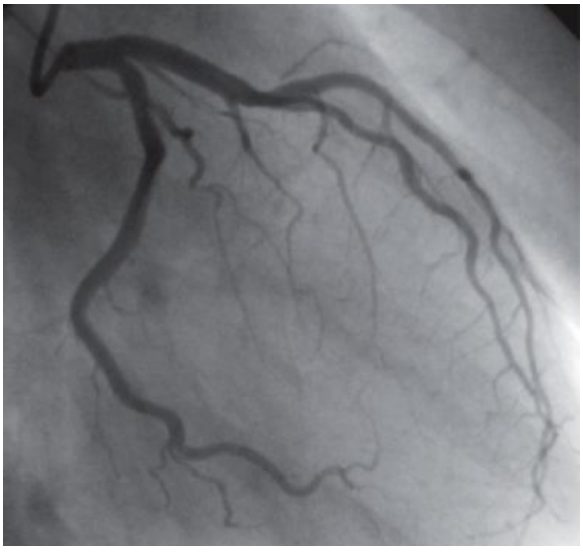
- Use Ionizing radiation. X-Ray!
- Invasive procedure.
- Contrast complications. (because it may cause Anaphylaxis or renal toxicity)

Cardiac catheterization

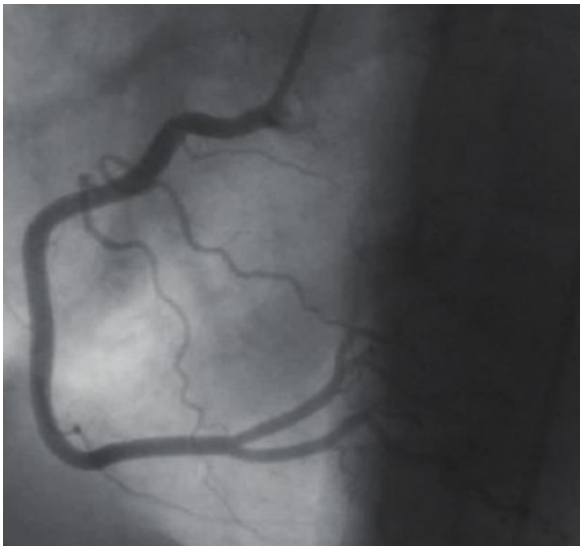




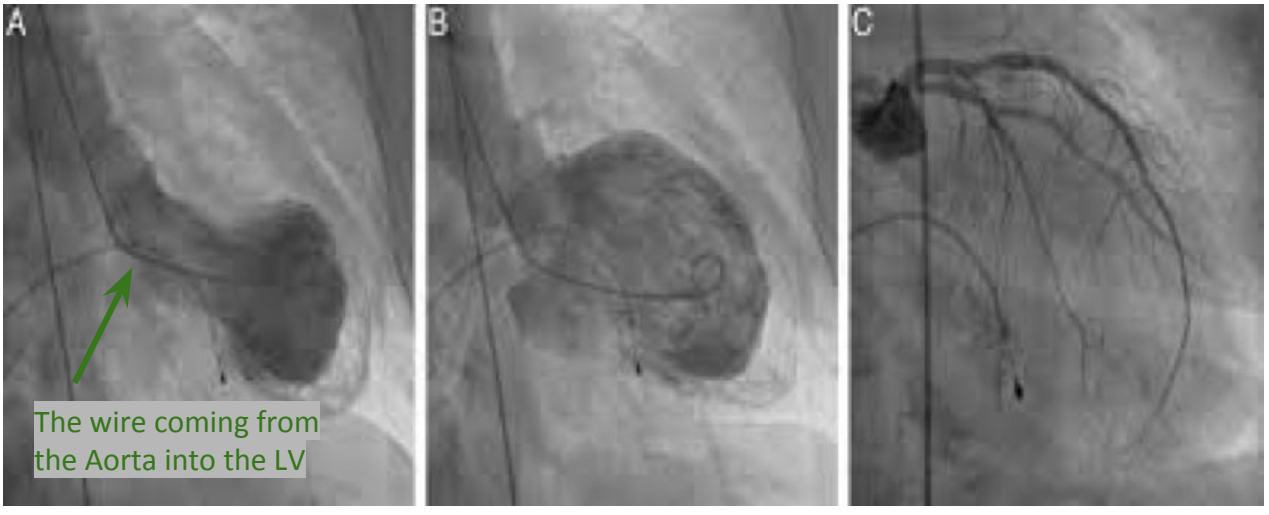
- Reach the coronary arteries through (femoral artery -> aorta -> coronary arteries)
- Mostly enter the body from puncturing a lower limb artery. ex: femoral artery.



Normal coronary arteries on the left side of the heart

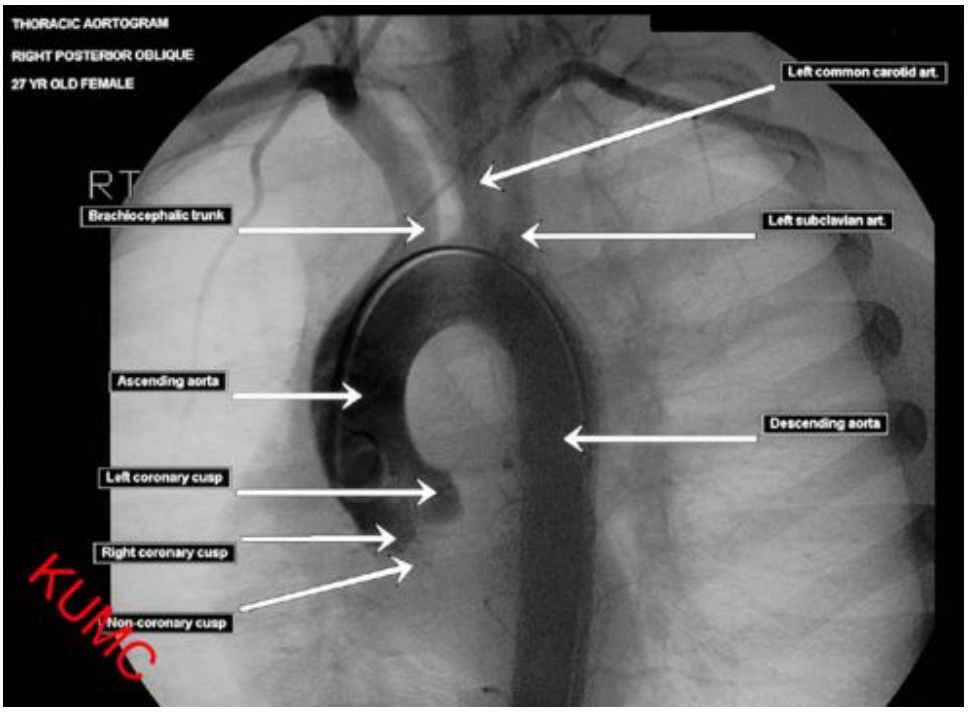


Normal coronary arteries on the right side of the heart

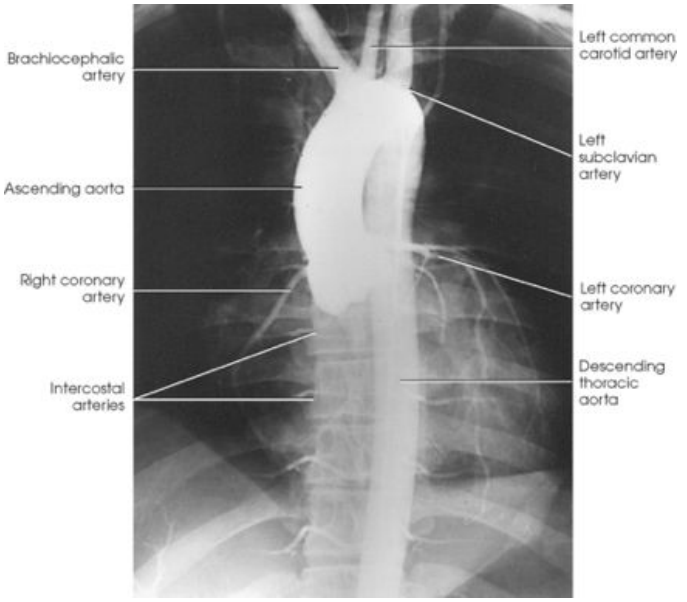


Left ventricles **Coronary arteries**

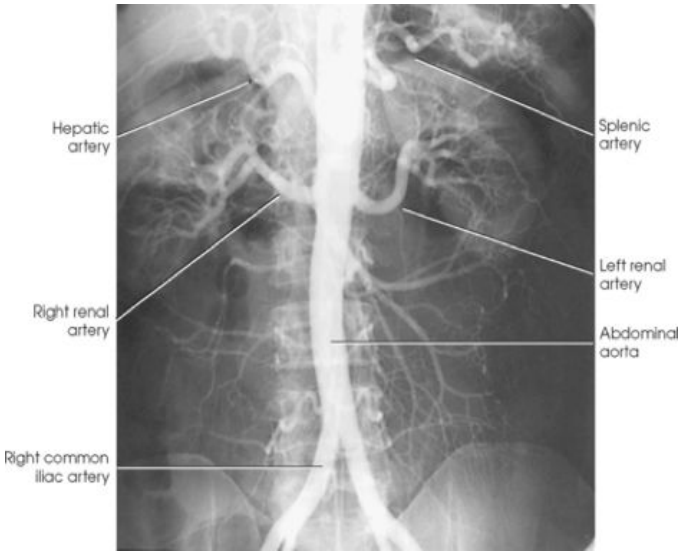
Aortogram



The same principle; we reach the aorta through an artery, inject the contrast and then assessing it.



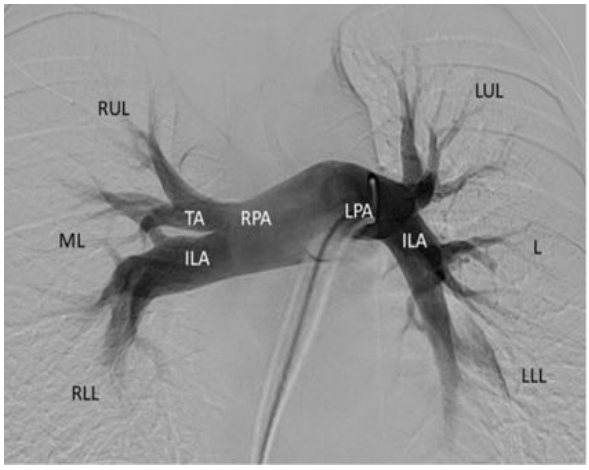
Thoracic aorta

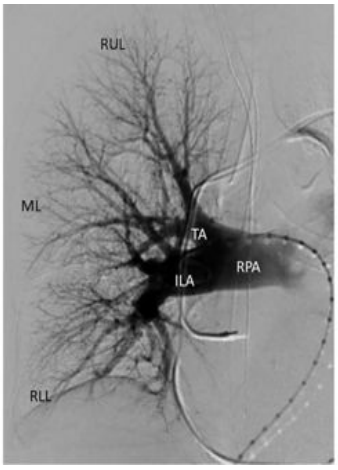


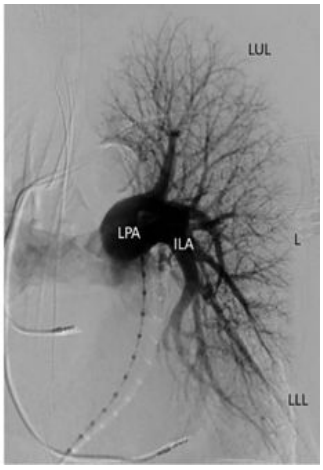
Abdominal aorta

Pulmonary angiogram

- Access through a **vein** not an artery.
- Mostly, from the common femoral vein (we enter from a vein so that we can easily access through the SVC or IVC to the right atrium then to the right ventricle then we reach pulmonary artery).







RPA = Right Pulmonary Artery; **LPA** = Left Pulmonary Artery; **ILA** = Interlobar Artery; **TA** =Truncus Anterior; **RUL** = Right Upper Lobe; **ML** = Middle Lobe; **RLL** = Right Lower Lobe; **LUL** = Left Upper Lobe; **L** = Lingual; **LLL** = Left Lower Lobe.

CT scan (assess not treat)

Advantages:

- Widely available, relative cheap.
- Proper in assessing pulmonary artery and aorta.
- Proper in assessing coronary arteries (e.g. stenosis, calcification).
- Proper in assessing heart anatomy.
- Proper in assessing structure around the heart and mediastinal vessels (e.g. lungs).

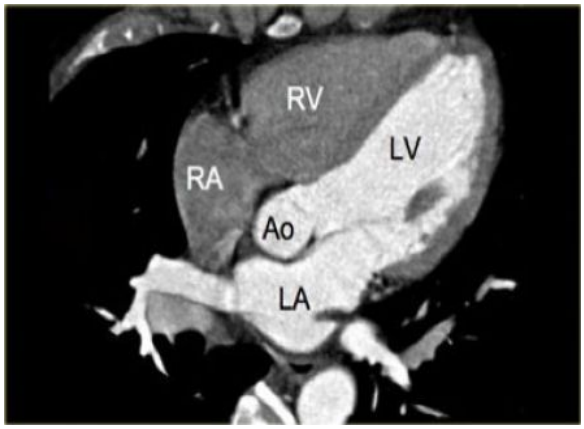
Disadvantages:

- Use Ionizing radiation.
- Heart rate < 60 beat/min for an adequate cardiac exam.
- Intravenous contrast complications.

Cardiac CT

a) Cardiac chambers

2 chambers view



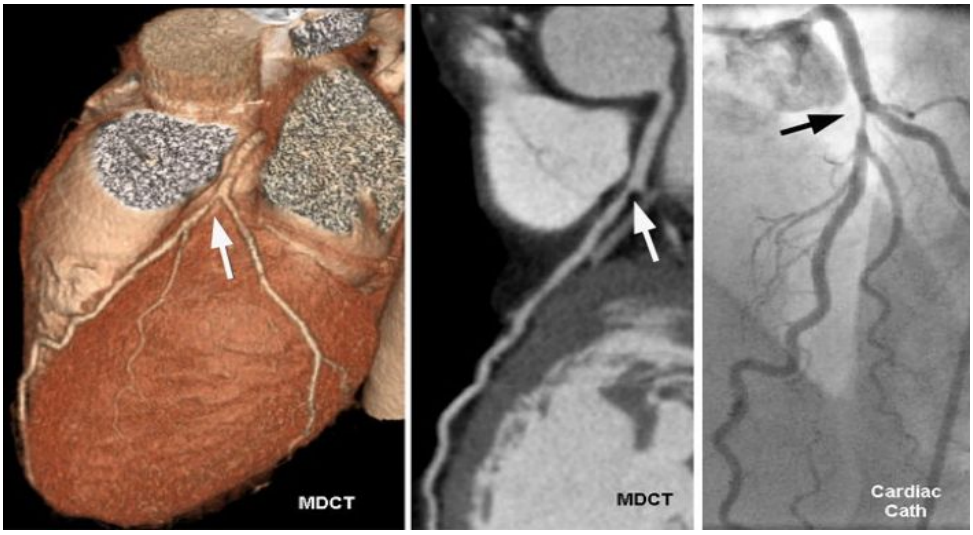
Axial view

In the right image, why the contrast is in LV, LA only? Because it moves as the blood with the cardiac cycle and depends also on the timing of the image taken.

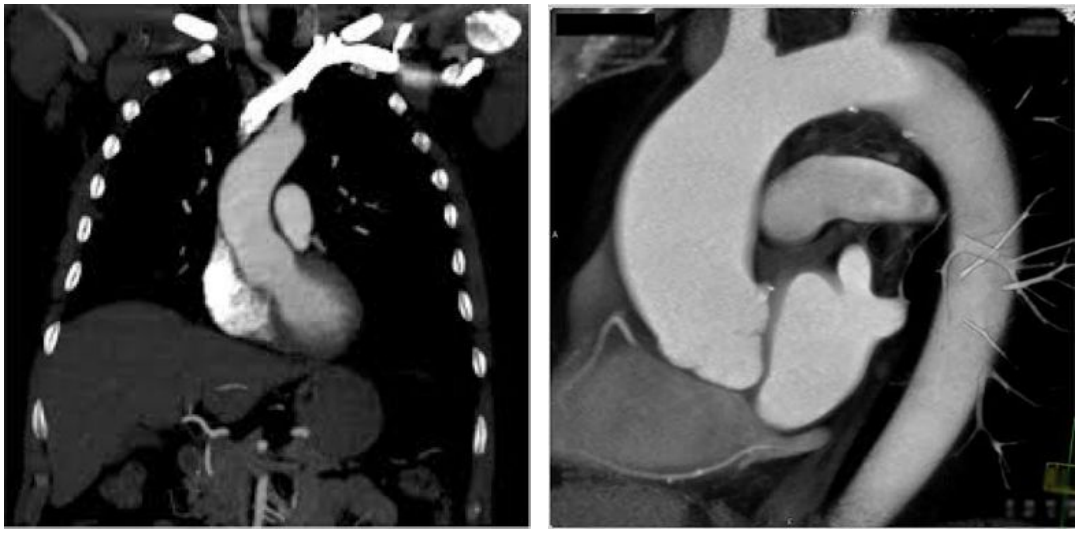
b) Coronary arteries

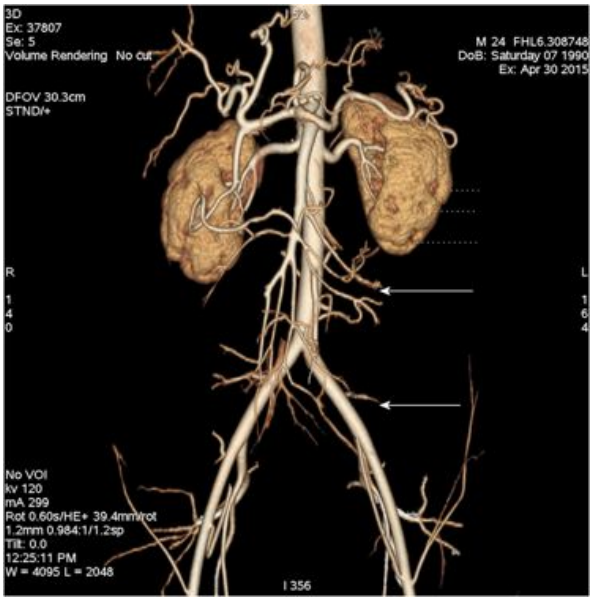
Multiple CT images are processed by the computer to be created as 3D image.

Cardiac CT vs cardiac cath



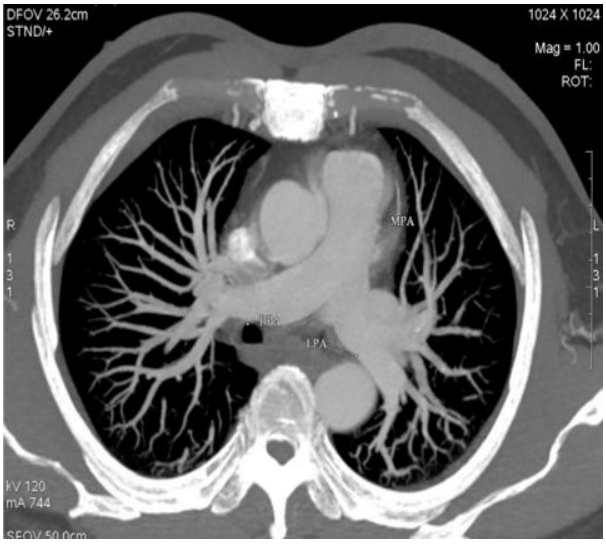
CT aortogram

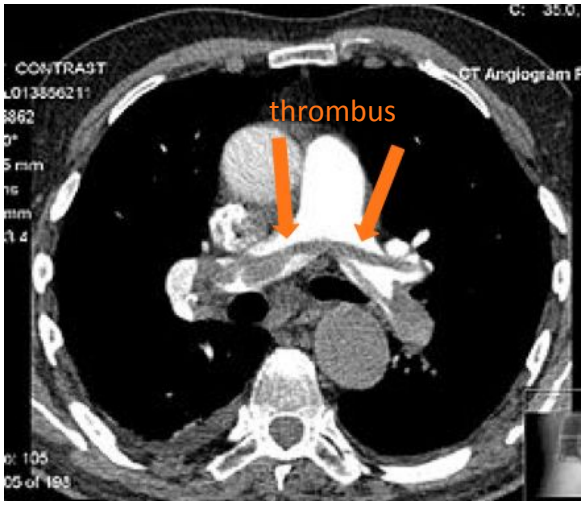




Volume rendering

CT Pulmonary angiogram Almost the same, except that in angiogram it could be used as a treatment





Gold standard exam to diagnose Pulmonary Embolism

A Rule: If you want to assess a vessel: you need to give contrast, because without contrast you can't see anything inside the vessel.

MRI

Advantages :

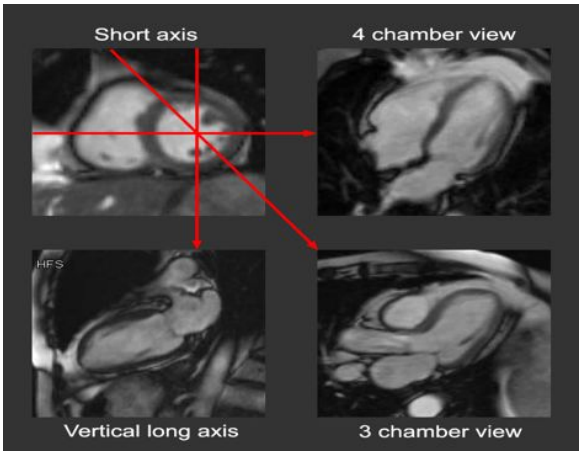
- No Ionizing radiation.
- Better soft tissue Characterization.
- Proper in assessing myocardium (e.g. infarction, infiltrative diseases).
- Proper in assessing cardiac valves.
- Proper in assessing aorta.

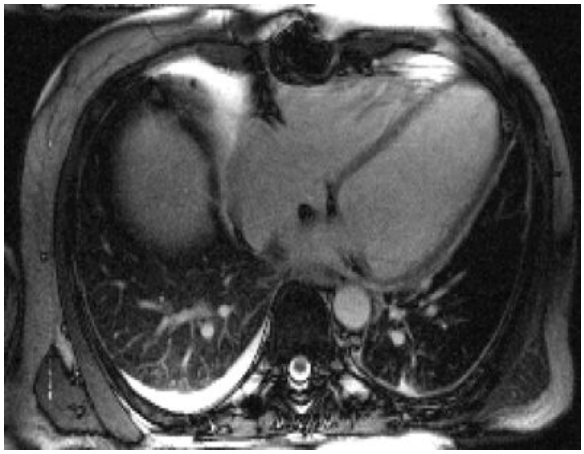
Disadvantages:

- Not widely available.
- Contraindications (cardiac devices) Because it alter the machine programming.
- Intravenous contrast complications. (still safer than the CT contrast)

Cardiac MRI

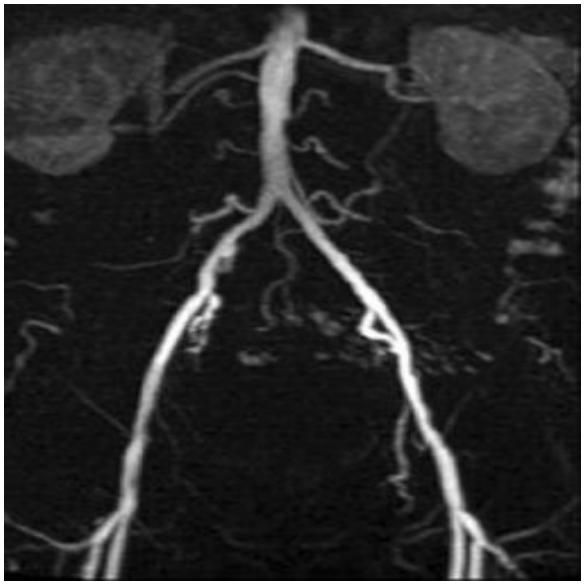
How real time MRI is created? by taken multiple MRI images and combining them to make to make it moving.





Click to see real time imaging!

MRI Aortogram



Click to see real time imaging!

MRI vs **CT**

Nuclear scan The machine has gamma cam.

Advantages:

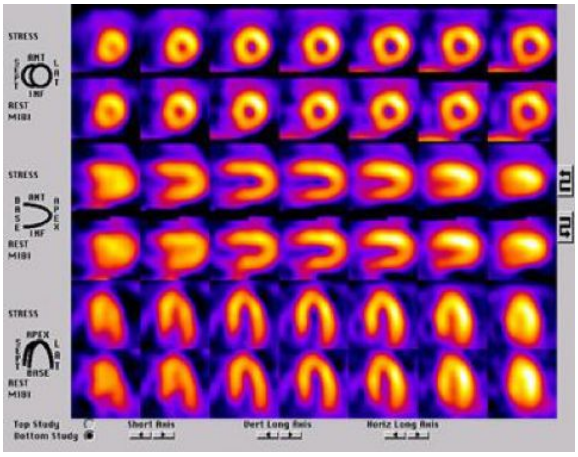
- Assess physiology/ pathophysiology
- Proper in assessing myocardium perfusion (e.g. ischemia vs infarction).
- Proper in assessing lung perfusion (pulmonary embolism) alternative to CT scan.

Disadvantages:

- Use ionizing radiation. (The patient is the source of radiation; after injecting him/her with radioactive material)
- Not widely available.
- Poor in assessing anatomy.

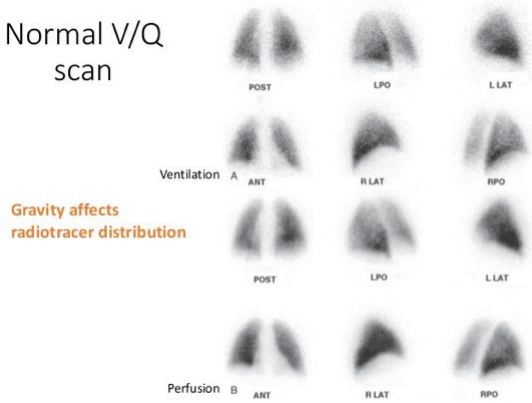
Cardiac scan: A type of nuclear scan

- A study to assess myocardial perfusion (mainly left ventricle). Left ventricle is thicker = more uptake.
- Includes a stress and rest phases. By medications & treadmill (to assess defects).
- Normal exam shows continuous uptake of left ventricle (no defects).
- Most important thing is we look for ischemia.

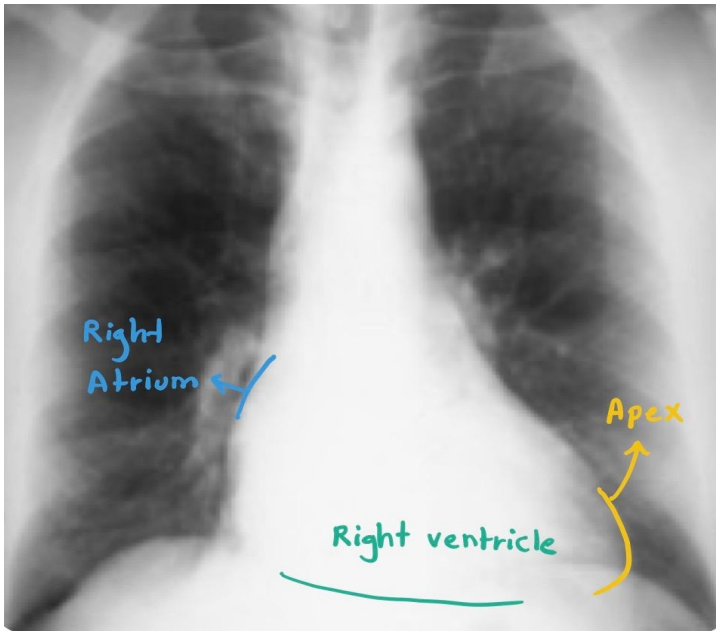


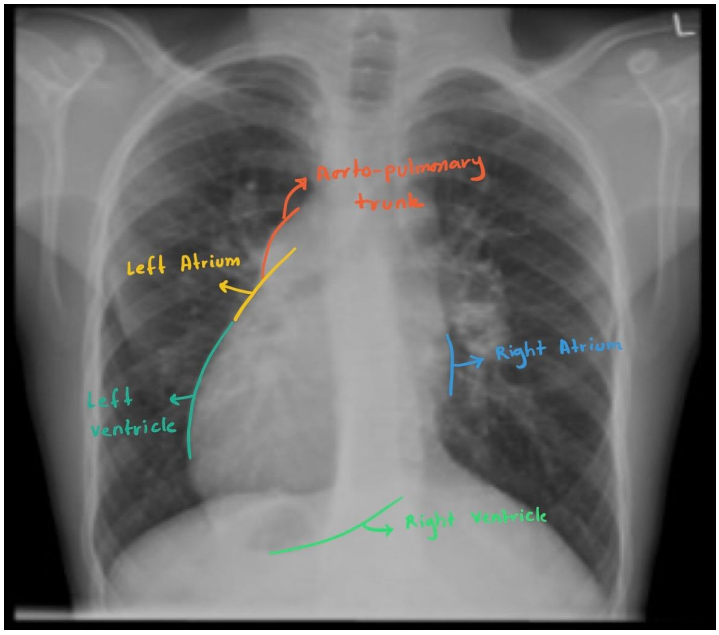
V/Q scan Perfusion study

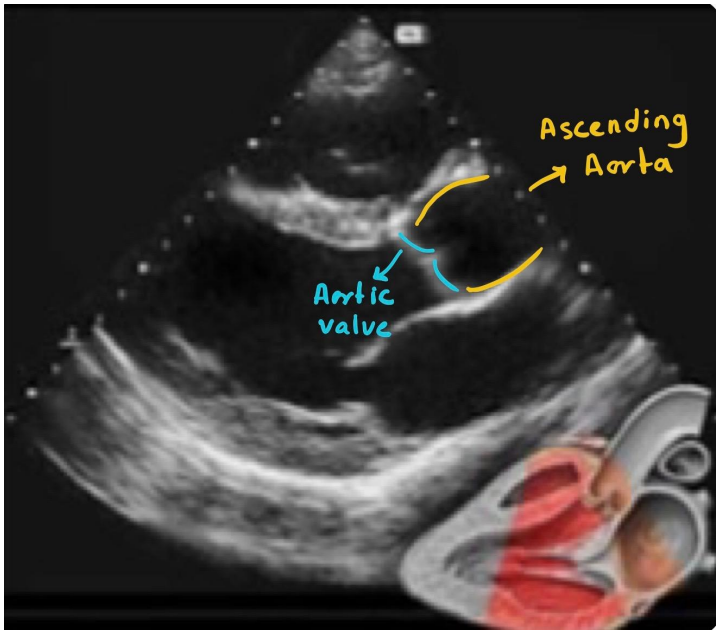
- A study to diagnose pulmonary embolism. Normal ventilation but abnormal perfusion
- Alternative to CT scan.
- Includes ventilation phase and perfusion phase.
- Normal exam shows similar lungs uptake in ventilation and perfusion phases.



For better understanding







Modality	Advantages	Disadvantages
X-Ray	• Widely available, portable, cheap. • Proper in assessing heart size & position. • Lung assessment.	• Use Ionizing radiation. • Limited assessment of heart chambers and myocardium & valves & pericardium & mediastinum.
Angiogram	• Minimal invasion. • Proper in assessing and treating coronary diseases.	• Use Ionizing radiation. • Invasive procedure. • Contrast complications.
Echocardiogram	• Proper in assessing heart morphology & function by using doppler effect. • Proper in assessing pericardial effusion.	• Operator dependent. • Not proper to assess coronary arteries.
CT scan	Gold standard for Pulmonary embolism. • Proper in assessing heart anatomy, pulmonary artery, aorta & coronary arteries. • Proper in assessing structure around the heart and mediastinal vessels.	• Uses Ionizing radiation. • Heart rate < 60 beat/min for an adequate cardiac exam. • Intravenous contrast complications.
MRI	• No Ionizing radiation. • Better soft tissue Characterization. • Proper in assessing myocardium, cardiac valves & aorta.	• Not widely available. • Contraindications (cardiac devices) • Intravenous contrast complications. •
Nuclear scan	• Assess physiology/ pathophysiology. • Proper in assessing myocardial perfusion & lung perfusion.	• Use ionizing radiation. • Not widely available. • Poor in assessing anatomy.
V/Q Scan	• To diagnose PE. • Includes ventilation phase and perfusion phase. • Normal exam shows similar lungs uptake in ventilation and perfusion phases.	

Questions

Q1: What is the gold standard in diagnosing pulmonary embolism?
A- MRI
B- CT
C- X-ray
D- Angiogram

Q2: One of the advantages of nuclear scan:
A- Assess anatomy, physiology and pathophysiology
B- Assess anatomy and pathophysiology only
C- Assess physiology and pathophysiology only

Q3: Echocardiogram is excellent in assessing heart function.
A- True
B- False

Q4: The cardio-thoracic ratio should be:
A- <50%
B- >50%
C- =50%
D- <0.5%

Q5: MRI Contraindicated with:
A- Children
B- Patient with pacemaker
C- Patient with previous exposure

Answers :
1- B
2- C
3- B
4- A
5- B
6- C